Journal of Environmental and Public Health

# Industrial Wastewater on the Environment and Human Health

Lead Guest Editor: Zaira Zaman Chowdhury
Guest Editors: Jalel Labidi and Raf Dewil

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Tongzhang Zheng, USA

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[1] B. Kurian and V.L Jyothi, "Comparative Analysis of Machine Learning Methods for Breast Cancer Classification in Genetic Sequences," *Journal of Environmental and Public Health*, vol. 2022, Article ID 7199290, 6 pages, 2022.

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# Retracted: Strategies of Ice and Snow Tourism to Optimize Ecological Environment and Economic Growth from the Perspective of Sustainable Development

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# Retracted: Juvenile Delinquency from the Perspective of Socialization and Social Control

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# Retracted: Sustainable Trend of Big Data in Enterprise Supply Chain Under the Artificial Intelligence Green Financial System

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# Retracted: Ecological Adaptability and Application of Traditional Historical Buildings under the Background of Environmental Protection

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# Retracted: Psychological Changes of Social Media on Charitable Cultural Behavior Based on Big Data Technology

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# Retracted: Path Deconstruction of Agricultural Environmental Sustainable Development Policy in the Process of International Agricultural Trade Liberalization

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# Retracted: Digital Protection of Historic Buildings in Urban Planning

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# Retracted: Sustainable Development Research of Green Smart Park in High-End Manufacturing Based on Internet of Things

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# Retracted: Static and Dynamic Demonstration of the Ecological Level of Ethnic Cultural Industries Based on the Internet of Things and Environmental Responsibility

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# Retracted: Rural Architectural Planning and Landscape Optimization Design under the Background of Ecological Environment Protection

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# Retracted: Influence Mechanism of Educational Leadership on Environmental Accounting Based on Big Data Algorithm

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# Retracted: Study on the Influence of Urban Built Environment Factors on the Social Behavior of ASD Children

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*Research Article*

# Study on the Influence of Urban Built Environment Factors on the Social Behavior of ASD Children

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The use of urban space by vulnerable groups, especially ASD children with social anxiety, is an important part of building sustainable urban development. In this study, we focus on the play behavior of ASD children from the perspective of urban planning; then, we discussed how the urban built environmental factors affect the social behavior of ASD children. In this paper, 220 parents of ASD children were given questionnaires and 197 valid questionnaires were obtained after removing invalid ones. Stepwise regression was adopted to further accurately analyze the influence of each factor index in the built environment on children's social behavior. The results showed that multiple urban built environment factors had significant influence on the social behaviors (observation, participation, retreat, and concealment) of children with autism at three stages: before departure, during journey, and arrived at destination. The purpose of study is to fully consider the use of urban space by ASD children when urban researchers or urban planners construct sustainable urban forms, formulate urban design guidelines, and implement old city renewal strategies.



## 1. Introduction

Autistic spectrum disorder (ASD) is listed by the WHO as the first mental disease that seriously affects children's health in global public health problems. Among them, social disorder is the core problem of children who suffer from ASD (Hereinafter referred to as ASD children), which has a far-reaching impact on children's social activities. If it is not treated in time, it will have a great impact on children's living ability and social function [1]. Therefore, this study discusses how the built environmental factors affect the social behavior of ASD children, so as to provide a new vision for urban planning and building a child-friendly city. At the same time, we also pay attention to vulnerable groups, take ASD children as a medium, and then explore the sustainable development of the city in view of social equity.

The Diagnostic and Statistical Manual of Mental Disorders (DSM-V, American) believes that ASD children have social anxiety in specific fear situations [2]. According to the Chinese classification of mental disorders (CCMD-3, China), they will try their best to avoid what they fear or endure it with fear [3]. There are significant characteristics of social anxiety in ASD children: one is the persistent anxiety in social situations; the second is the inability to control this social anxiety. Play behavior is considered as a major behavior of children, which can promote social interaction between children and others [4]. Studies have shown that if ASD children play pretend games, their social ability will be improved [5]. Moreover, gaming has a positive impact on children's mental health, thus alleviating social anxiety and improving the possibility of social behaviors [6]. Therefore, we have reason to believe that the social behavior of ASD children is closely related to the play behavior and

the play behavior can represent the social behavior. Children's play behavior is generally divided into the following steps [7]:

(1) Observation. Children observe the behavior of other children to further judge whether they have the willingness to participate in the activities that other children are engaged in

(2) Participation. After preliminary observation and judgment, children will try their best to join in but it may not be accepted. If rejected, children may still take some behaviors to join in, such as quietly blending in and sharing items

(3) Retreat. When children lose interest or confidence in activities, they have withdrawal behavior, which manifests as withdrawing from social situations

(4) Concealment. When children are tired or afraid, they will look for quiet rest space where they can be alone. Enclosed space with strong sense of privacy is easy to bring children a sense of security

Fyhri et al. studied the independent mobility of children to schools, friends, and places of leisure activities through the 2005 Norwegian National Tourism Survey and telephone interviews on children's living physical environment and activities. A structural equation model was used to investigate the impact of a range of background variables on the choice of schooling or leisure activity patterns among Norwegian children. The study found that the distance to school and the age of children were the most influential variables on the independent mobility of children, and there were significant seasonal differences in travel modes, and the overall travel level was low in winter. Objective descriptions (subjective assessments) of the traffic environment indirectly explain independent mobility through parents' experience of how safe roads are to go to school. Jiayao et al. investigated how a built environment affects children's independent walking to and from school by means of questionnaire survey and analyzed students from three primary schools in Wenshan, Zhongnan, Jingmei, and Xinhua in Taipei. The analysis results showed that higher shade density and higher sidewalk coverage encouraged children to walk to and from school independently, while a larger block size and increased number of intersections discouraged children from walking to and from school independently. In addition, while high building density, high vehicle density, and diverse commuting options encourage children to walk home from school, a bus or medium passenger transport, block size, and road width discourage children from walking. The study also proposes three strategies to reshape Taipei's built environment: compact structures, pedestrian-friendly designs, and frequent bus services. This study explores the interaction between children and their peers. The target population is ASD children whose behavior is highly dependent on parents and whose social behavior is in the basic stage. Through the questionnaire survey of parents, more real feedback can be obtained. According to previous interviews, ASD children often travel mainly by walking accompanied by their parents. Therefore, this study is aimed at exploring the influence of built environment on children's social behavior by representing social behavior through game behavior after a random trip. It should be noted that open space and semiopen space are the research scope of this study is and do not pay attention to an indoor environment.

According to the travel process, the built environment factors are matched (Table 1):

(1) Before departure (building density). Overcrowded housing conditions have a negative impact on the healthy development of children [8]

(2) During journey (traffic environment, road environment). Children's physical activities and outdoor games are positively correlated with the walking path, bicycle path, road connectivity, park accessibility, recreational facilities, destinations, and public transportation in the built environment; it is negatively correlated with high traffic exposure and crime [9, 10]

(3) Arrived at destination (population density, environmental safety, environmental quality, and land use). Children's play behavior is related to parents' cognition of the built environment. Facilities (parks and play spaces, street lighting, sidewalks and roads, public transportation, shops, and basic services), safety and cleanliness of destinations, population density, and surrounding greening degree all have an impact on children's play behaviors [11, 12]

## 2. Method

The participants in this study were parents of ASD children in special education schools in Fujian province, China. At the beginning of the study, we contacted the principal through the Internet, introduced the intention and method of the study through video clips, and invited the principal to spread the questionnaire to the parents of the children and through the "snowball" approach to more principals, to obtain their assistance.

This study focuses on three core issues: how the built environment before departure affects the social behavior of ASD, how the built environment during journey affects the social behavior of ASD, and how the built environment arrived at destination affects the social behavior of ASD. The dependent variable is the social behavior (observation, participation, retreat, and concealment) of ASD children, and the independent variable is the built environmental factor during the travel process (before departure, during journey, and arrived at destination).

In this study, an online questionnaire was distributed to parents of ASD children. Parents will be asked to take their children to destinations that are 5–10 minutes' walk away from where they live, such as parks. The first part of the questionnaire describes children's gender, age, family background, etc. The second part is based on parents' objective cognition of built environment and children's actual play

Table 1: Description of built environment factors based on the travel process.

| Travel process | Built environment elements | Element details |
|---|---|---|
| Before departure | Building density | Residential building density, residential greening degree |
| During journey | Traffic environment | Accessibility of destination, complete sidewalk facilities, traffic light waiting time, intersection environment |
| | Road environment | Sidewalk greening, sidewalk shading, isolation facilities for people and vehicles, roadside parking, vehicle occupancy on sidewalks, road connectivity, number of vehicles, vehicle speed, vehicles yield to pedestrians |
| Arrived at destination | Population density | Crowd density, number of children |
| | Environmental safety | Greening degree, noise interference, no peculiar smell, clean environment, building form |
| | Environmental quality | Safety, lighting equipment, monitoring function, private space, convenient transportation, safe intersection |
| | Land use | Complete service facilities, type of activity facilities, number of activity facilities, quality of active facilities, complete leisure facilities, number of leisure facilities, quality of leisure facilities, complete activity venues, number of activity venues, quality of activity venues |

behavior. The second part was based on the travel process (before departure–during journey–arrived at destination), and the built environment factors (building density, traffic, road environment, population density, environmental safety, environmental quality, land use, and children's games behavior) on children's journey will be completely divides to the above three processes. The questions were positively described (e.g., is there a good sidewalk facility between your residence and destination?); the answers are as follows: "strongly agree," "agree," "not necessarily," "disagree," and "strongly disagree," which are marked as 5, 4, 3, 2, and 1, respectively.

This research method is a combination of quantitative and qualitative research methods. The questionnaire is a subjective survey, which is used as the dependent variable after reliability and validity analysis. The objective built environment is the objective data, which is used as the independent variable. Multiple regression was used to explore the causal relationship between dependent variables and independent variables.

Open space and semiopen space are the research scope of this study, which expands the comprehensiveness of the research. In addition, autistic children and the research on vulnerable groups are the research object, which also enriches the theoretical knowledge of the built environment.

## 3. Result

Parents of 220 ASD children were invited to participate, but only 197 parents submitted valid questionnaires. There was only one difference in gender among the subjects. The age distribution is mainly concentrated in 6–9 (42 children aged 3–6 and 41 children aged 9–12). Of all the respondents, 67% have registered permanent residence and only 7.5% are single-parent families. 31% had parents and children living together, and 69% had parents, children, and grandparents living together. Most of the total household income was 10000–20000 RMB per month, accounting for 61.5% of the total. The educational background of the main guardians in their families is high school, accounting for 48.5%, followed by bachelor's degree or above, accounting for 38%. About 49.5% of families have two children, followed by the only child, accounting for 41%. 67% of the children in other families are healthy, 20% are subhealthy, and 13% have physical or mental defects.

As there are variables involved in the distance and destination, some coefficients are not significant in the regression analysis, which does not contribute to the goodness of $R$ squared. Therefore, stepwise regression is adopted in the regression part to further accurately analyze the influence of each indicator in the built environment on children's outdoor activities and games (which is described as follows as social behavior, and social behavior includes observation, participation, retreat, and concealment).

*3.1. How the Built Environment before Departure Affects the Social Behavior of ASD.* At the significance level of 0.01, residential building density has a positive influence on the four behaviors of children (Table 2). This happens to coincide with the positive correlation between children's activities and residential density found in previous literature studies [13]. Residential building density and residential greening degree have a positive impact on children's retreat and conceal behavior. Higher building density means more complex spatial relations and higher population density, which are positively correlated with ASD children's social retreat behavior [14]. Exposure to green space can effectively promote mental health [15] and increase the possibility of children's social behaviors (Table 2).

*3.2. How the Built Environment during the Journey Affects the Social Behavior of ASD.* At the significance level of 0.01, intersection environment and complete sidewalk facilities have a positive impact on children's observation behavior (Table 3). At the significance level of 0.05, children's observation behavior was positively affected by traffic light

Table 2: Linear regression analysis of the before departure built environment on social behavior of ASD children.

| Variables | Observation | Participation | Retreat | Concealment |
|---|---|---|---|---|
| Residential building density | 0.596*** | 0.411*** | 0.408*** | 0.486*** |
| Residential greening degree | 0.259*** | 0.467*** | 0.284*** | 0.354*** |
| Constant | 0.662*** | 0.477** | 1.369*** | 0.622** |
| *F*-Statistic | 154.28*** | 129.13*** | 100.92*** | 101.49*** |
| Observations | 200 | 200 | 200 | 200 |
| *R* squared | 0.610 | 0.567 | 0.506 | 0.507 |
| Adj *R* squared | 0.606 | 0.563 | 0.501 | 0.502 |

Robust *t*-statistics in parentheses; $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$.

Table 3: Linear regression analysis of the during journey built environment on social behavior of ASD children.

| Variables | Observation | Participation | Retreat | Concealment |
|---|---|---|---|---|
| Accessibility of destination | | 0.177*** | | 0.193*** |
| Complete sidewalk facilities | 0.192*** | | 0.204*** | |
| Traffic light waiting time | 0.194** | | | |
| Intersection environment | 0.234*** | | 0.174** | |
| Sidewalk greening | | 0.265*** | 0.150** | 0.204*** |
| Isolation facilities for people and vehicles | | 0.161** | | 0.148** |
| Roadside parking | | 0.133** | 0.224*** | 0.127** |
| Vehicle occupancy on sidewalks | 0.183** | | | |
| Road connectivity | | | 0.209*** | |
| Vehicle speed | 0.167** | | | |
| Vehicles yield to pedestrians | | 0.301*** | | 0.185*** |
| Constant | 0.025 | −0.173 | 0.132 | 0.608** |
| *F*-Statistic | 63.19*** | 77.44*** | 71.23*** | 51.98*** |
| Observations | 200 | 200 | 200 | 200 |
| *R* squared | 0.620 | 0.666 | 0.647 | 0.573 |
| Adj *R* squared | 0.609 | 0.657 | 0.638 | 0.562 |

Robust *t*-statistics in parentheses; $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$.

waiting affecting the observation behavior of arriving at the destination.

When the significance level was 0.01, destination accessibility, sidewalk greening, and vehicles yield to pedestrians had a positive impact on children's participation behavior. The perception of road environmental safety can improve children's enthusiasm in activities [16]. The proportion of green plants, pedestrian-friendly traffic environment, and accessibility of leisure areas can support children's active lifestyle and independent mobility [17]. However, when the significance level is 0.05, isolation facilities for people and vehicles and roadside parking have a positive impact on children's participation behavior [18, 19].

When the significance level was 0.01, sidewalk facilities, roadside parking, and road connectivity had a positive impact on children's withdrawal behavior. By reducing the number of roadside parking spaces, the proportion of children's activities can be effectively increased [20]. At the significance level of 0.05, the intersection environment and sidewalk greening had positive effects on children's retreat behavior. The number of intersections and road connectivity have a negative impact on children's outdoor activities [21].

When the significance level was 0.01, the accessibility of destination, sidewalk greening, and vehicle comity had a positive impact on children's concealed behavior. Children with autism experience the stress-relieving benefits of nature more than typically developing children [22]. At the significance level of 0.05, isolation facilities for people and vehicles and roadside parking had a positive impact on children's participation behavior. Isolation facilities for people and vehicles mean safety and have a positive impact on children's activity behaviors [19].

When the significance level is 0.01, the number of activity facilities, complete leisure facilities, quality of leisure facilities, and the number of activity venues have a significant positive impact on children's participation behavior. Improving the quantity and quality of community and park infrastructure (such as recreational facilities, rest seats, and dustbins) may have a positive impact on the activities of children and adults [23, 24]. Parents' awareness of the

Table 4: Linear regression analysis of the arrived at destination built environment on social behavior of ASD children.

| Variables | Observation | Participation | Retreat | Concealment |
|---|---|---|---|---|
| Number of children | | | 0.253*** | |
| Noise interference | | | 0.256*** | |
| No peculiar smell | 0.206*** | | | |
| Clean environment | | | | 0.196*** |
| Building form | 0.214*** | | | |
| Complete service facilities | | | | 0.156** |
| Number of activity facilities | 0.175** | 0.277*** | 0.228*** | |
| Complete leisure facilities | | 0.310*** | | |
| Quality of leisure facilities | | 0.244*** | 0.193*** | |
| Complete activity venues | 0.179*** | | | |
| Number of activity venues | | 0.217*** | | 0.207*** |
| Safety | 0.258*** | | | |
| Lighting equipment | | | | 0.198*** |
| Monitoring function | | | 0.180** | 0.124** |
| Constant | −0.220 | −0.229 | 0.641*** | 0.524** |
| $F$-Statistic | 67.81*** | 89.12*** | 69.35*** | 68.33*** |
| Observations | 200 | 200 | 200 | 200 |
| $R$ squared | 0.636 | 0.646 | 0.641 | 0.637 |
| Adj $R$ squared | 0.627 | 0.639 | 0.632 | 0.629 |

Robust $t$-statistics in parentheses; $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$.

environment will affect children's activity level [25]. In addition, the preliminary field observation also found that parents would give priority to places with more age-appropriate facilities when choosing destinations and these places are often visited, which also well explains the possibility that children can get more participation in familiar places (Table 4).

When the significance level was 0.01, the number of children, noise interference, the number of activity facilities, and the quality of leisure facilities had a significant positive impact on children's retreat behavior. ASD children are more sensitive to sound than ordinary people [26], and excessive noise will lead to high response of their sympathetic nervous system, which is related to problem behavior and pain [27]. However, when the significance level was 0.05, only the destination monitoring function had a significant positive effect on children's retreat behavior. Parental monitoring has a strong negative impact on children's activities, while the presence of other active children has a strong positive correlation with sports activities in parks [28]. However, in this study, the monitoring function comes not only from parents but also from some electronic monitoring facilities and the crowd. In addition, in the preliminary observation, it is found that parents will consciously guide children in their gaming behaviors, so children's retreat behavior at the destination will be affected by both the population density and the monitoring function.

At the significance level of 0.01, a clean environment, the number of activity venues, and lighting equipment have a significant positive impact on children's concealment behavior. ASD children have difficulty initiating and responding to social interactions with others, maintaining eye contact, sharing objects and activities, and responding to others' feelings [29]. In one of the early observations, a child was socially interrupted by inappropriate behavior and then went straight to another play space, avoiding the previous social situation. It shows that with more playgrounds in the destination, the ASD children may be able to hide themselves by leaving the current playgrounds and entering new ones. Children's vitality is positively correlated with the strength of lighting equipment [30]. Places with sufficient light often improve children's sense of security, which also explains the behavior of ASD children who tend to hide themselves in their parents' arms or some private space after being frustrated in games. However, when the significance level is 0.05, complete service facilities and monitoring function have a significant positive impact on children's concealment behavior. One study confirmed that children with ASD spend more time on aimless activities, interact less with others, and maintain a greater physical distance from their peers than their typically developing peers [31]. The more services a destination has, the more people it is likely to attract to use it, which is one of the reasons why ASD children have difficulty maintaining normal social behavior.

## 4. Discussion

This study focuses on the built environment for autistic children's activities, including open space and semiopen space and indoor environment (such as house, bedroom,

kindergarten, social welfare institution, hospital, and rehabilitation center). Therefore, it can be further studied as another study question in future research. At the same time, due to the difficulty in finding samples, this study was only conducted on autistic children in one city in China, which limited the external validity of the research conclusions. If conditions permit in the future, studies on autistic children in different types of cities can be conducted and the comparative study concludes that there are differences.

## 5. Conclusion

In the context of the global construction of a "child-friendly city" and "healthy city," this study focuses on the vulnerable group of children, ASD children. The improvement of the built environment can improve the social behavior of ASD children and alleviate their social anxiety. The empirical analysis draws the following conclusions and suggestions:

For the residential environment, appropriate control of building density in residential areas can increase the social behavior of ASD children upon arrival at their destination. Increasing the proportion of residential greening can not only promote the physical and mental health of ASD children but also play a significant role in promoting their social behavior in the destination. Therefore, the greening area should be increased in urban planning and design.

For the environment during journey, increasing sidewalk facilities at intersections and reducing waiting time at traffic lights, strengthening traffic control, enforcing speed limits by sections, and increasing roadside no-stop zones can promote pedestrian-oriented travel. At the same time, the establishment of green space with moderate distance, the increase of separation facilities between people and vehicles, and the reasonable division of no parking area for vehicles can also improve the possibility of social interaction of ASD children.

For the destination environment, keeping the environment clean and odor free, setting up a variety of activity venues with different functions, limiting the theme of the venue (such as a special children's park), and increasing the number of activity facilities can improve the observation behavior of ASD children. Increasing the completeness of leisure facilities (such as adding pavilions, landscape corridors, rest seats, and other facilities for people to rest) and improving the quality of leisure facilities can promote the participation behavior of ASD children. Controlling the crowd density of the destination, reducing noise interference, and increasing monitoring functions (such as setting up enough monitoring equipment and increasing patrol security personnel) can reduce the withdrawal behavior of ASD children and maintain the social process. Keeping the destination environment clean and tidy (such as without sundry and garbage being discarded), increasing the lighting equipment, and completeness of service facilities (such as toilet, canteens, and other infrastructure services) to the concealment behavior of ASD children have a positive role in promoting, can protect them after social rejection, and get enough security requirements.

## Appendix

### A.1. Description of the Research Process

The sources of the research object are Li Yanyu by Jinjiang city special education school principal help, further through the school teachers and the foundation of Xiamen New Hin Lee secretary general, Zhangzhou Angle beauty Huang Jiehong town special education school principal, Miss Huang Xiamen autism rehabilitation institutions, Xiamen Tongan district special education school principal, Lin Wang Jinjiang psychiatric hospital doctors, and others.

Collect individual data by using the "Wenjuan star online questionnaire collection tool." First, upload the questionnaire questions and answer options through the online platform of Wenjuan star and distribute the questionnaire links generated by the platform to parents and friends. The questionnaire was officially released and launched on October 1, 2020, with a total of 270 copies pushed. At the same time, on December 24, 2020, 200 valid questionnaires were collected after eliminating invalid questionnaires (for example, the answer time was decisive, the answers were the same, and they were the first option of each question), which were used as basic data to analyze "the influence of the urban built environment based on parents' subjective cognition on the social behavior of children with autism."

## Data Availability

The data used to support the findings of this study may be released upon application to the ethics committee of the school of architecture and urban planning, Zhuhai College of Science and Technology, who can be contacted at the following email address: arczcst@163.com.

## Additional Points

*Institutional Review Board Statement.* Ethical review and approval were waived for this study due to expediting procedure under the COVID-19 pandemic. However, before the beginning of this study, the purpose of this study and matters needing attention have been explained to the participants through video explanation.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgments

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*Retraction*

# Retracted: Sustainable Trend of Big Data in Enterprise Supply Chain Under the Artificial Intelligence Green Financial System

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether the authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] H. Wu, X. Zhang, and Y. Wang, "Sustainable Trend of Big Data in Enterprise Supply Chain Under the Artificial Intelligence Green Financial System," *Journal of Environmental and Public Health*, vol. 2022, Article ID 3065435, 8 pages, 2022.

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*Research Article*

# Sustainable Trend of Big Data in Enterprise Supply Chain Under the Artificial Intelligence Green Financial System

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Today, with the rapid development of the Internet, society has entered the era of "information explosion." Financial data are a particularly important part of network information, and it has also reached a new level of public demand. The frequent appearance of words such as "carbon peak" and "green" indicates the transition of national policies to the field of sustainable development. Sustainable development would become an inevitable choice, and a green supply chain has become a new trend under this policy background. Supply chain finance uses the ideas and methods of key supply management to provide financial services to related enterprises. If an enterprise cannot acquire, organize, and use the information and data in the supply chain, it is likely to be outdated or even abandoned in the short term. This paper takes the artificial intelligence green financial system as the background and uses the cooperation theory model to analyze and predict the big data information of the enterprise supply chain. It realizes the transformation of information into sustainable resources for enterprises and releases the huge potential of big data. In this model, this model not only helped the company's overall profit increase by about 8.79% but also provided scientific support for corporate decision-making and promoted the development of the company.



## 1. Introduction

At present, "green supply chain finance" has become a hot topic. It can be seen that the three words green, sustainable, and double carbon contained in the current supply chain finance industry indicate that these words have firmly grasped the "core" of the current supply chain finance development. Supply chain finance provides financial services for the real economy and is gradually moving from silent accumulation to the front. This requirement is even more urgent, particularly during the crucial time when supply-side structural change and the transformation of both new and old kinetic energy are being promoted.

There is scholars' related research on supply chain finance now: Kouvelis proposed that supply chain finance was a model in which two or more organizations in the supply chain finance composed of external service providers plan, execute, and control the flow of financial resources between organizations so as to achieve the purpose of jointly creating value [1]. Martin and Hofmann believed that supply chain finance literally mean the integration and innovation of supply chain and finance [2]. Thomas believed that supply chain finance was a financing activity, and the leading enterprises on the chain were crucial and played a huge role in capital transactions. Financing activities traditionally used fixed assets as mortgages. Under supply chain finance, enterprises mortgage current assets such as accounts payable, prepayments, and inventories to financial institutions, which have nothing to do with fixed assets [3]. Song et al. found that supply chain finance came into being, mainly because it combined the real economy with financial issues to meet the capital needs of SMEs. It reduced the risk of financial institutions, saved business development costs, improved the efficiency of institutional operations, and drove the development of the market economy to a greater extent [4]. Chen and Xu believed that supply chain finance was the use of

financing, risk reduction, and other means and technologies to optimize the management of working capital in the supply chain process and transaction process and to effectively use liquid investment funds [5]. Yan proposed that supply chain finance relied on the core enterprise credit with advantages in the industrial chain and effectively integrated the information flow, logistics, and capital flow between enterprises in the supply chain so as to provide financial services for the upstream and downstream procurement and production and sales process of core enterprises [6]. Simply put, supply chain finance refers to the practice of banks using the products and services offered by their main businesses as well as upstream and downstream companies as solvents to boost their liquidity.

There are scholars related to artificial intelligence research now: Hassabis et al. proposed that an expanding field of technology called artificial intelligence researched and developed a variety of ideas, approaches, tools, and software programs that imitated, enhanced, and extended human intellect [7]. Miller found through research that artificial intelligence was rising in the field of computing and has been widely used in various aspects, such as robot technology, economy, political decision-making, control system, simulation system, and other fields [8]. Institute M believed that artificial intelligence was a discipline that studies how to make computers do intelligent work that could only be performed by humans before. The underlying tenet and core ideas of the field of artificial intelligence were reflected in this phrase [9]. Krittanawong et al. believed that building artificial systems with specific intelligence and studying the rules governing human intellect were both considered to be forms of artificial intelligence. It looked at ways to program computers to perform tasks calling for the human intellect. That was how to use computer hardware and software to imitate certain fundamental ideas, practices, and strategies of intelligent human behavior [10]. Rongpeng believed that the goal of artificial intelligence, a subfield of computer science, was to comprehend intelligence and develop new kinds of intelligent robots that can react similarly to human intelligence [11]. Various research found that since the 1970s, artificial intelligence has been regarded as one of the three leading technologies of space technology, energy technology, and artificial intelligence, and it was also regarded as the three core technologies of genetic engineering, nanoscience, and artificial intelligence in the 21$^{st}$ century [12]. Generally speaking, making robots capable of doing complicated tasks that typically needed human intelligence was one of the primary research objectives of artificial intelligence. However, various individuals and periods have different perspectives on this "difficult labor."

In today's increasingly developed Internet, the market competition of core enterprises is becoming increasingly fierce, therefore the primary objective of today's key businesses was to have an efficient and dependable supply chain [13]. The integration of the Internet, artificial intelligence, and supply chain finance has brought about a favorable impact on the sustainable development enterprises. With the help of the Internet platform to achieve information integration, the Internet collected information and data for sharing greatly improves the financial operation efficiency of the supply chain, while ensuring capital security. Supply chain finance came into being and gradually penetrated various fields that enterprises needed to innovate and develop. It helped to improve the competitiveness of enterprises, and then new financing channels for small and medium-sized enterprises emerged as the times require. At present, the scope of application of supply chain finance is gradually expanding, supply chain finance is gradually entering a period of renewal, and the emergence of Internet technology has provided a new development opportunity for supply chain finance.

## 2. Big Data Application in Supply Chain

### *2.1. Overall Characteristics of the Big Data in Supply Chain*

*2.1.1. Supply Chain Strategic Decision.* Big data analysis provides precise information about an organization for enterprises to make strategic decisions [14]. Big data, for example, can provide precise information on any return on investment and provide insight into potential suppliers. The strategic procurement decision should take into account not only various procurement factors but also the strategic capabilities of suppliers [15]. Big data processing capability is an evaluation factor in the selection of supply chain partners. To weed out supply chain partners that can adapt to future big data difficulties, the analytical hierarchy process (AHP) and fuzzy comprehensive assessment approaches are applied [16]. Big data analysis has recently attracted a lot of interest in the field of product creation. Big data analysis can increase product flexibility and product designers' self-assurance. Customers' purchase history and online behavior are obtained from customers big data. In important industries, the value of big data manifests in the use of customer opinion data polarity to identify product characteristics and predict trends. The significant role of big data analysis summarized in this paper is shown in Figure 1.

*2.1.2. Supply Chain Network Design.* Big data analysis of supply chain network design enable enterprises to gain an advantage in the competition. Large randomly generated datasets in mixed-integer nonlinear models are exploited to screen distribution center locations and assume that intelligent marketing intelligence tools are leveraged to analyze behavioral datasets [17]. The findings have demonstrated that big data analysis may collect extra client information, opening up prospects for sophisticated distribution network design [18].

*2.1.3. Supply Chain Agility and Sustainability.* At present, numerous scholars have conducted research on the agility of advanced supply chains and the sustainability of supply chains. Using as an illustration of the multi-objective mathematical model of green supply chain management, it not only integrates big data science to collect data and control data quality but also integrates social media data and company financial and operational data to effectively

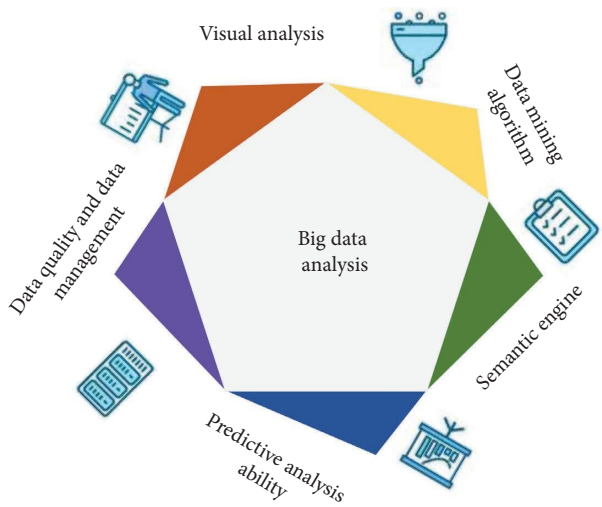


Figure 1: Role of big data analysis.

combine them [19]. Additionally, using expert judgment can help industrial growth be more resilient to risks and uncertainties and improve long-term sustainability.

*2.2. Big Data Throughout the Supply Chain Process.* Following a search of the database's pertinent literature, it is discovered that the supply chain industry's big data analysis focuses on strategic decision-making, network design, agility, and sustainability [20]. The big data analysis of the supply chain process mainly focuses on demand planning, procurement and production, inventory, and logistics distribution, etc. [21], as shown in Figure 2.

*2.3. Big Data Applications in Supply Chains of Different Industries.* Currently, one of the common goals, when big data are applied to supply chains of many sectors, is to make excellent use of data and increase productivity by giving accurate information to accurate users in a timely way [22]. Big data analysis have been used in different industrial supply chains, including finance, technology, medical care, consumption, energy, and manufacturing. Each of them has a unique data processing and commercial value, as shown in Figure 3:

According to the big data analysis survey and statistics in Figure 3, the proportion of the supply chain in the banking and financial industries is nearly half, which shows that they attach great importance to the application of big data. The supply chain of the high-tech industry has a relatively high proportion, ranking second and accounting for about 14%. The second proportion from high to low is medical care, consumption, energy, manufacturing supply chain, etc.

In view of the statistical data shown in Figure 3, this paper obtains the commercial value of big data for different industries by further reading related literature.

Table 1 shows the application status and commercial value of big data in industrial supply chains such as banking, technology, medical care, consumption, energy, and manufacturing. For example, data processing in manufacturing/high-tech industries for product failure analysis, patent record retrieval, and intelligent location provide business value for product optimization, cost reduction, and rapid problem resolution. It is precise because of this that big data can show its value in this industry.

The above analysis results show that various industries around the world regard the realization of big data analysis applications as an extremely important development direction, especially for data-oriented industries, the realization of its applications has become very necessary.

## 3. Big Data Benefit Model of Green Supply Chain Finance

Establishing a big data benefit model of green supply chain finance and using the replication dynamic equation method to study the impact of big data sustainability, provides an effective way to promote small and medium-sized enterprises in the upstream supply chain to use environmental management strategies to carry out production [23]. In this paper, the green degree improvement $X$ of the entire supply chain is taken as the research variable. This paper builds a financial big data benefit model of a green supply chain to study the decision-making problem of member enterprises in any supply chain under the condition of specific financial budget constraints. The aspects of demand planning, purchasing, production, inventory, and logistics and distribution are represented by variable $y_i$. The constructed model is as follows:

$$S_i(X, y_i) = A - \beta X^{-\gamma} y_i^{-\delta}. \tag{1}$$

Among them, the supply chain member companies are represented by $S_i$, and the sales effort invested by the company is represented by $y_i$. The greenness level of the entire supply chain is represented by $X$, and the greenness improvement contributed by the enterprise supply chain is represented by $x_i$. The maximum market capacity of enterprise supply chain products is represented by A, and $\pi_i$ is the income of the enterprise. The following studies the decision variables $X$ and $y_i$ of each firm $i$ when it reaches equilibrium and solves the following constraint maximization problem:

$$\begin{aligned} &\max_{X\, y_i} \pi_i = m_i\left(A - \beta X^{-\gamma} y_i^{-\delta}\right) \\ &s.t. \varphi(x_i, y_i)\colon\ hx_i + ky_i = B_i. \end{aligned} \tag{2}$$

Among them, $h > 0, k > 0, B_i > 0. i = 1, 2, \cdots, n$. The Lagrangian function constructed according to the above formula is as follows:

$$L(X, y_i) = m_i\left(A - \beta X^{-\gamma} y_i^{-\delta}\right) - \mu(hx_i + ky_i - B_i). \tag{3}$$

The first-order condition is solved. Among them, $x_i = X - \sum x_{-i}$, so $\partial L/\partial X = \partial L/\partial x_i$, and the gradient vector $\nabla\varphi(X^*, y_i) = (h, k)$ of the constraint is not 0, so there are

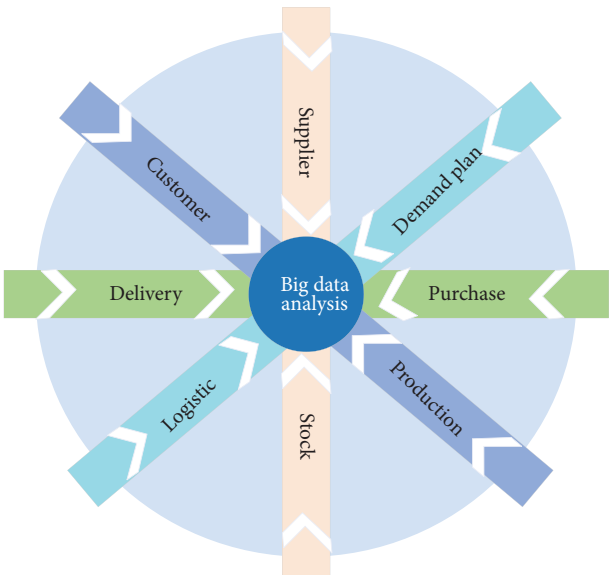


Figure 2: Applications of big data analysis in the supply chain.

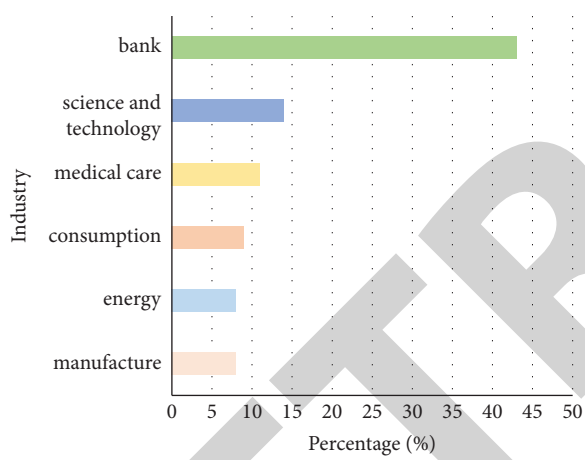


Figure 3: Application of big data analysis in the supply chain of different industries.

$$m_i\beta\gamma y_i^{-\delta}X^{-\gamma-1}-\mu h=0,$$
$$m_i\beta\delta y_i^{-\delta-1}X^{-\gamma}-\mu k=0 \tag{4}$$

It can be got that

$$X^*=\frac{\gamma k}{\delta h}y_i,$$
$$y^*=\frac{1}{k}\left(B_i-hx_{i_i}^*\right) \tag{5}$$

The reaction function between the enterprise $i$ and other members is obtained by eliminating constraint $y_i$

$$X^*=\frac{\gamma B_i}{h(\delta+\gamma)}-\frac{\delta}{\delta+\gamma}\sum x_{-i}. \tag{6}$$

Taking Formula (6) for the partial derivative function respectively, it can be got

$$\frac{\partial x_{i_i}^*}{\partial h}=-\frac{\gamma B_i}{(\delta+\gamma)h^2}<0,$$
$$\frac{\partial x_{i_i}^*}{\partial \gamma}=-\frac{\delta}{(\delta+\gamma)^2}\left[\frac{B_i}{h}+\sum x_{-i}\right]>0, \tag{7}$$
$$\frac{\partial x_{i_i}^*}{\partial \delta}=-\frac{\gamma}{(\delta+\gamma)^2}\left[\frac{B_i}{h}+\sum x_{-i}\right]<0.$$

The objective function of this supply chain should be expressed as follows:

$$\max_{X,y_i}\sum_{i=1}^{n}\pi_i=\sum_{i=1}^{n}m_i\left(A-\beta X^{-\gamma}y_i^{-\delta}\right), i=1,2,\cdots,n,$$
$$s.t.g\left(X,y_1,\cdots,y_n\right):\ hX+k\sum_{i=1}^{n}y_i=\sum_{i=1}^{n}B_i. \tag{8}$$

In order to solve the optimization problem defined by the above equation, a Lagrangian function is constructed, namely

$$\tilde{L}\left(X,y_i\right)=\sum_{i=1}^{n}m_i\left(A-\beta X^{-\gamma}y_i^{-\delta}\right)-\mu_1\left(hX+k\sum y_i-\sum B_i\right). \tag{9}$$

The first-order condition is solved by $\partial\tilde{L}/\partial X=0, \partial\tilde{L}/\partial y_i=0, i=1,2,\cdots,n$. Taking the product form of the matrix to simplify the expression, it is expressed as follows:

$$\beta\gamma X^{-\gamma-1}.\sum_{i=1}^{n}m_iy_i^{-\delta}-\mu_1h=0,$$
$$\beta\delta X^{-\gamma}\bullet\begin{bmatrix}m_1y_1^{-\delta-1}\\ \vdots\\ m_ny_n^{-\delta-1}\end{bmatrix}=\begin{bmatrix}\mu_1k\\ \vdots\\ \mu_nk\end{bmatrix}. \tag{10}$$

Combined with the elimination of constraints, the following equations can be obtained:

$$X^{**}=\frac{\gamma k}{\delta h}\sum y_i=\frac{\gamma}{h(\delta+\gamma)}\sum B_i,$$
$$X_{*I*}^{**}=\frac{\gamma}{h(\delta+\gamma)}\sum B_i-\sum x_{-i}. \tag{11}$$

Let $t=\sum B_i/B_i, \alpha=X^*/x_i^*$, when $t>\alpha$, after the entire supply chain achieves Pareto equilibrium, the total green degree $X^{**}$ is greater than the total green degree improvement $X^{**}$ when any of its enterprises reach equilibrium.

It can be obtained by calculation as follows:

$$\frac{X^{**}}{X^*}=\frac{t(\alpha\delta+\gamma)}{\alpha(\delta+\gamma)}. \tag{12}$$

Table 1: Application of big data in the supply chain of banking, science and technology, medical care, consumption, energy, and manufacturing industries.

| | Data processing mode | Commercial value |
|---|---|---|
| Banking/ Finance | Market evaluation new product risk assessment | Increase market value, improve customer loyalty, increase overall revenue, and reduce financial risk |
| High-tech | Comprehensive product analysis, patent record retrieval, smart device global positioning location service | Optimize products, design and manufacture to reduce warranty costs, and speed up problem-solving |
| Medical care | Shared medical records, accelerated diagnosis, and telemedicine | Improved diagnostic quality to speed up diagnosis and treatment |
| Consumption | Precise promotion behavior analysis | Promote customer buying enthusiasm and comply with customers' buying habits |
| Energy | Centralized analysis of sensor array data in exploration and drilling | Reduce accident risk and optimize the exploration process |

## 4. Evolutionary Model Stability

The high cost of third-party financing resources would increase the cost burden of upstream SMEs in the supply chain. So, for SMEs in the upstream supply chain, using green supply chain finance services has become the best course of action. From the model results, SMEs can choose to take green financial measures or not. Correspondingly, for upstream SMEs of different levels, core companies also adopt two strategic results when applying for supply chain financing, one is to provide guarantees to upstream SMEs, and the other is to have no guarantees. The final result of the strategic combination of core enterprises and SMEs is shown in Table 2.

Among them, assuming that $y$ represents the probability that upstream small enterprises choose "take". $x$ represents the probability that core enterprises choose "guarantee." Figure 4 shows the dynamic trend and equilibrium of the core enterprise group under the three conditions of $y = y_0$, $y > y_0$, and $y < y_0$. When $y = y_0$, then $F(0) = 0$, and $x$ is in a stable state at this time. That is, when the possibility of SMEs "taking" response is 0, there is no difference in the choice of "guarantee" and "no guarantee" for core enterprises. That is, when the possibility of SMEs' "taking" response is zero, the core enterprises have no difference in the "guarantee" and "no guarantee" response options.

If $x = x_0$, then $F(0) = 0$, then $y$ is in a stable state. That is, when the "guarantee" response possibility of the core enterprise is 0, there is no difference between the "take" and "not take" response choices of SMEs, as shown in Figure 5.

In the same coordinate system, the dynamic phase diagram of the core enterprises and their upstream SMEs is drawn, as shown in Figure 6.

By examining the dynamic evolution process of the asymmetric replication process between core enterprises and their upstream SMEs, the following four equilibria are obtained:

When the result is in the area ①, $x > x_0$ and $y > y_0$, then the deductive equilibrium point $x = 0$, $y = 1$ is that the core enterprise and its upstream SMEs would definitely choose the strategy combination of not to guarantee or adopt.

When the result is in the area ②, $x < x_0$ and $y < y_0$, then the deductive equilibrium point $x = 0$, $y = 0$ is that the core enterprise and its upstream SMEs would definitely choose the strategy combination of not to guarantee or not to adopt.

When the result is in the area ③, $x < x_0$ and $y > y_0$, then the deductive equilibrium point $x = 1$, $y = 0$ is that the core enterprise and its upstream SMEs would definitely choose the strategy combination of guaranteeing or not to adopt.

When the result is in the area ④, $x > x_0$ and $y > y_0$, then the deductive equilibrium point $x = 1$, $y = 1$ is that the core enterprise and its upstream SMEs would definitely choose the strategy combination of guaranteeing or adopting.

It is concluded from this that through the sustainable trend analysis of big data in the enterprise supply chain under the artificial intelligence green financial system, the enterprise strategy adopted under this model can increase the overall profit of the enterprise by 8.79%. In order to promote enterprises to implement green supply chain finance in the artificial intelligence green financial system, it is necessary for core enterprises to optimize their guarantee strategies. On the one hand, it is necessary to increase the proportion of guarantees provided for upstream SMEs when they implement management strategies for production and reduce the proportion of upstream SMEs that do not implement management strategies to implement management. The development of green supply chains and the promotion of green supply chain finance should be the primary concerns of core businesses. The core enterprises should concentrate on promoting the development of green supply chain finance and green supply chain so that the stakeholders of green supply chain finance can see the long-term benefits of green supply chain finance at the same time, not just the immediate short-term benefits. This would allow the relevant stakeholders of green supply chain finance to see another aspect. Let stakeholders of green supply chain finance not only see the long-term benefits of green supply chain finance but also the short-term benefits.

## 5. Suggestions for Green Supply Chain Big Data

*5.1. Green Supply Chain Finance Supports the Growth of the Green Supply Chain.* To effectively promote green supply chain management, it is important to thoroughly comprehend the function that green supply chain finance plays. It is also required to update pertinent laws and policies regarding green supply chain finance and increase the impact of this

Table 2: The strategic combination between core enterprises and upstream SMEs.

| | | Middle and upstream enterprises | |
|---|---|---|---|
| | | Action | No action |
| Core Enterprise | Guarantee | (Action, Guarantee) | (No Action, Guarantee) |
| | No guarantee | (Action, No guarantee) | (No Action, No guarantee) |

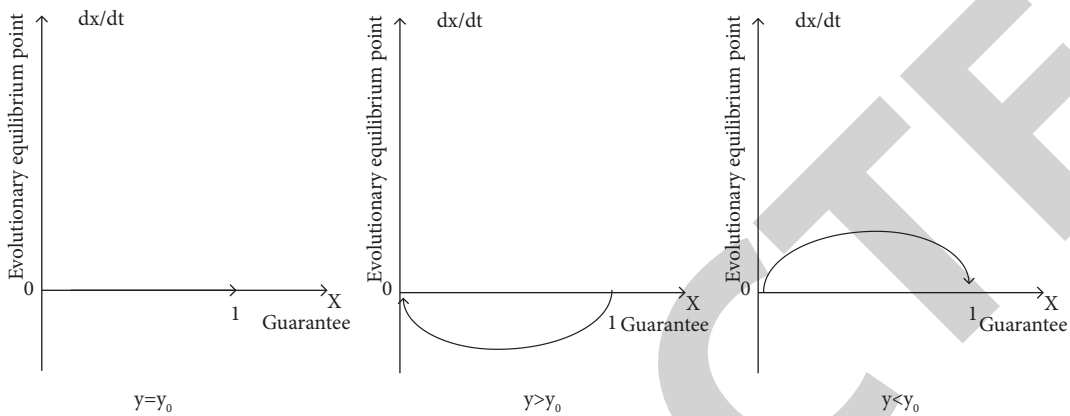


Figure 4: Replication dynamic phase diagram of the core enterprise group.

sector. The promotion of green supply chain management is still plagued by two major issues. First, small and medium-sized manufacturers upstream in the supply chain are hesitant to incorporate environmental protection into the production process because they want to maximize profits and have limited resources. Second, manufacturers who implement ecological supply chain management are faced with the dilemma of a shortage of funds because they invest part of their funds in environmental protection work. The implementation of an ecological supply chain finance strategy can not only promote upstream SMEs to use environmental management strategies to carry out production but also provide new financing channels for enterprises that use ecological supply chain management strategies, thereby promoting ecological supply chain management from the capital level. It further promotes the green supply chain management from the financial level. In this regard, the government should also improve the laws, regulations, and policies related to ecological supply chain finance and promote the implementation and development of the ecological supply chain finance strategy through policy guidance to enhance its influence.

*5.2. Enhancing the Participation of Green Supply Chain Financiers.* The main stakeholders of ecological supply chain finance are commercial banks, core enterprises, and small and medium-sized enterprises upstream of the supply chain. In addition, most core enterprises pay less attention to environmental pollution when financing. By establishing an evolutionary game model between core enterprises and their upstream SMEs and a noncooperative game model between commercial banks and core enterprises to verify the strategy that commercial banks, core enterprises, and upstream SMEs jointly participate in green supply chain financing so as to increase the enthusiasm of key stakeholders to participate.

*5.3. Intelligent Risk Control Using Big Data to Achieve Risk Prevention and Control in Key Links.* For the intensive legal compliance audit points, the procurement process and the implementation of material audit only rely on manual auditing and selection by procurement personnel, which results in a large workload. It is not conducive in improving the efficiency and quality of procurement and even leads to the risk of a clean government, which does not meet the current legal and compliant construction needs. Therefore, it is urgent to introduce big data processing capabilities to replace manpower to carry out procurement risk prevention and control. Big data are applied to risk prevention and control mechanisms such as pre-event control, in-event supervision, and post-event analysis to achieve safety compliance.

Data fields such as product name, material name, supplier name, and item name should be obtained through monitoring, as well as the property amount limits control mode, total quota, execution quota, budget quota, payment type, order number, material code, commodity price, and contract number code when performing the contract. Other data fields, such as product catalog decision-making information should be used to enforce the control of violations and refuse to execute violations.

*5.4. Intelligent Prediction to Realize Automatic Identification of Unstructured Data Risks.* The traditional procurement model is "demand-oriented," and there are management difficulties such as slow demand response and imprecise demand planning. Relying on big data analysis capabilities to change the way of demand response is the way demand-

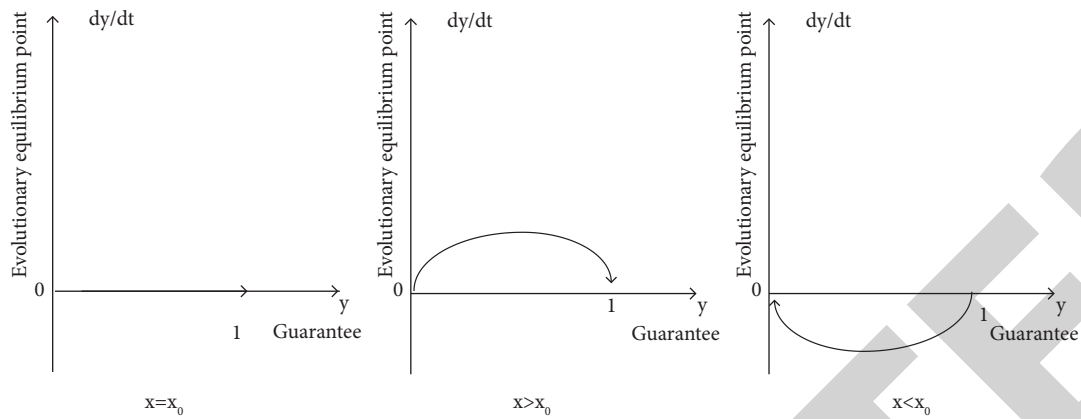


Figure 5: Phase diagram of replication dynamics of SME groups.

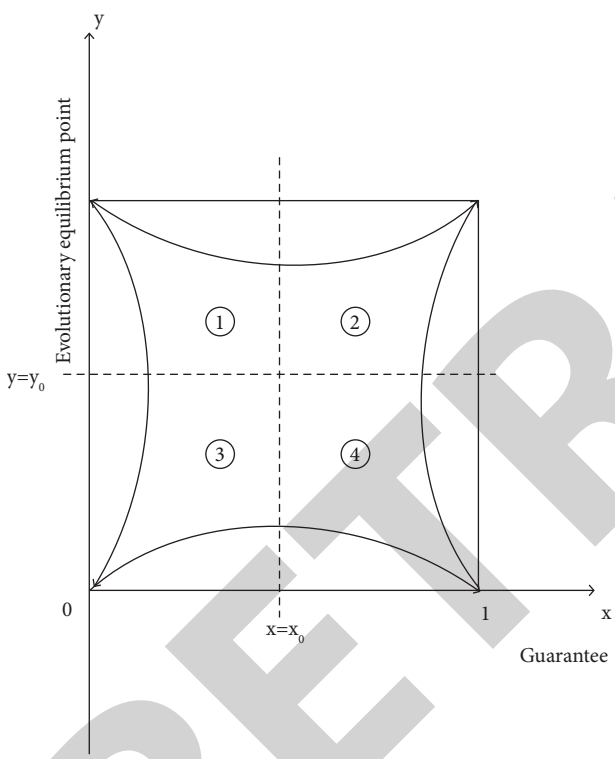


Figure 6: Evolutionary trajectory map between core enterprises and their upstream SMEs in the supply chain.

driven supply has been transformed into an active stocking to break the bottleneck of various professional systems and make data transparent and visualized. The correlation of demand, purchasing, supply, and sales forecasts is realized through data analysis and combined with the current inventory and purchasing cycle to realize active stocking. It significantly improves demand planning and procurement planning accuracy, further enhancing supply chain agility and demand responsiveness. Taking materials as an example, the key data in the supply chain system and the important data in the branch system are integrated, monitored, and analyzed by big data so as to grasp the market trend and identify bottlenecks and deal with them in time. Through big data analysis, the sales department can guide orders and stock up reasonably so as to avoid untimely supply or stagnant inventory that deviates from monitoring and sales. They can guide the network department to adjust the installation and maintenance capabilities and effectively guarantee business development.

Texts such as procurement documents and bids/receipts are standardized, and they are used to explore the value of parseable unstructured data. Then big data automated sharing tools are used to certify supplier qualifications for bid attachments. Monitoring the abnormal situation of expert scores can ensure that enterprises can legally implement various procurements and reduce and avoid legal and integrity risks.

*5.5. Intelligent Operation to Promote the Improvement of Supply Chain Efficiency.* Most of the traditional statistical analysis methods for indicators are to obtain the raw data of each system. The data are processed through EXCEL, and the statistical results of the indicators are counted. Its calculation process is complicated, and due to the statistical cycle, the data have a lag, which cannot meet the needs of real-time control and tracking of index results. By building a big data analysis system, data can be deeply excavated and presented in real time, such as comprehensive statistical analysis of key procurement indicator data so as to have an accurate and timely grasp of the business development in the supply chain. It can also conduct in-depth and specific analysis to find out key influencing indicators and provide data support for subsequent judgment and decision-making.

## 6. Conclusion

On the basis of replicating dynamic equations, this paper used the static game method of complete information to construct cooperative and noncooperative evolutionary game models of core enterprises and small and medium-sized enterprises. In order to better promote the development of green supply chain finance, it is combined with financing methods. By analyzing the individual interests and overall interests of core enterprises and small and medium-sized enterprises in cooperation and noncooperation, this

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*Retraction*

# Retracted: Juvenile Delinquency from the Perspective of Socialization and Social Control

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] T. Zhang, "Juvenile Delinquency from the Perspective of Socialization and Social Control," *Journal of Environmental and Public Health*, vol. 2022, Article ID 8657491, 6 pages, 2022.

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*Research Article*

# Juvenile Delinquency from the Perspective of Socialization and Social Control

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In recent years, the crime rate of minors in our country has risen steadily, laying a hidden danger for the harmonious and orderly development of the country and society. The healthy growth of teenagers is not only related to the harmony of a family and the future of a nation but also to the destiny of a country. Therefore, in order to ensure the healthy growth of young people and prevent juvenile delinquency, we should start with the causes of juvenile delinquency, identifying the core issues, so as to better study juvenile delinquency. In schools and families, strengthen the education of minors and guide them to develop positively. In terms of law, strengthen the supervision of minors to prevent them from breaking the law.



## 1. Introduction

The phenomenon of juvenile delinquency can be defined from multiple angles. In criminology, juvenile delinquency generally refers to the phenomenon in which people under 14 and under 25 are punished for breaking the law. Sociology focuses on the study of juvenile delinquency.

## 2. Youth Cybercrime

Compared with ordinary juvenile delinquency, the age structure of juvenile cybercrime groups tends to be younger. For one thing, this is due to the different ways of committing crime. The tool for juvenile cybercrime is the computer network, which greatly reduces the age limit in terms of physical strength and access to tools. For another thing, ordinary computer operation does not have high requirements from people, and the average elementary school students are fluent and skilled enough to operate it [1]. Young people lack self-control and cognition of their behavior; therefore, the scale of juvenile cybercrime has expanded rapidly. With the continuous development of the age of science and technology, computer applications are becoming more and more popular, and the scope of juvenile cybercrime has rapidly spread from the city to the countryside. In China, there are a large number of left-behind children in rural areas, and the intensity of education management is much lower than that in cities. As more and more rural left-behind youths come into contact with the Internet world, their lives are monotonous and lonely, which have changed dramatically [2]. Young children are more likely to be "abetted" by criminals when they make calls on the Internet and contact unsafe and unhealthy information, which leads to the continuous expansion of the scale of juvenile cybercrime.

## 3. The Causes of Youth Cybercrime

*3.1. Weak Will and a Lack of the Ability to Identify Right from Wrong.* As shown in Figure 1, when a person is in adolescence, he will be impulsive and self-willed because he lacks responsibility. In addition, their understanding of the law is far from normal. Teenagers have relatively weak willpower and are more prone to incitement by illegal information on the Internet [3]. Many criminals at home and abroad have pointed to immature young people, and the online platforms that young people often use are the worst-hit areas for bad information. However, due to their wrong

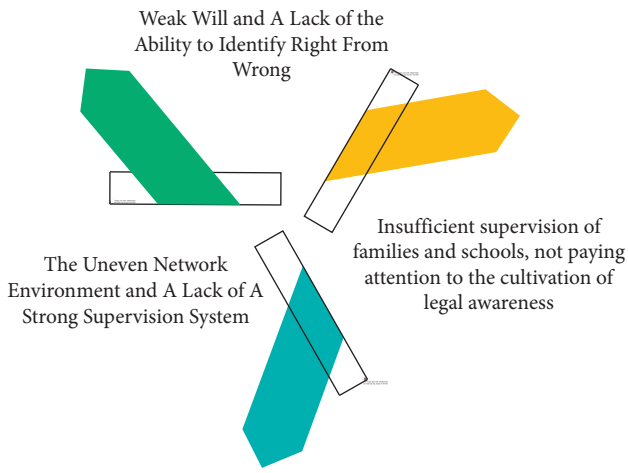


Figure 1: Causes of juvenile cybercrime.

understanding of new things, it is more likely to cause many serious consequences [4].

*3.2. Insufficient Supervision of Families and Schools, Not Paying Attention to the Cultivation of Legal Awareness.* A good family environment and strong school supervision are often the basis for avoiding youth cybercrime. However, in this regard, schools and society lack real supervision and supervision. In particular, there is still a considerable gap between the current requirements for school legal education and the new requirements for school legal education in the Internet age [5]. The school lacks legal educators who are proficient in both business and network technology, which means they cannot help young people understand the network in a timely manner, abandon uncivilized and unhealthy online activities, and stop online criminal activities in a timely manner. The lack of discipline and legal awareness will lead children to make illegal activities on the network.

*3.3. The Uneven Network Environment and a Lack of a Strong Supervision System.* The supervision system is a system formed by a series of legal provisions and various provisions promulgated by the state to supervise the state organs and their staff's compliance with laws and disciplines in state management activities [6]. The supervision system includes a wide range of content, including not only the legislative, administrative, and judicial supervision of state organs but also the supervision of political parties, the masses, and public opinion. Today's Internet is full of vulgar, bloody, and violent content, including reactionary and inciting speech that has penetrated from abroad. Due to a lack of self-control and the ability to distinguish right from wrong, our teenagers have become the most easily accepted objects of such bad information on the Internet [7]. Today, we have to think deeply about issues such as school violence, youth violent crimes, and youth online reactionary comments.

## 4. Prevention and Treatment of Youth Cybercrime

With the frequent occurrence of juvenile cybercrime, how to prevent and control juvenile cybercrime has become a major issue of concern to all walks of life [8]. The author analyzes the characteristics and causes of juvenile cybercrime and puts forward the following prevention and control measures, as shown in Figure 2.

*4.1. Strengthening the Guidance Education for Young People and Cultivating Legal Awareness.* For young people in a period of vague consciousness, their world outlook, values, and life views have not been fully established. Therefore, they need active and correct guidance and education from all walks of life [9]. Schools should develop specialized legal education to cultivate young people's good legal awareness and psychological quality and to eliminate the hidden dangers of crime. At the same time, young people should be educated in cybersecurity to increase their awareness and immunity against harmful information and cultivate their network behaviors and good network psychology [10].

*4.2. Strengthening the Construction of Internet Culture and Creating a Good Network Environment for the Young People.* Relevant departments should carry out "green network" activities for the whole society and prohibit users from posting vulgar, pornographic, violent, bloody, and other bad information on the network platform [11]. If any problems are found, the government will seize the illegal website and punish the relevant personnel. When departments are establishing a sound age classification system to prevent imperfect youths, they should also avoid premature contacting with inappropriate articles. Reasonable measures should be taken to prevent young people with improper concepts of right and wrong from being exposed to bad online information and provide them with a relatively good online environment [12].

*4.3. Formulating Relevant Laws and Regulations to Combat Youth Cybercrime.* The author believes that computer cybercrime, especially juvenile cybercrime, can be incorporated into the legislative focus in recent years. For one thing, a more comprehensive and scientific computer network legal system will be promulgated to form a set of reasonable and effective management systems to strengthen the management of cybercrime. For another thing, it is necessary to increase the crackdown on cybercrime against minors [13]. At present, laws and regulations are not enough to properly punish minors for cybercrime. Therefore, the author recommends that in order to prevent and control minors' cybercrime, the state should promulgate reasonable and perfect relevant network laws and regulations to increase the intensity of attacks on minors' cybercrime and maintain social stability.

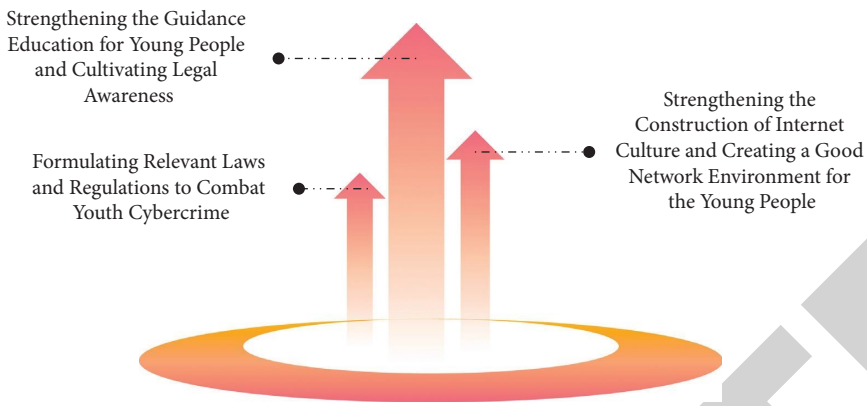


Figure 2: Prevention and control of juvenile cybercrime.

## 5. Characteristics of the Times for Juvenile Delinquency

President Su of "*World Education Information*" pointed out the characteristics of the era of juvenile delinquency in our country during the interview.

*5.1. Su Chunjing: The Current Situation of Juvenile Delinquency Is Mainly Manifested in the Following Six Points.* First, the number of crimes has increased, and the environment is harsh. Juvenile delinquency almost involves the entire criminal field, among which theft, robbery, and provocations are the most common, especially new types of crimes such as online fraud and involvement in triad crimes. Secondly, the causes of crime are simple, which are sudden and blind. Due to lack of social experience and strong rebellious psychology, young people have poor self-control abilities and are prone to impulses [14]. Third, the crime committed is obviously younger. Since the 1990s, juvenile delinquency in my country has become significantly younger. The fourth is the occurrence of criminal methods towards high-tech crime. With the development and popularization of science and technology, the phenomenon of young people using high-tech or technological products to commit crimes is increasing [15]. Fifth, gang crime has increased, and the trend of grouping is obvious. Sixth, juvenile offenders are mostly children from divorced and poor families. In judicial practice, juvenile offenders have more children from divorced and poor families, who are generally low in education and weak in legal awareness [16].

*5.2. Four Stages of Juvenile Delinquents' Growth Trajectory.* The first is bad behavior. Juvenile delinquency often starts with low-level bad behaviors, including smoking, alcoholism, skipping classes, addiction to the Internet, participating in gambling, watching pornographic violence or reading materials, running away from home for no reason at night, running away from home, and so on. The second is illegal. Due to weak supervision or disobedience of the teacher's teaching, the seriousness of minor crimes has gradually increased, and there have been illegal acts such as fights, robberies, and theft. The third is crime. If a minor commits a crime, which cannot be corrected in time, he will constitute making mistakes [17]. The fourth is a serious crime. Criminology considers intentional killing, intentional injury to cause serious injury or death, rape, robbery, drug trafficking, arson, explosions, and poisoning as serious crimes. If minors do not repent after committing multiple crimes, they will most likely commit serious crimes in the end [18].

## 6. Research Situation of Youth Social Education at Home and Abroad

*6.1. Development of Social Education of Young People Abroad.* Before the 16th century, when society helped vulnerable groups, whether it was economic or material, the week would be divided into youth groups and adult groups. After the 16th century, people must not only serve the disadvantaged groups but also gradually extend the service to all children and adolescents [19]. Due to the early development and rich experience of Germany and the United States, the level of social education development is relatively high. For example, Germany clearly stipulates in the "*Juvenile Protection Law*" that children aged 4–18 must be systematically and comprehensively educated in health. The clear provisions of this law prompt German governments at all levels to attach importance to health education [20]. There are state institutions and many professional organizations in society.

Social education in Asia started late, and Japanese social education occupies an important position in their education system, which is closely related to the importance of the government. In the middle and late last century, the concept of lifelong education began to spread in the Japanese education community [21]. Therefore, more and more people of insight in Japan realize that social education and school education are inseparable for personal development.

*6.2. Youth Social Education Development in Our Country.* Compared with other countries in Asia, our country's social education is better, but compared with the old developed countries, there is still much room for improvement. From the perspective of historical and cultural processes, as early as China's primitive society, there has been a relevant social education [22]. The ancient Chinese peasant economy paid

attention to learning and researching practical technologies, such as firewood and fire, Shennong farming education, and so on, which are social education of social education. In current society, the development of social education in Hong Kong, Shandong province, and other places is relatively prominent. For example, Hong Kong advocates a new social education model, with theory first. Therefore, in the study of social education theory, Hong Kong has strengthened its research on western successful models and regarded social workers as the main advocates of social education [23]. It opposes multiple educational models that use NGOs and social media as a means of publicity and education.

## 7. The Necessity of Social Work Intervention

*7.1. Theoretical Aspects.* From the perspective of China, its society is in a critical period of transformation. Social change conflicts with the individual's original three views, the formed way of thinking, and habitual behavior, which makes the socialization of adolescents endlessly difficult. Based on this background, more and more scholars regard youth social education as the main research object. Since reform and opening up, the current status of social education has improved significantly. The purpose of youth social education is to help them better integrate into social life. This requires that in the education of young people, it is necessary to ensure the improvement of adolescents' practical ability and the integrity of their socialization. At the same time, this kind of education should be combined with school classrooms and parent family education.

*7.2. Practice.* Judging from the time effect of the existing social work intervention in the social education for adolescents, social work can largely standardize works and promote the formation of the social education system.

As early as the second half of the last century, scholars in developed Western countries believed that social education was equivalent to social work. They consider that social education is "the science of social work." Therefore, the essence of social education is that the target of social work is the youth group. The purpose is to let young people understand social work through social work methods. The goal and content of social work are to understand the true value of social work so that after learning social work, adolescents can use corresponding methods to analyze social behavior so as to achieve the purpose of learning about society, understanding society, and integrating into society. Therefore, social work and education are inseparable, and social work is of great significance in the practice of education.

According to Figure 3, it can be found that the crime rate of junior high school students is the highest, as high as 72%; the crime rate of high school students is the lowest, which is at 2%. When students receive education, it is not only the acquisition of knowledge but also the improvement and development of all aspects. They begin to learn and understand society and thus understand the inadmissibility of criminal behavior.

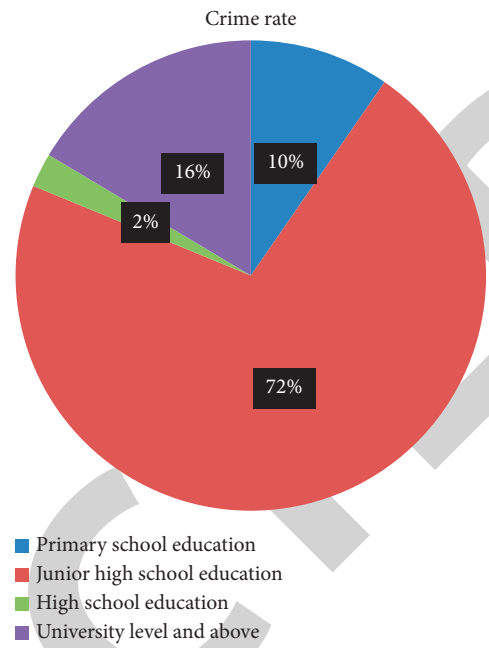


Figure 3: Crime rate.

*7.3. Current Situation and Problems of Youth Social Education*

*7.3.1. Overall Status of Social Education in Our Country.* Judging from the current status of social education development in various provinces and cities in our country, there are regional gaps in the development of youth social education. The cities with relatively developed economic infrastructure in the eastern coastal regions and the central region have carried out better social education for adolescents, while the western mountainous regions and the economically underdeveloped cities in the central region are less developed. The economic base determines the superstructure, and the relative underdevelopment of the economy results in the shortage of basic resources and teachers, which leads to the relative backwardness of social education.

*7.4. Problems in Social Education.* On the whole, youth education in our country is still in a superficial state, and the application of social work in education is relatively scattered, resulting in incomplete and unconcentrated social education. Through relevant data and analysis, the problems in social work can be summarized as shown in Figure 4.

*7.4.1. A Lack of Professional Talents and Not High Professional Quality.* China's social work industry is in a positive stage of construction, and the industry's foundation is not enough. Therefore, only a part of the social education team has social worker qualification certificates. In this part of professional social workers, a considerable number of people lack social work experience and cannot effectively combine theory with practice, which has also led to the administration of social education for young people.

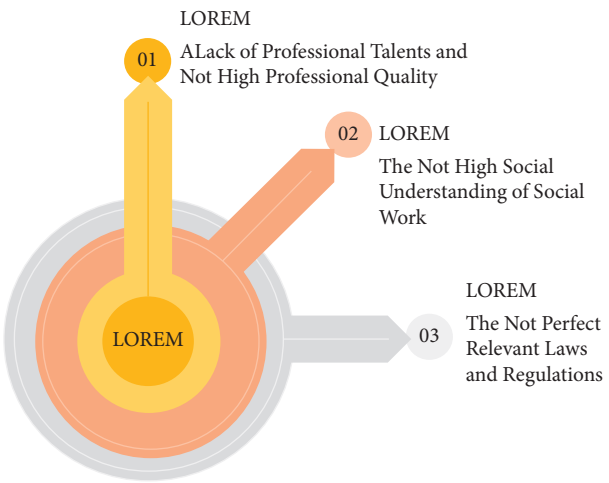


Figure 4: Problems in social work.

*7.4.2. The Not High Social Understanding of Social Work.* The social work major is a subject newly added by universities in our country in a short time. In 1988, Peking University first opened the social work major, which only experienced short 30 years of construction in major universities. Therefore, when referring to the social work major, many people express that they do not understand the role of the subject or mistakenly understand the social work major as a profession engaged in community work in the future. These issues directly affect the social education of our youth. Social work is a sociology major. This major cultivates the professional values of "people-oriented, self-help, fairness, and justice," that has a solid theoretical foundation, skilled social work methods, and other aspects of knowledge and ability and that can be used in party and government organs, enterprises, institutions and social organizations, and other departments and organizations. Compound application-oriented professionals are engaged in social work services and social welfare management in the field.

*7.4.3. The Not Perfect Relevant Laws and Regulations.* Judging from the existing social education policies, the lack of relevant laws and regulations as support for social work intervention in social education has exacerbated the difficulty of combining social work with social education for youth.

From Figure 5, it can be seen that from 2008 to 2015, the number of documents with minors as keywords has gradually increased, reaching a maximum of 772 in 2015. In recent years, with the improvement of laws and regulations, the number of documents with minors as the key word has gradually decreased.

## 8. Strategies for Social Work Intervention

The essence of social work intervention in youth social education is to allow social workers to participate in social education activities, so the work can be divided into the following intervention areas, as shown in Figure 6.

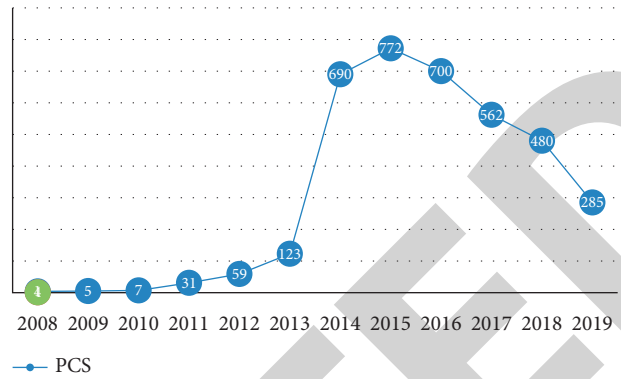


Figure 5: Statistics on the number of documents with "minor" as the key word in 2008–2019.

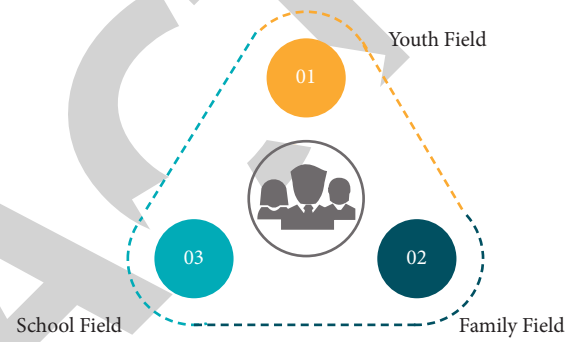


Figure 6: Fields of social work involvement.

*8.1. Youth Field.* The youth field means that according to the understanding of adolescents' physical and psychological characteristics, social workers combine with corresponding professional theoretical knowledge to promote the participation of young people in social education activities, such as summer camps, agricultural bases, agricultural bases, research activities, volunteer activities, and so on. Through these activities, youth groups can sum up the experience through their own experiences and gradually develop good habits so as to achieve the goal of comprehensive development of young people. The wide dissemination of social work among youth groups also promotes its development.

*8.2. Family Field.* The family plays an important role in the growth of teenagers. It can be said that the family is an individual enlightenment teacher. The participation of social workers in the family field refers to a way of living with young people to establish positive and harmonious family relationships, thereby realizing the support role of the family. According to the existing social work research and analysis of youth problems, it can be found that most of the youth problems are caused by negative family relationships. Therefore, promoting the construction of active family support is conducive to promoting the development of social education for young people.

*8.3. School Field.* School is the place with most adolescents, who spend most of their time on campus. Therefore, school work interventions have a positive effect on youth social

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*Retraction*

# Retracted: Income Uncertainty and Consumer Demand among Rural Residents Analysis Based on Optimisation of Household Consumption Utility

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] X. Cheng, Y. Qiao, Q. Feng, and S. Huang, "Income Uncertainty and Consumer Demand among Rural Residents Analysis Based on Optimisation of Household Consumption Utility," *Journal of Environmental and Public Health*, vol. 2022, Article ID 2068963, 13 pages, 2022.

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*Research Article*

# Income Uncertainty and Consumer Demand among Rural Residents Analysis Based on Optimisation of Household Consumption Utility

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As China enters a new era, the role of consumption as a driving force for the economy has become increasingly prominent. The consumption of rural residents is not only a matter of high-quality economic development but also an important part of realizing people's aspirations for a better life. This study contributes to the literature by establishing an econometric model based on the construction of a theoretical model for optimizing the utility of household consumption, using panel data from China's 31 provinces, eliminating endogenesis by using instrumental variables, taking 2*SLS* and dynamic *GMM*. The results show that the relationship between income uncertainty and rural residents' consumption varies in the same direction, stimulating consumption when real income exceeds psychological income and reducing consumption when real income does not reach psychological income. The quantile model shows that income uncertainty has a greater impact on the middle-high-consumption groups and a smaller impact on the lower-income groups.



## 1. Literature Review

As one of the "troika" of economic growth in the traditional sense, the lack of demand for residential consumption is an important reason for the lack of pulling power for the economy. Therefore, the importance of residential consumption in social and economic development has become more prominent. The "14th Five-Year Plan" and the "visionary goal for 2035" clearly put forward "to build a new development pattern with the domestic circulation as the main body and the domestic and international circulation promoting each other," with the domestic circulation as the main body means that we must expand and increase domestic demand. The main body of the domestic cycle means that it is necessary to expand domestic demand, increase the development of the domestic consumer market, meet the demand for upgrading domestic consumption, and provide a constant source of power for high-quality economic development. Rural residents, who account for nearly half of China's population, should not be neglected in terms of their consumption power on economic and social development, especially the huge consumption potential of rural residents. The "No. 1 Document" of the Chinese Central Government in 2021 focused on rural revitalization, proposing that "the whole party should make efforts to make the majority of farmers lead a better life" and explicitly requesting "to comprehensively promote rural consumption." Subsequently, the National Rural Revitalization Bureau was established, and the Law of the People's Republic of China on Promoting Rural Revitalization was officially implemented. Therefore, how to effectively increase the income of rural residents and stimulate their consumption is a matter of overall economic development and an important element in building a happy China, realizing the "Chinese dream," realizing

people's aspiration for a better life and accomplishing the goal of "two hundred years."

The research literature related to rural residents' income and consumption can be said to be overwhelming and innumerable, but the vast majority of studies are based on the perspective of income distribution and total income to study the impact of income on consumption ([1–9], etc). Some scholars also discuss it from the perspective of income composition, mainly dividing rural residents' income into persistent income and temporary income, with persistent income being more stable and expected income, which is the main source of supporting consumption, so persistent income is the main influence of rural residents' consumption vulnerable to loss, while temporary income is unstable and does not enable consumers to generate future income expectations.

The influence effect on consumption is weak, while studies also find that the marginal propensity to consume is greater for persistent income and smaller for temporary income ([10–12], etc). At the same time, relative to Chinese urban residents, the growth rate of rural residents' persistent income is relatively slow and vulnerable to external environmental factors, e.g., the returns of crops are vulnerable to the natural environment and market supply and demand, and there is a certain degree of uncertainty, while the uncertainty of temporary income is even stronger and the marginal propensity to consume is already small, thus causing the overall marginal propensity to consume of rural residents to be smaller.

In the early days of the dualistic household registration system, the main source of income for farmers came from net business income, while other types of income were negligible. With the loosening of the household registration system and the increasing scale of population mobility, the number and proportion of rural residents moving to the cities for work have been rising, resulting in a marked increase in farmers' wage income; in recent years, along with the increasing attention paid by the state to the "three rural issues" and the gradual opening of land transfer, farmers' net property income and net transfer income have also been increasing. The impact of different sources of income on consumption has also changed accordingly, which has attracted the interest of some scholars.

For rural residents, the share of net business income in total income has been declining in recent years in general, but the total amount is increasing, and it is a relatively large and stable source of income, which plays a very obvious role in supporting basic consumption [13, 14]. The rapid development of urbanization has increased a large number of non- agricultural employment opportunities for rural residents, and the continuous improvement of transportation and other basic facilities has provided a good basis for rural residents to work in cities, the wage income of rural residents has grown faster, the growth rate has been higher than that of net business income since 2000, and the influence on rural residents' consumption has gradually increased [15]. The net property income of rural residents mainly comes from land, houses, and idle capital; the value of houses in rural areas is not high, farmers have less idle capital due to income constraints, and the transfer fees for land are not high, resulting in a relatively low level of net property income all the time despite the growth, which ultimately makes the consumption effect of net property income limited, mainly in the promotion of food consumption [16–18]. With the improvement of the level of social security and basic public services in rural areas, the increase in government financial expenditure on education has also alleviated the education expenditure of rural residents' children, and the net transfer income received by rural residents is growing, which has a positive effect on promoting consumption, but as the absolute value is still at a low level, the impact on rural residents in some areas is not yet significant [19].

Many factors affect the income of rural residents, among which there are also highly contingent and unpredictable factors, such as weather, natural disasters, market prices, and policy preferences, leading to a high level of uncertainty about rural residents' income, which has a significant impact on their consumption [20–23], and an increase in uncertainty can influence consumption behavior towards caution to the extent that it reduces consumption and increases savings [24–27]. With China's rapid socioeconomic development, the uncertainties affecting rural residents' income are also increasing, and the negative impact of income uncertainty on rural residents' consumption is significantly higher than that of urban residents due to the motive of precautionary saving and the sensitivity of consumption to income [28–32].

The literature is a good reference for clarifying the factors affecting consumption and the relationship between consumption and income. Most of the studies have explained how the changes in consumption are affected from the perspectives of consumption habits, total income level, fiscal expenditure, and public goods. The relationship between income level or income level and consumption has also been adequately studied, and the empirical studies have mainly adopted time series and panel. The empirical studies have mainly used time series and panel data analysis methods. However, after careful examination, it is found that there are still areas that need to be added.

For example, the impact of income uncertainty on consumption demand is mainly at the level of normative analysis, but not much quantitative analysis is available. The reliability of the findings is debatable.

Drawing on existing studies, this paper attempts to make up for the above shortcomings, with the following possible academic marginal contributions: using two methods to measure income uncertainty, paying particular attention to reflecting the directionality of income uncertainty through the choice of measurement method, this is a clear departure from most of the current research; paying attention to analyzing the positive impact that income uncertainty may play on consumption when constructing a consumer utility maximization model changes the existing research often pays attention to the negative influence which the income uncertainty plays, ignores the possible positive influence, enriches the research to this question, and then conducts a comparative analysis on the basis of the overall study by time period. The model was constructed with attention to the possible

positive impact of income uncertainty on consumption, and on the basis of the overall study, two types of econometric analyses were carried out: time period and subregion, and a comparative regression analysis was conducted using different income uncertainty indicators to enhance the stability and reliability of the empirical findings as far as possible.

## 2. Theoretical Model Construction

It is assumed that the principle of representative rural household consumption is utility optimisation, i.e., $u = u(c)$, where $u$ denotes utility and $c$ denotes consumption.

Given the temporal inconsistency between income and consumption, consumers tend to base their consumption on earned income, i.e., consumption is often influenced by income from the previous period rather than the current period; current consumption is influenced by past consumption habits due to the "ratchet effect"; optimistic future income expectations will boost current consumption, and pessimism will discourage it; the price level of consumer goods will also have a significant impact on consumers, i.e., the current price level will influence consumption demand; with urbanization, the income level and structure of the rural population will influence consumption demand to a large extent. The price level of consumer goods also has a significant impact on consumers, i.e., the current price level affects consumer demand; as urbanization progresses, the income level and structure of rural residents have changed significantly, which also affects consumer demand. In addition to this, factors such as policies and consumer preferences can also have different effects. Combined with the research objectives of the article, it is assumed that the factors affecting representative household consumption are income level, consumption habits, income uncertainty (the uncertainty of income is used here in place of future income expectations, and the specific measurement is described below.), price level, and urbanization rate, and the effects of other factors (such as policy and social security level) are represented by random error terms. The above utility function is therefore deformed as follows:

$$u_t = u\left(c_{t-1}, y_{t-1}, y_t^i, p_t\right). \tag{1}$$

In Equation (1), $c_{t-1}$ represents past consumption habits, $y_{t-1}$ represents prior period income, $y_t^i$ represents income uncertainty, and $p_t$ represents current price levels.

The relatively low level of income and uncertainty of rural households leads to a tendency for rural households to be conservative in their consumption, so the utility function of rural households can be assumed to be constant absolute risk aversion function (CARA) and Equation (1) can be replaced by

$$u_t = -\frac{1}{\theta} \exp\left\{-\theta\left(\alpha_1 c_{t-1} + \alpha_2 y_{t-1} + \alpha_3 y_t^i + \alpha_4 p_t\right)\right\}, \tag{2}$$

where $\theta$ is the absolute risk aversion coefficient and $\alpha$ is the parameter for each variable.

Households face a budget constraint when making consumption decisions, and since real estate such as the rural household home is not easy to realize, household income is considered the only constraint. The constraint is then

$$\sum p_t c_t = y_{t-1}. \tag{3}$$

Therefore, the representative household utility optimization can be expressed as

$$\max\left\{-\frac{1}{\theta} \exp\left[-\theta\left(\alpha_1 c_{t-1} + \alpha_2 y_{t-1} + \alpha_3 y_t^i + \alpha_4 p_t\right)\right]\right\}. \tag{4}$$

The constraint is Equation (3).

## 3. Measurement of Revenue Uncertainty

There are about three types of measures of income uncertainty: first, the proxy variable approach, which uses economic indicators that have some correlation with income uncertainty as a proxy, such as the unemployment rate, economic growth rate, standard deviation, or variance of income groupings, and the difference between trend and actual values of income ([33–36], etc). The second is the questionnaire method, i.e., the subjective evaluation of respondents is obtained through questionnaires, and uncertainty is obtained through statistical analysis [37]. The third is the use of adjusted deviation rates to calculate income uncertainty [38–40].

Proxy variables can explain income uncertainty to different degrees and are indirect measures of income uncertainty, which have the shortcoming of being too homogeneous and can only reflect income uncertainty from one aspect, resulting in large differences between the findings of different proxy variables, and are not reliable enough. Questionnaire surveys can avoid the indirectness of proxy variables and directly calculate income uncertainty, but the questionnaire design lacks uniform specifications and relies on the designer's perception of income uncertainty, which is relatively weak in objectivity, in addition to not being able to obtain continuous data and cannot conduct dynamic research. According to Knight's (1921) definition of uncertainty, income uncertainty should be the fluctuation of income that are not within the range of public expectation, i.e., it should be equal to the difference between expected income and actual income. Uncertainty itself should be directional, with positive values having a positive effect on consumption, i.e., a "windfall" stimulating consumption, and negative values having a negative effect, i.e., a "loss of income" inhibiting consumption. Adjusting for deviations reflects both the degree of deviation between unanticipated and actual income and is suitable for continuous data. For these reasons, this paper uses two methods to measure income uncertainty: the first is to choose the adjusted deviation rate used by Wang et al. to measure income uncertainty, and the second is to use the HP filter to isolate fluctuations in the actual income of rural residents and use the fluctuate on value as an indicator of income uncertainty. The

empirical part uses the data from the above two measures separately for empirical analysis and comparison to make the findings more reliable.

Assuming that the actual income of rural residents in year $t$ is $y_t$, the expected income is $y_t^e$, the annual income growth rate that rural residents can expect is $k_t\%$($k_t\%$ taking the arithmetic average of the real income growth rate of rural residents in every three years), and the real income growth rate in year $r_t\%$ is denoted as

$$y_{t+1}^e = y_t(1 + k_{t+1}\%),$$
$$k_{t+1}\% = \frac{r_{t-2}\% + r_{t-1}\% + r_t\%}{3}. \quad (5)$$

From Equations (1) and (2), the expected income of rural residents in each year can be calculated, and the adjusted deviation in the first $t$ years is

$$AD_t = y_t^e - y_t. \quad (6)$$

Further, due to factors such as price increases and income levels, the adjustment deviations between periods cannot be compared only in absolute magnitude, and the uncertainty of income can be better expressed by using the ratio of adjustment deviation to actual income, noted as $EAD_t$ as the adjustment deviation rate in $t$ years, with

$$EAD_t = \frac{AD_t}{y_t^e} \times 100\% = \frac{y_t^e - y_t}{y_t^e} \times 100\% = 1 - \frac{y_t}{y_{t-1}(1 + k_t\%)} \times 100\%. \quad (7)$$

The positive and negative signs of the adjusted deviation rate calculated according to Equation (7) represent the direction of income uncertainty, $EAD_t > 0$, indicating that rural residents are overoptimistic about their future income and their actual income does not reach their expected income, resulting in an "income loss"; $EAD_t < 0$ indicating that rural residents' actual income exceeds their expected income, resulting in a "windfall." The negative sign represents the direction of income uncertainty.

## 4. Empirical Results and Interpretation

*4.1. Description of Data and Variables.* The original data used in this paper are all from China Statistical Yearbook and Wind database, except the price index, and the other indicators are per capita level, all of which exclude the price factor to be comparable data.

*4.1.1. Explained Variables.* In per capita consumption level $RC_t$, according to the National Bureau of Statistics of the People's Republic of China's interpretation of household consumption expenditure, household consumption expenditure includes cash consumption expenditure and in kind consumption expenditure, so we use a unified indicator of household consumption expenditure to measure the per capita consumption level.

*4.1.2. Core Explanatory Variables.* In income uncertainty, the expected income of consumers will affect consumption, the expected income is the subjective judgment of future income, and the actual income often has a certain margin, so we can use the income uncertainty to replace. Based on the analysis in Section 3, this is measured using $EAD_t$ or income fluctuations $\ln Y_{tv}$ (obtained using the $HP$ filter method).

*4.1.3. Control Variables.* In per capita income level $RY_t$, according to the change of the statistical caliber of the National Bureau of Statistics, the income indicator of rural residents was changed from net income per capita to disposable income per capita (used since 2013, due to the unified implementation of the household income and expenditure and living conditions survey system from 2013), in order to ensure the consistency of the data, the data were processed with the base period of 1998, and the indicator of disposable income per capita was used uniformly to measure.

In price level $P_t$, as the study is on the consumption level of rural residents, the Consumer Price Index for Rural Residents is used as a measure.

In urbanization rate $UR_t$, it is expressed using the number of urban population as a proportion of the total population.

Taking into account the large differences between East, Central, and West China, regional dummy variables $A_1$ and $A_2$ are introduced, defined as $A$ value of $A_1$ is 1 for the eastern region and 0 for the other regions; a value of $A_2$ is 1 for the central region and 0 for the other regions.

In order to eliminate possible heteroscedasticity and skewness and reduce the influence of extreme values on the model, natural logarithmization was done for the above variables except dummy variables. Taking into account the availability and consistency of data to ensure sufficient observations, this paper selects annual data from 31 provinces (municipalities and autonomous regions) throughout the country from 2000 to 2020, Hong Kong, Macao, and Taiwan are not included.

*4.2. Econometric Model Construction.* Based on the above analysis, and considering that consumption is generally influenced by prior period income, rather than current period income, the econometric model constructed in this paper is

$$\ln RC_t = \alpha_0 + \alpha_1 \ln RC_{t-1} + \alpha_2 \ln RY_{t-1} + \beta \ln EAD_t + \delta_1 \ln p_t + \delta_2 \ln UR_t + \sum_{i=1}^{2} \lambda_i Ai + \varepsilon, \quad (8)$$

$$\ln RC_t = \alpha_0 + \alpha_1 \ln RC_{t-1} + \alpha_2 \ln RY_{t-1} + \beta \ln Y_{tv} + \delta_1 \ln P_t + \delta_2 \ln UR_t + \sum_{i=1}^{2} \lambda_i Ai + \varepsilon. \quad (9)$$

A comparative analysis of model (8) and model (9)

allows testing whether different measures of income uncertainty affect the reliability of the conclusions.

Based on the use of Chinese subprovincial data, the impact of income structure and its uncertainty on consumption will be empirically analyzed in three stages, with the first stage focusing on testing the smoothness and cointegration of the variables, the second stage selecting the most appropriate model form through testing, and the third stage testing the stability of the model, including a discussion of issues such as endogeneity, and analyzing the impact of income uncertainty at different levels of consumption through a quantile model impact changes.

### 4.3. Empirical Results

*4.3.1. Descriptive Statistics for Variable Data.* In order to better understand the characteristics of the numerical values of the variables, descriptive statistics of the variables and statistical analysis of the results are shown in Table 1.

Table 1 shows that the mean and median values of the variables are close to each other, indicating a regular distribution of the values of the variables. The largest difference between the maximum and minimum of each variable is the level of per capita consumption, indicating that per capita consumption is more volatile than other variables and that the maximum and minimum of income uncertainty are quite different; it shows that the change of rural residents' income in China is also quite obvious. The corresponding standard deviation of each variable also confirms the above conclusion. If the standard deviation of average consumption level is the largest, it also shows that its volatility is the largest. The skewness value shows that the income uncertainty expressed by the adjusted interest rate is a left-skew distribution, per capita consumption level, per capita income level, urbanization rate, price level, and income uncertainty expressed by income fluctuation which are right skew distribution. Since the peak value of all variables is greater than 0, the distribution of the values of each variable is steeper than that of the normal distribution and is the peak, especially when the peak value of income uncertainty is greater than 3, indicating a very steep distribution, the peak value of other variables is less than 3, which indicates that the steepness is limited. The J-B statistics of each variable also verifies the skewness value and the analysis results.

*4.3.2. Unit Root Test for Panel Data.* To avoid possible bias in the estimation results caused by each variable not being a smooth series, two methods with opposite assumptions are used for testing, an *LLC* method that assumes all cross-sections have the same unit root and an *ADF* method that assumes all cross-sections have different unit roots. The test results are shown in Table 2.

The above test results show that the *LLC* test and *ADF* test of the original series of $\ln RC_t$, $\ln RY_t$, $\ln UR_t$, $\ln P_t$, $\ln EAD_t$, and $\ln Y_{tv}$ show a nonstationary series, the first-order difference series of 1 shows a first-order stationary series except $\ln Y_{tv}$, and the *PP* test of $\ln Y_{tv}$ shows a first-order stationary series. Therefore, the above variables are homogeneous single-integer series, and theoretically, there is cointegration relationship.

*4.3.3. Cointegration Test of Panel Data.* Each variable is a single-integer sequence of the same order, and the cointegration test is used to test whether there is a long-term equilibrium relationship. The test results are shown in Tables 3 and 4.

The above results show that the variables in Equations (8) and (9) reject the "original hypothesis of no cointegration relationship" except for the within-group $v-Stat$, $rho-Stat$, and between-group $rho-Stat$ statistics, and the overall judgment is that there is a cointegration relationship between the above panel variables.

## 5. Estimated Results

*5.1. General Panel Regression Results.* The variables used are cointegrated and can be regressed. The model was first estimated using least squares (5) and was found to be potentially autocorrelated, with coefficient tests on the regional dummy variables showing that none were significant (regression results omitted). To determine the appropriate panel model type, the *F* test and *Hausman* test were used to determine the model category, with the *F* test used to determine whether to build a mixed model or a fixed-effects model and the *Hausman* test used to determine whether to build a fixed-effects model or a random-effects model. The value of the *F* test is calculated as 45.271, rejecting the original hypothesis that the true model is a mixed model and accepting the fixed-effects model, while the value of *P* for the *Hausman* test is 1.000, indicating that the original hypothesis of "the random-effects model is valid" is accepted at both 5% and 10% significance levels. For this reason, the panel random-effects model is chosen, and the estimation results of the fixed-effects model are also given for comparison. The estimate is shown in Table 5.

The results of the random-effects estimation are in full agreement with the fixed-effects estimation, the goodness of fit reaches 99.5%, the *F* test passes, and the $D-W$ values can basically exclude autocorrelation and the regression results are acceptable without considering endogeneity. The results show that the per capita income in the previous period, urbanization, price level, income uncertainty, and per capita consumption in the previous period are all positively correlated with per capita consumption.

It is worth noting that the coefficient of income uncertainty is positive, i.e., income uncertainty moves in the same direction as consumption, but it does not mean that income uncertainty will necessarily boost rural residents' consumption; it is important to note that there are positive and negative income uncertainties calculated above. When income uncertainty is negative, it means that rural residents have lost their expected level of income and their consumption sentiment tends to be pessimistic, favouring increased saving as opposed to consumption. Both cases are consistent with a homogeneous relationship between the two, but the positive and negative results affecting rural residents' consumption are different, which is quite different from the existing

Table 1: Descriptive statistics of variables.

| | $\ln RC_t$ | $\ln RY_t$ | $\ln UR_t$ | $\ln P_t$ | $\ln EAD_t$ | $\ln Y_{tv}$ |
|---|---|---|---|---|---|---|
| Average value | 8.16 | 8.42 | 0.40 | 0.80 | -0.07 | 0.001 |
| Median | 8.14 | 8.40 | 0.40 | 0.79 | -0.01 | -0.02 |
| Maximum value | 9.59 | 9.50 | 0.64 | 1.05 | 0.15 | 1.14 |
| Minimum value | 6.64 | 7.57 | 0.17 | 0.67 | -0.73 | -1.14 |
| Standard deviation | 0.65 | 0.43 | 0.10 | 0.09 | 0.18 | 0.34 |
| Skewness | 0.08 | 0.27 | 0.30 | 0.22 | -2.11 | 0.14 |
| Kurtosis | 2.01 | 2.55 | 2.83 | 1.79 | 6.30 | 3.76 |
| J-B statistic | 27.32 | 13.71 | 10.65 | 45.00 | 777.30 | 17.78 |
| Probability | ≤0.001 | ≤0.001 | ≤0.001 | ≤0.001 | ≤0.001 | ≤0.001 |
| Cumulative sum | 5314.36 | 5482.02 | 259.42 | 518.14 | -44.83 | 0.002 |
| Sum of squares | 270.87 | 118.52 | 7.09 | 5.05 | 20.52 | 74.35 |

Table 2: Unit root test results for panel data.

| Variables | Method | | | | Conclusion |
|---|---|---|---|---|---|
| | *LLC* test | | *ADF* test | | |
| | Test value | *P* value | Test value | *P* value | |
| $\ln RC_t$ | 1.914 | 0.972 | 7.3569 | 1.000 | Nonstationary |
| $\ln RY_t$ | 0.431 | 0.667 | 63.800 | 0.413 | Nonstationary |
| $\ln UR_t$ | -1.189 | 0.117 | 51.999 | 0.814 | Nonstationary |
| $\ln P_t$ | 3.610 | 0.999 | 2.491 | 1.000 | Nonstationary |
| $\ln EAD_t$ | 5.429 | 1.000 | 41.725 | 0.978 | Nonstationary |
| $\ln Y_{tv}$ | 13.692 | 1.000 | 7.910 | 1.000 | Nonstationary |
| $\Delta \ln RC_t$ | -4.124 | ≤0.001*** | 152.919 | ≤0.001*** | Stable |
| $\Delta \ln RY_t$ | -62.977 | ≤0.001*** | 586.953 | ≤0.001*** | Stable |
| $\Delta \ln UR_t$ | -1.420 | 0.078* | 139.811 | ≤0.001*** | Stable |
| $\Delta \ln P_t$ | -11.519 | ≤0.001*** | 215.959 | ≤0.001*** | Stable |
| $\Delta \ln EAD_t$ | -3.710 | ≤0.001*** | 254.406 | ≤0.001*** | Stable |
| $\Delta \ln Y_{tv}$ | -2.015 | 0.022** | 65.791 | 0.347 | Stable |

Note: * indicates significance at the 10% level, ** indicates significance at the 5% level, *** indicates significance at the 1% level, and $\Delta$ indicates first-order difference. The *ADF* test of the first-order difference series of $\ln Y_{tv}$ shows nonstationary, the *LLC* test shows stationary, so the *PP* test with the same hypothesis as *ADF* is added, and the *PP* test shows stationary (test value 78.692, *P* value = 0.075*). The overall assessment is that $\ln Y_{tv}$ is a first-order smooth series.

Table 3: Panel cointegration tests for the variables used in Equation (8).

| Variables | | Panel cointegration test results | | | | |
|---|---|---|---|---|---|---|
| Explained variables $\ln RC_t$ | Explanatory variables $\ln RY_t$ $\ln EAD_t$ $\ln P_t \ln UR_t$ | Within-group statistics | $v - Stat$ 0.312 | $rho - Stat$ 2.248 | $pp - Stat$ -2.775*** | $ADF - Stat$ -3.068*** |
| | | Between groups statistics | | $rho - Stat$ 3.969 | $pp - Stat$ -3.185*** | $ADF - Stat$ -5.396*** |

literature which mostly considers that income uncertainty has a negative impact on consumption. In addition, by regressing the uncertainty of per capita consumption and income and its quadratic term, it is found that the estimated coefficient of quadratic term is positive, which means that there is a U-shaped relationship between per capita consumption and income uncertainty.

*5.2. Endogenous Discussion.* If there are endogenous variables in the explanatory variables, the estimation result of

Table 4: Panel cointegration tests for the variables used in Equation (9).

| Variables | | | Panel cointegration test results | | | |
|---|---|---|---|---|---|---|
| Explained variables $\ln RC_t$ | Explanatory variables $\ln RY_t \ln EAD_t$ $\ln P_t \ln UR_t$ | Within-group statistics | $v - Stat$ -2.508 | $rho - Stat$ 0.838 | $pp - Stat$ -2.775*** | $ADF - Stat$ -6.367*** |
| | | Between groups statistics | | $rho - Stat$ 3.194 | $pp - Stat$ -6.032*** | $ADF - Stat$ -2.506*** |

Note: * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level. All are left-tailed tests except for $v - Stat$, which is a right-tailed test.

Table 5: Fixed and random-effects estimation results for the general panel model of Equation (8).

| Explanatory variables | Random-effects model Regression coefficient | Random-effects model $t$ statistical | Fixed-effects model Regression coefficient | Fixed-effects model $t$ statistical |
|---|---|---|---|---|
| Constant term | 0.351 | 5.829*** | 0.351 | 5.829*** |
| $\ln RC_t(-1)$ | 0.532 | 16.007*** | 0.532 | 16.007*** |
| $\ln RY_t(-1)$ | 0.195 | 6.593*** | 0.195 | 6.593*** |
| $\ln UR_t$ | 1.244 | 3.340*** | 1.244 | 3.340*** |
| $\ln EAD_t$ | 0.096 | 4.622*** | 0.096 | 4.622*** |
| $\ln P_t$ | 1.724 | 6.367*** | 1.724 | 6.367*** |
| $Adjusted\ R^2 = 0.995 D - W = 2.223$ $F = 24393.28 Prob(F) \leq 0.001$ | | | $Adjusted\ R^2 = 0.995$ $D - W = 2.223$ $F = 3314.49$ $Prob(F) \leq 0.001$ | |

Note: * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

4.1 may be biased. The per capita income of rural residents in the model may be an endogenous variable; on the one hand, the main influencing factor of consumption is income and per capita income obviously affects per capita consumption, and on the other hand, an increase in per capita consumption causes consumers to seek higher income to maintain their own consumption levels. To determine the endogeneity of this variable, a $Durbin - Wu - Hausman$ test was used. The education level of rural residents is chosen as the instrumental variable, because per capita consumption does not affect the level of education, which affects the per capita income; at the same time, the change of people's education level will change people's expectation of future income, that is, it will affect the core explanatory variable, but it will have little effect on people's consumption demand, that is, it can be ignored on the explanatory variable. The least squares regression was conducted with rural per capita income as the explanatory variable and educational attainment as the explanatory variable along with other explanatory variables to obtain the residual term $\mu$; the least squares regression was conducted with the residual term $\mu$ as the explanatory variable along with all explanatory variables in the original model and rural per capita income as the explanatory variable to obtain the coefficient $t$ test of $\mu$ as 25.650, the concomitant probability is less than or equal to 0.001, and it is significant, so the rural per capita income is indeed an endogenous variable. To address the endogeneity of rural per capita income, the instrumental variables approach was adopted.

In order to determine whether the instrumental variables chosen above are appropriate, it is necessary to test whether the level of education directly affects per capita consumption. The test is to put the educational attainment into the random-effects regression equation in Table 4 and see if the $P$ test value of the instrumental variable coefficient is greater than 0.1, which means that educational attainment does not directly affect per capita consumption and is a good instrumental variable. The $P$ test value of the regression coefficient of educational attainment was found to be 0.514 (corresponding to a test value of 0.653), which means that educational attainment is a good instrumental variable.

After determining the education level as the instrumental variable, to better ensure the reliability of the regression results, $2SLS$ and dynamic $GMM$ estimation methods were used to regress Equation (8) separately, and to test the variability of the results between different methods, seven different weighting methods were used in dynamic $GMM$ estimation to eliminate serial correlation, the existence of heteroskedasticity between individuals, the existence of heteroskedasticity in second panel data, and the existence of temporal heteroskedasticity in individuals. The robustness of the results was verified by different estimation methods, and the results are shown in Table 6.

The regression results in Table 6 show that the estimation results for $2SLS$ and dynamics $GMM$ are basically consistent, with very close coefficients for each variable, and all of them are significant at the 1% level. Compared with the results in Table 5, the relationship between each explanatory variable and the explained variable remains unchanged and positively correlated, but there is a significant change in the degree of influence. Among them, the influence of consumption in the previous period increases significantly, while the influence of income in the previous period decreases, indicating that the "ratchet effect" of rural residents' consumption is stronger; the main reason is the low level of income, easy to be affected by their own consumption habits; the influence of income uncertainty also increases significantly, indicating that rural residents' consumption may still be at a lower level; "windfall" will significantly increase the level of consumption, and "loss of income" will significantly reduce the level of consumption. After the elimination of endogenesis, the impact of urbanization and prices has been greatly weakened, indicating that urbanization may not have a relatively positive promoting effect on the income of rural residents, resulting in a failure

Table 6: Equations (8) 2*SLS* and the dynamics *GMM* of the estimation results.

| Variables | Method | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2*SLS* | *GMM* | | | | | |
| | | 2*SLS* | White cross | White period | White diagonal | Period SUR | Period weights |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $\ln RC_t(-1)$ | 0.853*** | 0.853*** | 0.853*** | 0.851*** | 0.850*** | 0.852** | 0.853** |
| | (40.583) | (40.583) | (22.725) | (40.814) | (40.495) | (44.953) | (41.960) |
| $\ln RY_t(-1)$ | 0.109*** | 0.109*** | 0.111*** | 0.110*** | 0.110*** | 0.109*** | 0.109*** |
| | (8.010) | (8.010) | (3.950) | (8.012) | (8.489) | (9.144) | (8.638) |
| $\ln UR_t$ | 0.085* | 0.085* | 0.078* | 0.089** | 0.087* | 0.085 ** | 0.086 * |
| | (1.910) | (1.910) | (1.695) | (2.222) | (1.825) | (2.146) | (1.903) |
| $\ln EAD_t$ | 0.197*** | 0.197*** | 0.209* | 0.195*** | 0.198*** | 0.196*** | 0.198*** |
| | (6.565) | (6.565) | (1.729) | (8.370) | (5.944) | (7.619) | (5.847) |
| $\ln P_t$ | 0.429*** | 0.429*** | 0.415*** | 0.435*** | 0.439*** | 0.432*** | 0.431*** |
| | (5.309) | (5.309) | (3.291) | (5.552) | (5.462) | (5.789) | (5.384) |
| $R^2$ | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| $D-W$ | 2.149 | 2.149 | 2.147 | 2.145 | 2.143 | 2.147 | 2.148 |

Note: $t$ test values in brackets. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

to significantly increase the consumption level of rural residents, the reason may be that China's urbanization is more reflected in the urbanization of land and the concentration of resources in cities and towns and that rural residents do not share much in the process; most of the rural residents in China are engaged in manual labor, and their income is relatively low in the cities, which does not play an obvious role in promoting consumption, coupled with the high proportion of rural households in China that are self-sufficient, and rural residents are not price sensitive.

### 5.3. Robustness and Further Discussion

*5.3.1. Robustness Tests.* The discussion of the endogeneity issue in Section 4.3 tests the robustness of the regression results to a certain extent. To further enhance the credibility of the results, this part tests the robustness of the estimation results by multiple means, through time period and subregional tests and by replacing the core explanatory variables, i.e., estimating Equation (9).

*(1) Robustness Tests Over Time*. To avoid possible additional autocorrelation problems associated with taking the mean value of the variables, robustness tests were conducted by taking values two years apart. As with the national regression process, after unit root tests and cointegration tests on the series of variables, 2*SLS* and dynamic *GMM* methods were used for estimation. The results of the unit root and cointegration tests show that the series of each variable in the time period are all first-order single-integer series with cointegration (specific test results omitted).

The results of the regressions by time period are homogeneous with no change in direction for each variable compared to Table 6, indicating that the municipal findings are robust. What has changed significantly in Table 7 is that the effects of urbanization rate and prices have increased significantly, and the effect of income uncertainty is no longer significant. This is due to the fact that the time length of the split-time test is only 7 years, and the urbanization process attracts a large number of rural people to work in cities in the short term, which makes the income of rural residents increase significantly and effectively stimulates the consumption of rural residents, while urbanization cannot continue to transfer a large number of rural laborers in the long term, which has a limited pull on the income of rural residents and a limited stimulation of consumption; for a short time, rural residents are not yet aware of the income. In the short term, rural residents are not aware of the impact of income uncertainty, and their psychological feeling of income uncertainty is weak, so the impact is not significant; in the short term, prices increase due to consumption inertia and the "ratchet effect," and in order to maintain the original consumption level, rural residents' expenditure increases more, so the impact of prices in the short term is more obvious.

*(2) Robustness Tests by Region*. Similar to the analysis of the 31 provinces (municipalities directly under the central government) in China, the unit root test and cointegration test results of the variable series of different regions in East, Central, and West are consistent with the national one. To save space, only the dynamic panel 2*SLS* estimation results and the *White diagonal* weighted *GMM* estimation results of East, Central, and West are given below Table 8.

The regression results for East, Central, and West do not change in direction, and the relationship between the explanatory variables and the explained variables is still positive, again indicating the robustness of the findings. For East, Central, and West, the impact of prior period consumption is roughly the same, indicating that the "ratchet effect" of rural residents in East, Central, and West is basically comparable; the impact of prior period income is

Table 7: Equation (8) for the time periods 2*SLS* and dynamic *GMM* estimation results.

| Variables | Method | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2*SLS* | *GMM* | | | | | |
| | | 2*SLS* | White cross | White period | White diagonal | Period SUR | Period weights |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $\ln RC_t(-1)$ | 0.536*** (5.936) | 0.536*** (5.936) | 0.538*** (3.145) | 0.536*** (4.990) | 0.536*** (5.754) | 0.536*** (5.856) | 0.536*** (6.137) |
| $\ln RY_t(-1)$ | 0.310*** (4.986) | 0.310*** (4.986) | 0.308** (2.076) | 0.310*** (4.426) | 0.310*** (4.864) | 0.310*** (5.113) | 0.310*** (5.241) |
| $\ln UR_t$ | 0.449*** (3.127) | 0.449*** (3.127) | 0.449** (2.708) | 0.449*** (3.192) | 0.449*** (3.015) | 0.449*** (3.041) | 0.449*** (3.212) |
| $\ln EAD_t$ | 0.349 (0.917) | 0.349 (0.917) | 0.332 (0.293) | 0.349 (0.971) | 0.349 (0.883) | 0.349 (1.043) | 0.349 (0.979) |
| $\ln P_t$ | 1.504*** (5.805) | 1.504*** (5.805) | 1.503*** (5.671) | 1.503*** (4.712) | 1.504*** (5.864) | 1.503*** (5.479) | 1.504*** (5.882) |
| $R^2$ | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| $D-W$ | 1.790 | 1.790 | 1.799 | 1.790 | 1.790 | 1.790 | 1.790 |

Note: $t$ test values in brackets. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 8: Robustness tests for Equation (8) by region.

| Region | | Variables | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $\ln RC_t(-1)$ | $\ln RY_t(-1)$ | $\ln UR_t$ | $\ln EAD_t$ | $\ln P_t$ | $R^2$ | $D-W$ |
| East | 2*SLS* | 0.879*** (33.134) | 0.091*** (4.983) | 0.052 (0.918) | 0.166*** (3.682) | 0.367*** (3.275) | 0.99 | 2.035 |
| | *GMM* | 0.890*** (33.426) | 0.087*** (4.894) | 0.007 (0.133) | 0.176*** (3.679) | 0.320*** (3.005) | 0.99 | 2.056 |
| Central | 2*SLS* | 0.777*** (11.314) | 0.170*** (3.611) | 0.415*** (1.840) | 0.301** (2.123) | 0.410 (1.240) | 0.99 | 2.277 |
| | *GMM* | 0.805*** (32.733) | 0.145*** (8.477) | 0.259*** (2.662) | 0.258*** (5.225) | 0.459*** (3.498) | 0.99 | 2.330 |
| Western | 2*SLS* | 0.761*** (9.969) | 0.188*** (3.486) | 0.254* (1.917) | 0.341*** (4.192) | 0.489** (2.340) | 0.99 | 2.129 |
| | *GMM* | 0.761*** (9.981) | 0.188*** (3.499) | 0.225* (1.686) | 0.337*** (3.312) | 0.493** (2.480) | 0.99 | 2.126 |

Note: $t$ test values in brackets. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

smaller for East and relatively larger for Central and West, because the income level of rural residents in East is much higher than that in Central and West, and rural residents in East are less dependent on prior period income. The impact of urbanization on the eastern region is very small or even negligible, and the impact is very insignificant, which is due to the high degree of urbanization in the eastern region; the impact on the consumption of rural residents has been basically released, the impact of urbanization in the western region is obviously improved compared with the eastern region, and the impact of urbanization in the central region. The impact of urbanization in the central region is the highest because the central region has a concentrated population, and the role of urbanization in stimulating consumption is strong, while the western region is subject to a special geographical environment, urbanization is slower, and the stimulating effect on consumption is not as obvious as in the central region; income uncertainty has a positive impact on both the East, Central, and Western regions, with the smallest impact in the eastern region and the largest impact in the western region, for reasons similar to those of income in the previous period, with high income in the east and a very low percentage of uncertain income. The impact on consumption is limited, and the lowest income in the West, with a relatively high proportion of uncertain income, has a significant impact on consumption relative to the east; price level has a positive impact on both the East, Middle, and West, with the smallest impact in the East and the largest impact in the West, but the difference is not significant.

*5.3.2. Robustness Tests for Replacing Core Explanatory Variables.* To test the robustness of the empirical results from additional perspectives, the approach of replacing the

Table 9: Estimation results of Equation (9) 2*SLS* and the dynamics *GMM*.

| Variables | Method | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2*SLS* | *GMM* | | | | | |
| | | 2*SLS* | White cross | White period | White diagonal | Period SUR | Period weights |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $\ln RC_t(-1)$ | 0.581*** | 0.581*** | 0.495*** | 0.595*** | 0.581*** | 0.582*** | 0.578*** |
| | (5.316) | (5.316) | (2.552) | (3.969) | (5.543) | (3.159) | (5.156) |
| $\ln RY_t(-1)$ | 0.340*** | 0.340*** | 0.420** | 0.329*** | 0.340*** | 0.339** | 0.343*** |
| | (3.638) | (3.638) | (2.383) | (2.689) | (3.769) | (2.208) | (3.568) |
| $\ln UR_t$ | 0.162*** | 0.162*** | 0.157*** | 0.150 | 0.158** | 0.161 | 0.163*** |
| | (3.008) | (3.008) | (2.975) | (1.375) | (2.531) | (1.552) | (2.937) |
| $\ln Y_{tv}$ | 0.313*** | 0.313*** | 0.393* | 0.302** | 0.312*** | 0.312** | 0.315*** |
| | (3.249) | (3.249) | (1.842) | (2.510) | (3.279) | (2.070) | (3.135) |
| $\ln P_t$ | 0.691*** | 0.691*** | 0.727*** | 0.675*** | 0.691*** | 0.688*** | 0.694*** |
| | (5.202) | (5.202) | (4.454) | (3.071) | (5.215) | (2.742) | (5.156) |
| $R^2$ | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| $D-W$ | 0.983 | 0.983 | 0.763 | 1.020 | 0.985 | 0.986 | 0.977 |

Note: $t$ test values in brackets. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 10: Results of panel quantile estimates.

| Variables | $\tau = 0.1$ | $\tau = 0.3$ | $\tau = 0.5$ | $\tau = 0.7$ | $\tau = 0.9$ |
|---|---|---|---|---|---|
| $\ln RC_t(-1)$ | 0.959*** | 0.957*** | 0.915*** | 0.883*** | 0.785*** |
| | (49.961) | (63.430) | (54.730) | (58.546) | (31.357) |
| $\ln RY_t(-1)$ | 0.027** | 0.030*** | 0.065*** | 0.085*** | 0.149*** |
| | (2.304) | (3.486) | (6.459) | (10.048) | (10.843) |
| $\ln UR_t$ | 0.070* | 0.020 | 0.030 | 0.058 | 0.145* |
| | (1.923) | (0.488) | (0.704) | (1.397) | (1.878) |
| $\ln EAD_t$ | 0.094*** | 0.061*** | 0.101*** | 0.112*** | 0.104*** |
| | (3.241) | (4.376) | (6.545) | (7.623) | (3.108) |
| $\ln P_t$ | 0.233*** | 0.186*** | 0.274*** | 0.391*** | 0.738*** |
| | (3.587) | (2.871) | (3.706) | (5.110) | (6.005) |
| $R^2$ | 0.91 | 0.93 | 0.93 | 0.92 | 0.89 |

Note: $t$ test values in brackets. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

core explanatory variables is tested again, using the income volatility $\ln Y_{tv}$ obtained by *HP* filtering as a proxy for income uncertainty, i.e., regression estimation of Equation (9). The previous unit root and cointegration tests provide the basis for estimating Equation (9), and the following directly employs 2*SLS* and dynamic *GMM* methods for estimation.

The results of the Tables 6 and 9 show that the explanatory variables show a positive relationship with the explanatory variables, both in terms of adjusted rates of deviation and in using income volatility to represent income uncertainty, differing only in the magnitude of the effect, again indicating that the results of Table 6 are plausible.

Combining with the test results of endogenesis, multiple regression methods, time division, region division, and substitution core explanatory variables discussed in this paper, it is fully proved that the result of Table 6 is robust and the conclusion is reliable.

*5.3.3. Further Discussion.* In order to fully appreciate the role of the core explanatory variables on the consumption of rural residents, particularly at different levels of consumption, and also as a further test of the robustness of the estimation results, the following panel model quintiles regressions are adopted and estimated at the 10%, 30%, 50%, 70%, and 90% levels (only results where the core explanatory variables are adjusted for the rate of deviation are presented).

The test of regression coefficients for the quantile regression model shows in Table 10 (test procedure omitted) that all coefficients pass the test except $\ln UR_t$ when they ($\tau$) are insignificant at 0-0.2.8, indicating that the results of the quantile regression are acceptable. The relationship between each explanatory variable and the explanatory variable is fully consistent with Table 6 for both the low quantile regression results and the high quantile regression results, indicating that the estimates in Table 6 are robust and reliable.

The impact of income uncertainty on rural residents' consumption is always positive during the transition from low to high levels of consumption. The impact of income uncertainty declines in the process of shifting from minimum to low consumption, indicating that rural residents do not give much thought to whether their actual income is in line with their expectations when they increase their consumption at very low levels, as the increased consumption at this point is basically spontaneous. In the shift from low to high consumption, the influence of income uncertainty tends to rise, due to the fact that during this period, rural residents have greater flexibility in consumer spending, and some commodities can be consumed or not, as confirmed by changes in the impact of price levels. The decline in the impact of income uncertainty in the shift from medium to high consumption is due to the higher income levels of the high-consumption group, which is less concerned with relatively small "windfalls" or "loss of income."

## 6. Conclusions and Insights

In this paper, using panel data of 31 provinces across China from 2000 to 2020, we calculate the adjusted deviation rate indicating income uncertainty and obtain another variable representing income uncertainty by the *HP* filtering method, conduct a unit root test of panel data to test the smoothness of the variables, then test the cointegration relationship among the variables, and conclude that all variables are first-order single integer and have cointegration relationship. Using the *F* test and *Hausman* test to determine the random-effects model, the least squares method of panel data is applied to estimate the effects of income uncertainty, lagged one-period consumption, lagged one-period income, urbanization rate, and price level on the consumption level of rural residents, and good instrumental variables are selected based on the discussion of endogeneity issues and estimated using 2*SLS* and multiple dynamic *GMM* methods; the core explanatory variables are replaced by time period, region, and other means to test the robustness of the estimation results, further discuss the impact of income uncertainty on rural residents' consumption levels at different consumption levels using a panel quantile model, and obtain the following conclusions.

(i) There is a homogeneous movement between income uncertainty and rural residents' consumption, and since the proxy variables for income uncertainty used in the paper have positive and negative signs, this means that for rural residents, real income exceeding psychological income stimulates consumption and real income falling short of psychological income reduces consumption. Specifically for the East, Middle, and West, the impact is the greatest for the West and the least for the East. This is because higher real incomes make consumers more optimistic and thus more willing to spend, while lower real incomes make consumers more pessimistic and less likely to spend. The income gap in different regions of China is obvious, with the highest per capita income in the East, next in the Middle, and lowest in the West. The change of real income has different effects on different income groups and has the least effect on the high-income groups; the impact on low-income groups is greatest.

(ii) The consumption of rural residents has a "ratchet effect," with the consumption in the previous period moving in the same direction as the consumption in the current period, and the "ratchet effect" in the East, Middle, and West is roughly equal. Urbanization and rural consumption are in the same direction, with the highest impact in the central region, followed by the western region, and little impact in the eastern region. The price level and rural consumption move in the same direction, with slightly different effects on the East, Central, and West, but the differences are not significant. This is because the overall level of consumption of rural residents is not high, more to meet the basic needs of life, less enjoyable consumption, has obvious consumption inertia. In addition, urbanization has generally boosted the income level of rural residents, thus driving up the level of consumption. The level of urbanization in the eastern region is very high, basically over 80%, and the level of urbanization in the central region, especially in the western region, is still relatively low, about 60%, so the promotion of urbanization has little impact on the eastern region, due to the sparsity of population in the western region, the impact of urbanization is relatively limited, the central region as a population concentration of the region, and the impact of urbanization is relatively obvious.

(iii) The quantile model indicates that income uncertainty has a greater impact on the middle- and high-consumption groups and a smaller impact on the low-income groups. The consumption of low-income groups themselves is mostly survival consumption, and whether they have more or less income has little influence on consumption. In addition to survival consumption, middle- and high-income groups also have different proportions of development consumption and enjoyment consumption, and the income change will have the obvious influence to the development consumption and the enjoyment consumption.

The policy implications of the above empirical findings are threefold: First, we should highly implement the spirit of the General Secretary's important speech on the "three rural issues," truly realize "making farmers an attractive occupation," and take various measures to increase the income of rural residents, continuously. We should take various measures to increase the income of rural residents, so as to obtain "unexpected benefits" and make up for the possible "income loss," promote consumption of rural residents, and realize consumption upgrade. Second, we should pay attention to the differences in factors affecting the consumption of rural residents in the East, Central, and West and implement different policy preferences in different regions, so as to narrow the regional differences between the East, Central, and West according to local conditions. Third, on the basis of "putting the interests of farmers in the first place," give priority to the income growth of rural low-income groups, prevent the return of poverty due to various reasons on the basis of poverty eradication, and promote the common prosperity of the majority of farmers.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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*Retraction*

# Retracted: Influence Mechanism of Educational Leadership on Environmental Accounting Based on Big Data Algorithm

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] M. Jin and L. Yao, "Influence Mechanism of Educational Leadership on Environmental Accounting Based on Big Data Algorithm," *Journal of Environmental and Public Health*, vol. 2022, Article ID 5690230, 15 pages, 2022.

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*Research Article*

# Influence Mechanism of Educational Leadership on Environmental Accounting Based on Big Data Algorithm

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Over the last 20 years, big data techniques in teaching have been overgrown. Making educational decisions now includes information knowledge as a crucial component. This started a trend for using big data algorithms strategically. Technological advances have been used to analyze the enormous amount of information and develop strategic judgments. The current study aims to address issues with the conventional instructional, administrative management solution focused on manual rule formulation in big data storage and interpretation and has poor efficiency in analyzing big data and lacking value in developing education leadership qualities. The study suggests an educational leadership model based on big data algorithm (ELM-BDA) to explore the student leadership performance that relies on cooperative filtration and fuzzy C-means (FCM) and big data. The different influencing mechanisms and factors directly linked to educational leadership were also analyzed using a big data algorithm. To build an intelligent institutional administrative system, the research also exposes it to organizational studies. By evaluating the big data research already in existence, this study emphasizes the expanding significance of big data. Additionally, this study explores the effects of big data analytics on educational leadership qualities by utilizing an FCM. A scoring system is designed to predict the student's leadership level, and using the big data algorithms, the students are motivated and trained to improve their skills. The education and learning method can be enhanced at educational institutions through better decision-making to use this big data for leadership development. Big data facilitates efficient educational decision-making by merging various data and telecommunications technologies. Using big data in schooling will increase—leadership quality among students. To effectively use big data for decision-making, academic leaders must create new types of learning and monitoring systems.



## 1. Introduction to Educational Leadership

Many initiatives have attempted to evaluate and analyze the performance of education leadership management in elementary, secondary, and university education tiers worldwide. The qualities, behaviors, and styles of leaders were the subject of several studies, but it is still essential to examine how each factor contributes to strong leadership. The main goal of this study is to explore the relationships between these fundamental elements and the efficacy of administration concerning them. The development of an adequate evaluation tool for evaluating the effectiveness of education management using measurements and criteria related to the activities and behaviors of leaders is another target of this research.

From ancient times to the present, humanity has been preoccupied with the question of management and its effects. Researchers, academics, scientists, industry and affiliation executive officers, private and general populace sector managers, politicians and authorities, structured communities and informal institutions, military installations, and educational establishments have all given it some thought. The notion of leadership has occasionally been interpreted and analyzed based on the traits of the leader's character on the foundation of the outcomes and the commanding style or with "hybrid" frameworks that mix the management and

academic models. Additionally, schools routinely examine various initiative variables that significantly impact academic success to assess the reform process [1].

By connecting the efficacy of management with the traits of the managers, the leadership styles, their behaviors, and the linkages between them, this study is aimed at fostering reflection and drawing conclusions about education leadership management.

Over the past few years, there has been an increasing trend toward creating learning solutions for processing big data [2]. Learners worldwide are now using smartphones' web content due to the advent and quick growth of the internet. Their online activities produce a vast amount of information that can be gathered using various technologies. This enormous volume of data is used to provide helpful information when making decisions about schooling.

Researchers define big data in several ways [3]. In teaching, "big data" refers to the practical analysis of huge amounts of information to provide helpful knowledge [4]. This idea can fundamentally alter how it handles the educational process by changing how students and teachers connect and effectively meeting every learner's unique needs [5]. Typically, there are a variety of questions about leadership and government, such as whether something is efficient, what qualities define it as efficient, if the traits of the ruler or the management style study its effect, or more purely when a manager is able or willing to do something. Environmental accounting is a field that identifies the environmental factors that affect the nation's economy. Educational leadership is defined as the process of guiding the talents and energies of teachers. Environmental accounting or ecological factors affect the educational context and may be applied in schools, colleges, or universities to improve student leadership skills. The study shows a strong relationship between leadership and learner performance considering environmental accounting factors. To fully incorporate environmental accounting into educational leadership, big data algorithms are needed to provide enough data for the process. The big data algorithm helps provide enormous data and fetch the required factor to enhance the education leadership skills from the available data.

The primary contributions of the study are listed below:

(i) A leadership score prediction model for the student is designed in this research using FCM. This model is used to analyze the leadership quality present in the students, and prediction results can be increased using a big data algorithm

(ii) The different influencing factors which affect and improve the education leadership quality are analyzed and discussed

(iii) The implications of the big data algorithm in education leadership are discussed, and future suggestions and recommendations are enumerated in this research

The reminder of the article is organized as follows: Section 2 enumerates the background of educational leadership and its impact. The proposed educational leadership model based on big data algorithm (ELM-BDA) is designed and mathematically derived in Section 3. Section 4 analyses and shares the proposed system's outcomes and exhibits the system's higher yields. Section 5 illustrates the conclusion and findings of the study.

## 2. Background to the Education Leadership and Its Impact

An exhaustive relative literature analysis in education management has been conducted in this study to examine the most crucial elements of instructional leadership from top to bottom. The focus of this study is more explicit on which of these factors is thought to add more to strong leadership in educational settings—leader personal qualities, applied specific behaviors, or good leadership styles. The sole objective of this study is to establish the relevant research issues and to propose a structure for more essential elements of teacher management so that the investigations are more successful.

The relative importance of every one of the main crucial management styles, regardless of academic efficiency and the relationship between them and effectiveness, was examined in a follow-up survey using a relevant survey. Concerning teachers' perspectives as attendees and shareholders in a sample solution, the survey attempts to determine the significance of leaders' behaviors and analyze which of the above individual elements are deemed more essential and have a more significant impact on academic leader behavior. Management in education is a growingly fascinating field of study. This is due to the thorough exploration of the educational function's outcomes on the one side and the pursuit of leaders' effects on products on the other [6].

Another factor that keeps people interested in the education sector is that it has become increasingly demanding as new problems for leaders emerge. Globally, the education system has come to recognize the role and importance of education institutions. It is said to play a crucial part in enhancing academic development and performance by influencing teachers' motivations and skills and the culture and community of the classroom. The usefulness and worth of tutoring can only advance with competent school management [7]. Among the most critical variables in the progression of the standard and uniqueness of a school is believed to be the school founder [8]. Education leadership can be categorized into transformational leadership, transform leadership, and decision-making leadership.

Many studies in the past have shown that the management style and skills of the principal have an impact on a range of teacher characteristics, including job contentment and efficiency, as well as levels of engagement and academic accentuation [9]. It can influence the motivation and performance of educators by creating the right mood and working environment, which significantly affects the quality of the school's outcomes [10]. Additionally, research has shown that a principal's management can have a considerable, albeit indirect, impact on students' academic performance [11–13]. The most important factor contributing to the

growing importance of educational change is the rising expectations of people and organizations, both within and without the education sector and from institutions suggested by Farley-Ripple et al. [14]. Additionally, as should be clear from the reading of the pertinent literature, the many groups of people who are "included" in or benefit from any sort of academic management, such as educators, pupils, or families, depend significantly on the decisions made by the educational leaders.

Big data has made it possible for educational leadership to take prompt, efficient actions to enhance corporate culture and the educational experience for students [15]. Big data can fundamentally alter how education and study are conducted in the future. The use of data to drive teaching was among the five most comprehensive policies linked to significant educational achievements, according to a study done on 35 school choices in New York City in the United States suggested by Ray and Saeed [16].

Cloud computing is a component of big data technologies. These collaboration solutions can enhance educational offerings by providing underprivileged students with the inexpensive expansion of online content [17]. Furthermore, as the author noted, big data can complement the conventional instructional system by aiding teachers in analyzing what kids know and what approaches are most successful for every pupil. As a result, it also gives teachers data on how to enhance learning by altering their classroom practices and methodologies. Moreover, learners and staff can receive fast feedback regarding their academic achievement using technologies like information analysis [18]. According to the author, such technologies aid in developing educational patterns that give educational authorities crucial information.

For instance, instructional patterns can release secrets about a student's unique needs, and by making wise choices, the risk of their failures and dropouts can be reduced. The author further claimed that these instructional patterns aid in creating unique pedagogical strategies that are effective with a specific group of pupils with special requirements.

In addition to these applications, their research indicates that big data can transform the traditional educational system into an online one suggested by Hong [19]. The use of learning systems has recently spread around the globe. More and more people are using these networks, which leads to the online creation of new data. This further information gathered through various channels assists faculty members in understanding educational requirements and emerging trends [20].

Even though there are few applications of big data in education, this trend is steadily growing. This growing tendency is caused by how well data-driven decision-making works. Academic institutions require trained personnel who can manage vast amounts of data and all these technologies as this trend is expected to intensify soon. To support the data-driven selection process, school administrators must get conversant with these new resources or create a dedicated department or position. Thus, the need for computer scientists and information analysts in the education sector is undoubtedly increasing shortly.

## 3. Proposed Educational Leadership Model Based on Big Data Algorithm

Environmental accounting is a field that identifies the environmental factors that affect the nation's economy. Educational leadership is defined as the process of guiding the talents and energies of teachers. Environmental accounting or ecological factors affect the educational context and may be applied in schools, colleges, or universities to improve student leadership skills. The study shows a strong relationship between leadership and learner performance considering environmental accounting factors.

The research revealed that most students' educational leadership quality is hidden. This research aims to focus on the different education leadership affection influenced environmental parameters, and the outcomes are enhanced using a big data analytical model. The model initially analyzes and predicts the student's leadership score.

The clustering model of the proposed research is indicated in Figure 1. The study starts with clustering the students based on their leadership skills, initializing their weighting index, and then the threshold level for leadership detection is identified and initialized. Based on the cluster and cluster center of the function, the convergence of better skills for leadership is analyzed, and if not attained, the cluster initialization is repeated.

*3.1. Influencing Factors of Education Leadership Conditions.* Teaching technique design, practical assistance, and material circumstances are three factors that impact how students learn. When viewed from the standpoint of instruction, it primarily entails the creation of instructional goals and developing instructional materials, strategies, and activities. The main component influencing the learning experience is that, from the students' perspective, the teaching goals must be established in a manner that is compatible with the educational purposes of the classmates.

The education platform's publications and course materials are typically provided using graphics and film, with video serving as the primary medium. According to the survey, most students utilize their free time to learn. Thus, the teaching time must satisfy their objective needs. For instance, if the teaching time is too lengthy, the student cannot finish the learning about education leadership; however, it slows down the learner's perseverance to a specific extent, making it difficult for the learner to focus solely; conversely, if the teaching is too limited, it hurts the other edge. On the other side, learning development forces students to operate too often. The typical course video lasts 30-45 minutes.

From the standpoint of the teaching material, the selection and configuration of the teaching material can empower the learners to engage with the framework, educators, and other beginners, the video play screen, the place of the course warning, the doorway of the comment bar, the opening of the message board, the glass wherein the teacher's aide and the student talk, or if the place of these streams is sensible. The learner's ability to participate in the program depends on the video's length, clarity, and reasonableness, as well as whether or not there will be any stuttering.

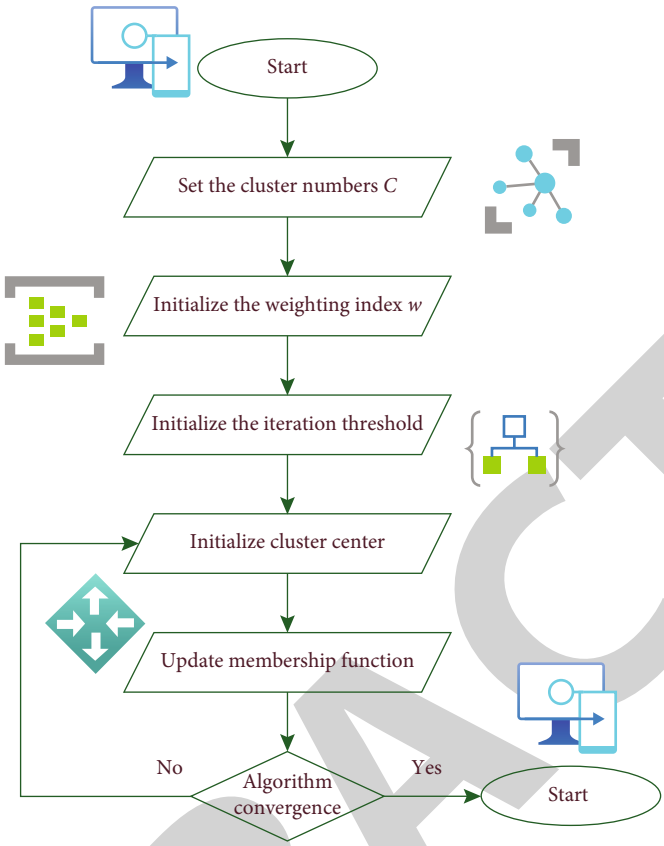



Figure 1: The FCM clustering model for educational leadership on environmental accounting.

How well the different teaching connections, like the number of tasks, the regularity of exams, the frequency of giving answers, and how well the pedagogical practices can ultimately mobilize and enhance the students' passion are matched to the level of learners for leadership quality. Whether the job is challenging enough, whether the teaching method can accommodate the learner's smart device's learning requirements, and whether the student tries to talk via instant messenger programs to increase the viscosity among the student and the platforms, it is essential to determine if the teaching approach can successfully increase the student's internal interest in leadership. If the way of evaluating instruction can successfully assess the learner's learning methods and results, it is said to be diverse and acceptable.

*3.2. Emotional Conditions for Leaders.* Social networks between students and other students and between students and professors, and managers are all connected with learner involvement, such as attitudes and excitement for learning and systems. Whether the design of the education process, such as the different instructional links, the volume of assignments, the regularity of quizzes, the frequency of Question and Answer (Q&A), or if the learners can be fully mobilized and enhanced, can fit the requirements of the learner. If the student's enthusiasm and the level of difficulty of the assignment are compatible; if the teaching method can accommodate the student's mobile extension's educational needs; and if the student needs to talk via instant messenger program.

To increase the viscosity among the student and the platforms, it is essential to determine whether the approach to teaching can successfully motivate the student's innate drive for studying or if the learner's leadership participation is appropriately rewarded. Suppose the approach to assessing instruction is flexible, reasonable, and capable of efficiently evaluating, and the student's learning results are enhanced.

Together, instructors, administrators, and students can boost emotional involvement, and their positive interactions make students more likely to continue with their classes, platforms, and peers. The education system is promoted in many domestic and international studies, and student accomplishment levels are not scored and graded.

Nevertheless, in the education leadership environment, the primary goal of rating or marking is not to motivate students who are learning more slowly but motivating students who are learning more quickly and with more incredible excitement through the same rankings. Enhance the student's feeling of accomplishment to some level, recognize the value of learning, provide the learner with a sense of connection, and foster a healthy competitive market. The social component of the learning platform must be strengthened, and interactions between users and other players must be improved. The classroom experience falls short of the ambiance of traditional instruction in the classroom setting without a big data algorithm.

The learning environment ought to make an effort to establish a higher education leadership quality among students. Together domains include panel discussions, course

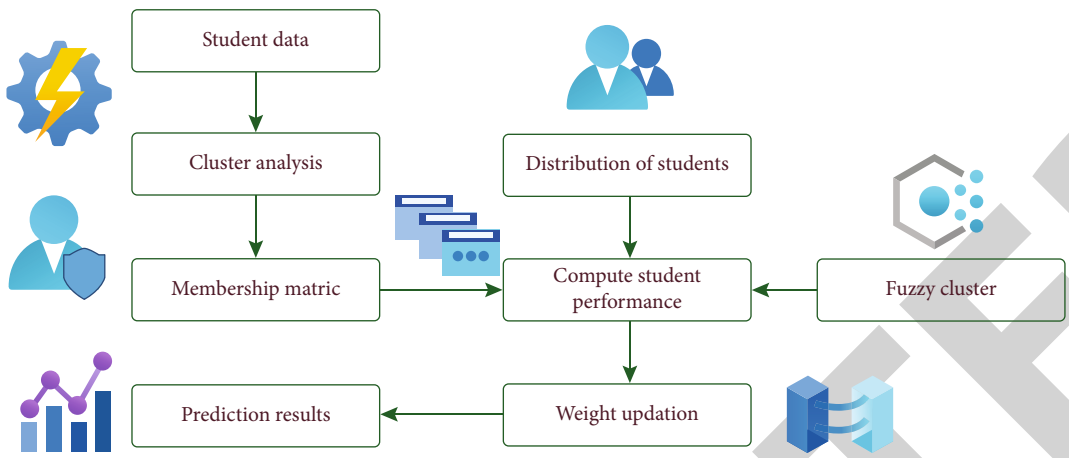



Figure 2: The student education leadership performance analysis based on environmental accounting factors.

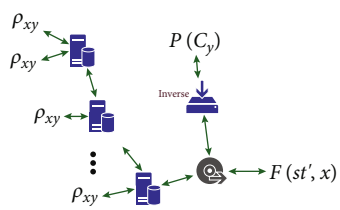



Figure 3: The graphical representation of $F(st', x)$.

boards, and post bars? These environments test teachers' and supervisors' ability to manage and promptly reply to message boards and post bars, as well as the ability of students to pose teacher questions and receive timely answers, whether or not students can assist and correct one another. In addition to providing instruction, the learning platform should be able to schedule offline activities concurrently with in-person instruction to increase students' emotional engagement and leadership quality. In summary, the learner's inner driving force frequently impacts how their emotional state affects their learning experience.

While a bad impact cause students to become disinterested in their studies, lack trust, and find it challenging to solve difficulties, a positive result can encourage students to invest in their education.

*3.3. Students' Leadership Score Expectation.* The process of studying and processing the provided objects using analytical models, then, separating and categorizing them based on how similar they are to one another, is known as a clustering algorithm. With the development of fuzzy theory, individuals started applying fuzzy techniques to clustering issues, specifically the fuzzy-based study. Fuzzy grouping can handle a variety of objects where attribute differentiation is not always clear in real-world situations. To indicate the similarity among samples, the classifier is used. Fuzzy clustering represents the ambiguity of the sampling for the group, which could more accurately represent the actual world because it obtains the level of uncertainty for every classification and the sample size.

The targets are typically clustered using the fuzzy clustering technique based on empirical function using different students based on their educational leadership skills. The sample set represented is $S = \{s_1, s_2, \cdots, s_N\}$. The weighted function of the cluster is denoted as $\beta_{yn}$. And equation (1) shows the relationship of all the cluster weighting function sum as 1. The different parameters should be weighted with varying scales of weight to find the optimum results.

$$\prod_{y=0}^{N-1} \beta_{yn} = 1. \tag{1}$$

$y = 0, 1, \cdots, N$ and $n = 0, 1, \cdots, N$. The number of sample $S$ transmitted is indicated by the variable $n(0 \le n \le N)$. The parameter represents the level of sample $n$'s participation in the class $y$ as $\beta_{yn} \in [0, 1]$. The fuzzy division matrix $M$ is indicated in equation (2). The grouped students are separated, and their teaching model is varied based on the $M$ value. This matrix is formed using the different environmental influencing factors $\beta_{xy}$.

$$M = \begin{bmatrix} \beta_{11} & \beta_{12} & \cdots \beta_{1N} & \\ \beta_{21} & \beta_{22} & \cdots & \beta_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ \beta_{N1} & \beta_{N2} & \cdots & \beta_{NN} \end{bmatrix}. \tag{2}$$

The matrix is used to find the leadership quality of a student using different parameters. The degree to which the sample $S_n$ belongs to class $y$ is indicated by the symbol $\beta_{yn}$. Currently, fuzzy C-means, which primarily determines the class of key points to categorize sample information automatically, is the most frequently used FCM. FCM obtains the membership grade of every sampling site to all category centers by optimizing the optimal solution to enhance the influencing environmental mechanisms. The function for each cluster is assigned to a sample, and the data are then categorized according to the membership functions. The

object method $O_f$ is represented in equation (3). The objective function is expressed as the central theme of the proposed model, which is the leadership analysis.

$$O_f = \prod_{x=0}^{N-1}\prod_{y=0}^{N-1}\frac{\beta_{xy}^{w}}{(S_n^y - C_c)^2}. \quad (3)$$

The term $w$ stands for a weighted index, where $w > 1$ designates the fuzzy level of the grouping outcomes. The most accurate empirical results are used, with $w = 2$. The variable $S_n$ denotes sample $n$ inside the source ($S$). The cluster center is characterized by $C_c$, and the participation function is represented by $\beta_{xy}^{w}$.

Equation (4) is used to address the constraint minimization function and make $O_f$ minimal. The constraints show the limitation of the educational leadership, and the factors that influence the prediction score are constrained by 1.

$$\min \prod_{x=0}^{N-1}\prod_{y=0}^{N-1}\frac{\beta_{xy}^{w}}{(S_n^y - C_c)^2} \text{ where } \prod_{y=0}^{N-1}\beta_{yn} = 1. \quad (4)$$

The sample $n$ in $S$ is denoted by $S_n$. The cluster center is characterized by $C_c$, and the participation function is represented by $\beta_{xy}^{w}$. The total number of samples available is indicated as $N$. The logistic regression ($L$) technique resolves the issue using equation (5). $L$ solves the solution for the clustering head, and the education leader is selected based on the higher $L$ value.

$$L = \prod_{x=0}^{N-1}\prod_{y=0}^{N-1}\frac{\beta_{xy}^{w}}{(S_n^y - C_c)^2} - \prod_{x=0}^{N-1}\rho_x\left(\prod_{y=0}^{N-1}\beta_{yn} - 1\right). \quad (5)$$

$w$ is a weighted index, $S_n$ is a reference to samples $n$ in $S$, $C_c$ is the group center, $\beta_{yn}$ is the participation function, $L$ represents the logistic regression method, and $\rho_x$ is a component multiplier. The total sample size is denoted as $N$. The partial dependencies of $L$ about $C_c$, $\beta_{yn}$, and $\rho_x$ are then brought to zero in the manner described using equation (6). The partial influencing environmental factors which are linked to educational leadership are analyzed and shown below:

$$\beta_{yn} = \frac{(S_n - C_c)^{2/w-1}}{\prod_{x=0}^{N-1}(S_n - C_c(x))^{2/w-1}}. \quad (6)$$

The terms $\beta_{yn}$ and $w$ denote for a membership value and weighted index, samples $n$ in $S$ are indicated as $S_n$, and $C_c(x)$ is the group center. $N$ indicates the total number of samples. The cluster center is shown in equation (7) which is used to find the optimum leadership quality among the students. The cluster center is the best student with higher education leadership quality with higher influencing environmental factors.

$$C_c(x) = \frac{\prod_{y=0}^{N-1}\beta_{xy}^{w} \times S_n}{1 + \prod_{y=0}^{N-1}\beta_{xy}^{w}}. \quad (7)$$

$C_c(x)$ is the group center, $w$ is a weighted index, $S_n$ is a reference to samples $n$ in $S$, and $\beta_{xy}^{w}$ is a participation value. The total number of samples is denoted as $N$.

First, the parameters $N$ and $w$ are specified to represent the number of fuzzy-based categories. $i$ reflects on the number of iterative processes and describes the threshold to cease iteration. The clustering center is then set up a second. To achieve the final grouping center and fuzzy partition matrices, iterative transactions are carried out during the third step, updating the membership degree and the grouping center only until the outcome converges.

Using the fuzzy clustering technique, the school leadership system's data could be mined for valuable data and its underlying laws. To better understand trainees, enhance teaching, fortify management, and enhance pertinent systems, it aids in proving the effectiveness of school enrollment and jobs administration, teacher management, instructional strategic planning, learning outcomes guidelines, governance, and investment and hardware management.

A method used in systems and network filtering is the FCM algorithm. It is being used to assess students' interests, locate students in the user community who feel the same way as the particular student, combine these students' evaluations of the same material, and create a system to anticipate the student's choice for that information. It is possible to think of the forecast of students' achievement as the "recommended" of students' success, and the nearer students' test scores are to one another, the more comparable the circumstances or other factors are among them. The previous student information can be used to identify equivalent students to forecast a student's leadership success.

Students in the information retrieval of new datasets correlate to students' interests. The previous outcomes of these comparable students can be combined to forecast the success of the chosen students. The current work combines FCM and big data to suggest a model for predicting education leadership achievement.

The student education leadership performance analysis based on environmental accounting factors is indicated in Figure 2. The student data is collected from 200 boy and 100 girl students. Based on their response, they are grouped into different clusters using the cluster membership function. The education leadership is computed and predicted based on environmental factors and big data. The results are calculated using the updated weighting function using FCM and a big data algorithm.

The participation matrices of every student in every group are obtained when the historical students' academic data are first clustered using cluster analysis technology. Then, using the dispersion of every student subscribing to every group and the information retrieval approach related to students, the forecast of every cluster to anticipate students' return is measured.

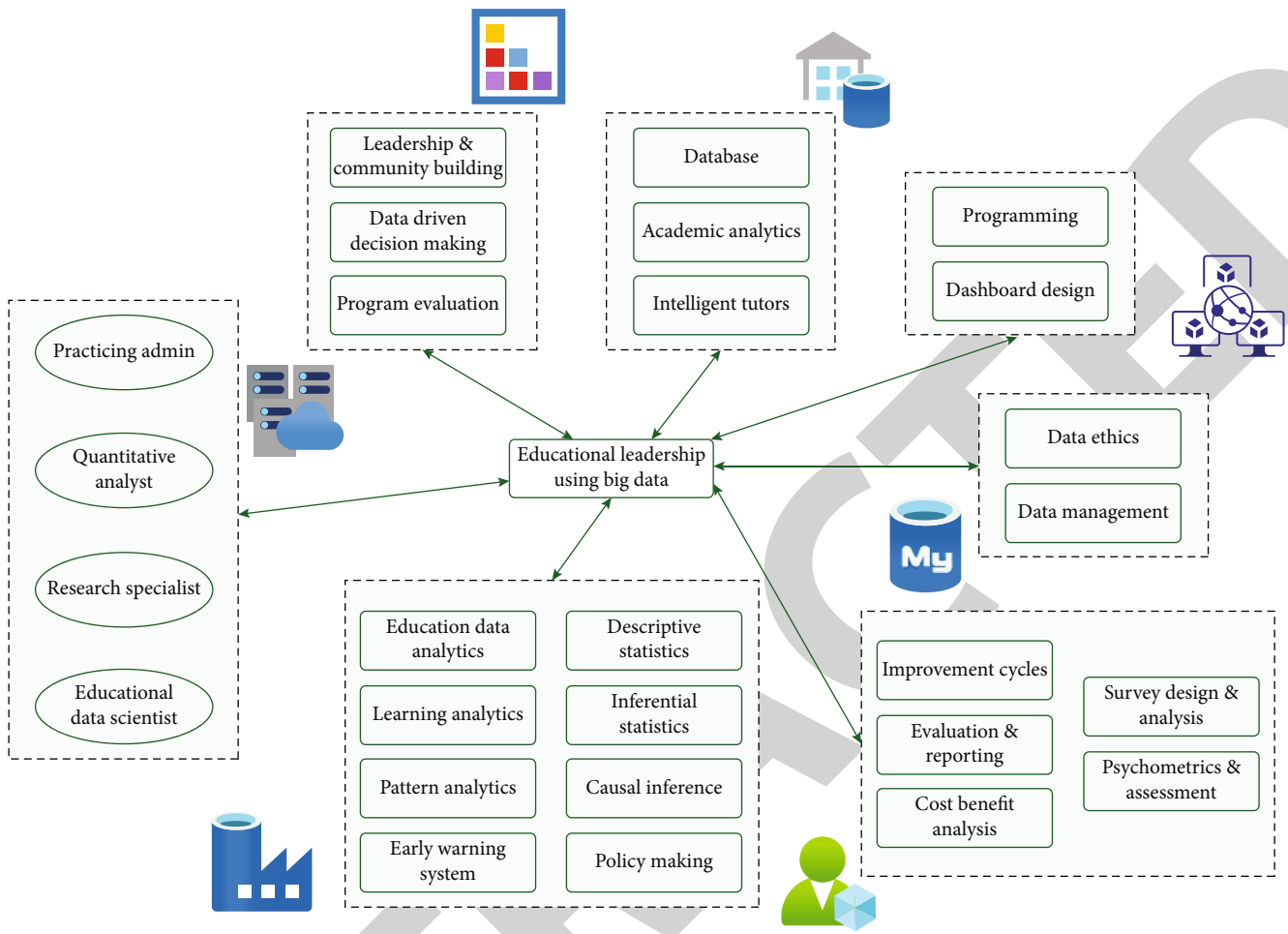



Figure 4: The education leadership analysis system based on environmental accounting using big data.

Finally, the proportion of the targeted candidates admitted per each cluster is weighted to produce the final predictive performance. The different leadership qualities include transformation quality, leadership quality, and decision-making skills. The following are specific forecasting methods.

The efficiency of student-$st$ in cluster-c could be estimated using a subsidiary matrix and the circumstances of every student residing in every clustering center. The education leadership evaluation of a student, which is enhanced using environmental factors, is shown in equation (8). The student's progress is directly linked to influencing factors, and step-by-step improvements are expressed below:

$$P(C_y) = \frac{\prod_{y=0}^{N-1} \rho_{xy} \times Q_{st}(y)}{1 + \prod_{y=0}^{N-1} \rho_{xy}}. \quad (8)$$

$N$ signifies the number of students, $Q_{st}$ indicates the progress of the students' underneath the $y$ factors involved, and $P(C_y)$ reflects the progress of the student $s'$ in cluster-c. The multiplication factor is indicated as $\rho_{xy}$. Depending on which group the student belongs to, one may determine how well the student $st'$ performs under the variable $x$. The target leadership quality of a student is denoted in equation (9), and it shows the outcomes of the system. The final obtained prediction results of the education leadership of the student are shown below:

$$F(st', x) = \prod_{y=0}^{N-1} \rho_{xy} + \frac{1}{P(C_y)}. \quad (9)$$

$\rho_{xy}$ corresponds to a component of multiplier $\rho$, and $F(st', x)$ denotes the target learning performance underneath the factor $N$. $P(C_y)$ indicates the progress of students in the cluster $C_y$.

The graphical representation of the function $F(st', x)$ is illustrated in Figure 3. The function uses the multiplier function $\rho_{xy}$, and the progress of the education leadership of the students in the cluster $C_y$ is denoted as $P(C_y)$. This function is used to analyze educational leadership improvement using FCM and big data algorithms.

*3.4. Big Data Implications for Educational Leadership.* The different environmental factors which affect the educational

Table 1: Influencing factor analysis.

| Component inducing movement | Initiative | Control strategy |
|---|---|---|
| Instructional layout | Actions to instruct and ways to teach | Need to be wealthy, and move learning resources introduced by various organizations or media based on how you learn best. |
| | Review process scheme | Must be enhanced |
| The task of a framework | Assistive technology for education | The learner's present development level can be depicted visually. Observe how students in your class are progressing in their studies. Learners' development compared to usual progress can be shown as a gap. Inform the slow people. |
| Cultural viewpoint | Trainer and students | Encouraging and reminding students who receive little or no attention |
| Emotional literacy | Learning data | Students' academic achievements can be visualized. Analyze the existing class's or status' overall score if possible. Think about how the learners in the existing group or rating compare to each other. |

Table 2: Survey data characteristics.

| Characteristics | Variants | Count | Percentage |
|---|---|---|---|
| Gender | Male | 200 | 67 |
| | Female | 100 | 33 |
| Age | Below 20 | 50 | 17 |
| | 20-25 | 86 | 29 |
| | 25-30 | 82 | 27 |
| | Above 30 | 82 | 27 |
| Education | Higher | 180 | 60 |
| | Postgraduate | 120 | 40 |
| Leadership position | Lower | 120 | 40 |
| | Middle | 80 | 27 |
| | Higher | 70 | 23 |
| | Superior | 30 | 10 |

leadership quality of the students are analyzed by FCM and big data algorithm. The varying parameters to enhance the outcomes are shown below:

*3.4.1. Learning Benefits.* For educational leaders, big data presents new learning opportunities. Educational leaders must familiarise themselves with these new resources and devices to successfully apply data-driven choices in the classroom context. They see how technology-based teaching methods account for most of the big data. In this situation, analytics can assist college principals in being more productive and effective in their research. Additionally, it enhances learning outcomes favorably. Students have more options for novel active learning due to using these tools. Students benefit from and broaden their knowledge by exchanging information with one another and with academic institutions. Educational institutions can use this information to address issues in education and prepare for the future.

*3.4.2. Efficiency and Effectiveness in Decision Making.* Making decisions is a complex process, whether individually or in groups. Leaders must make various decisions, including basic and complex ones, big and minor ones, programmable and nonprogrammer ones, technical and operational or practical judgments, and decisions involving individuals and groups. These decisions are made to pick the best options given the situation and raise the group's quality and efficiency. The "Big Data" notion can fundamentally alter how it conducts education by changing the modes of communication among learners and instructors and effectively meeting each learner's unique needs. Big data is a data system that college administrators utilize to make decisions about education. They can make decisions made by school administrators more efficient and successful.

The education leadership analysis system based on environmental accounting factors using big data is illustrated in Figure 4. The system uses FCM and environmental factors to detect and predict the students' education leadership. The big data modules help to provide the necessary data required for the survey and analysis. When using "Big Data" to make decisions, educational leaders gain several benefits. Here are a few big data benefits for school administrators in decision-making.

(i) *Effectiveness in Managing Tasks*. Without sound administrative decision-making, all of an academic institution's other responsibilities cannot be carried out as intended. Big data offers current information to decision-makers. This improves the effectiveness of leaders' managing duties

(ii) *Beneficial for Development and Planning*. Making a decision is the initial step in constructing any plan. Big data offers an accurate study of history and can be applied to forecast the future. The planning and policy-making processes of any educational organization are improved when educational leaders have access to a wealth of information

(iii) *Time Savings*. In today's cutthroat business environment, promptly selecting the best options is crucial to any corporation's success. Big data assists faculty members in various methods and enhances the

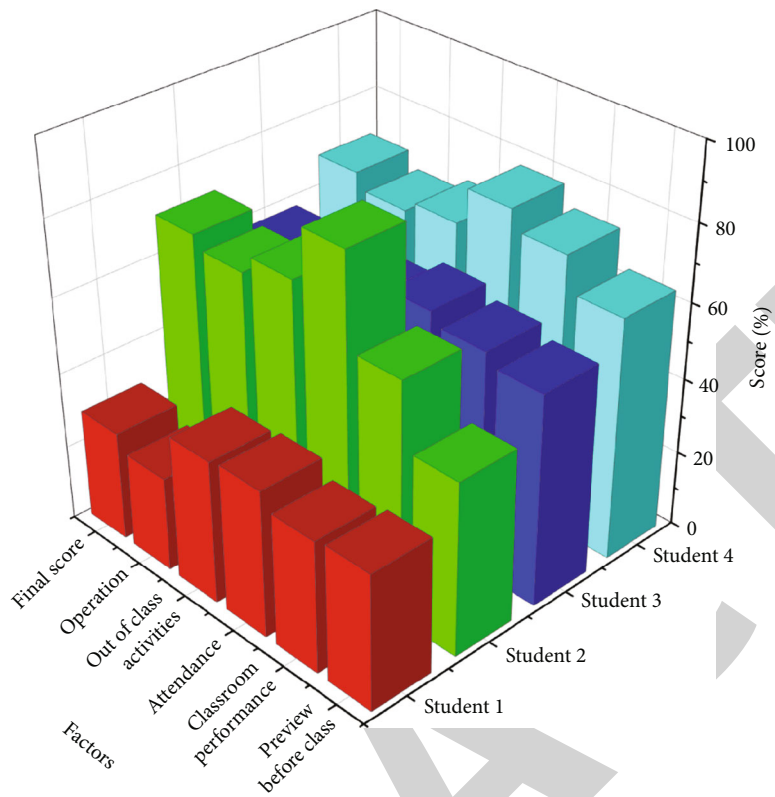



Figure 5: Student leadership score analysis

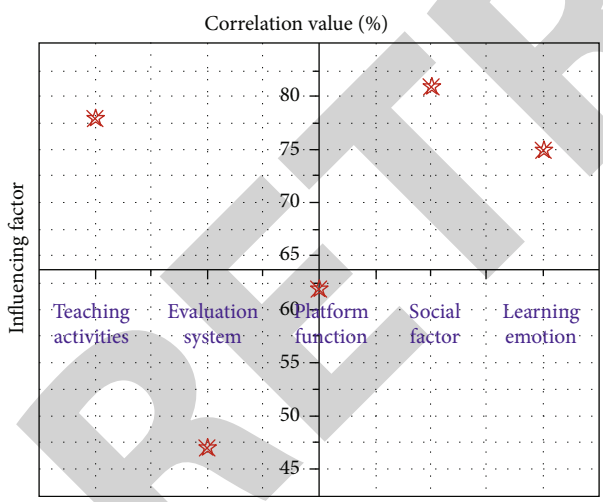



Figure 6: Influencing environmental factor analysis of the ELM-BDA system

performance and profitability of an academic institution's activities. Therefore, it is essential to the achievement of educational organizations

*3.5. Strategy Analysis Based on Big Data.* The associated control approach is set following the correlation test for various indicators. Multiple elements of the analysis results are based on the cognitive control systems using different influencing environmental factors, as indicated in Table 1.

The different influencing factor that affects the education leadership of the student is analyzed, and the comparison results are shown in Table 1. The different influencing factors, namely, instructional design, platform function, social factor, and learning motion, help to increase the education leadership outcomes.

*3.6. Policy Recommendations and Future Study.* Understanding how educational leadership affects numerous receivers, including students, staff members, and teachers, is crucial. A clearer picture of what an instructional leader needs to do to strengthen their competencies, any weak points and collaborate on them for advancement, change management style, or embrace other management philosophies can be achieved by analyzing the impacts of teacher management via its essential parts, realizing the way and level of control that every activity in the feature of the educational leadership and its outcomes, and acknowledging which contribution is more essential.

Ultimately, leaders can behave more effectively, increasing the results of teacher management by acknowledging the impact of leadership elements in everyday operations and the effective interaction between them. Teachers and administrators find this valuable study in better comprehending the relevance of interactions between leader traits, behaviors, and styles and how they affect effectiveness. Via these contributions, leaders learn how to deal with the issues of the moment to enhance results, elevate and create better energy, be competitive, and adapt to the changes of the times.

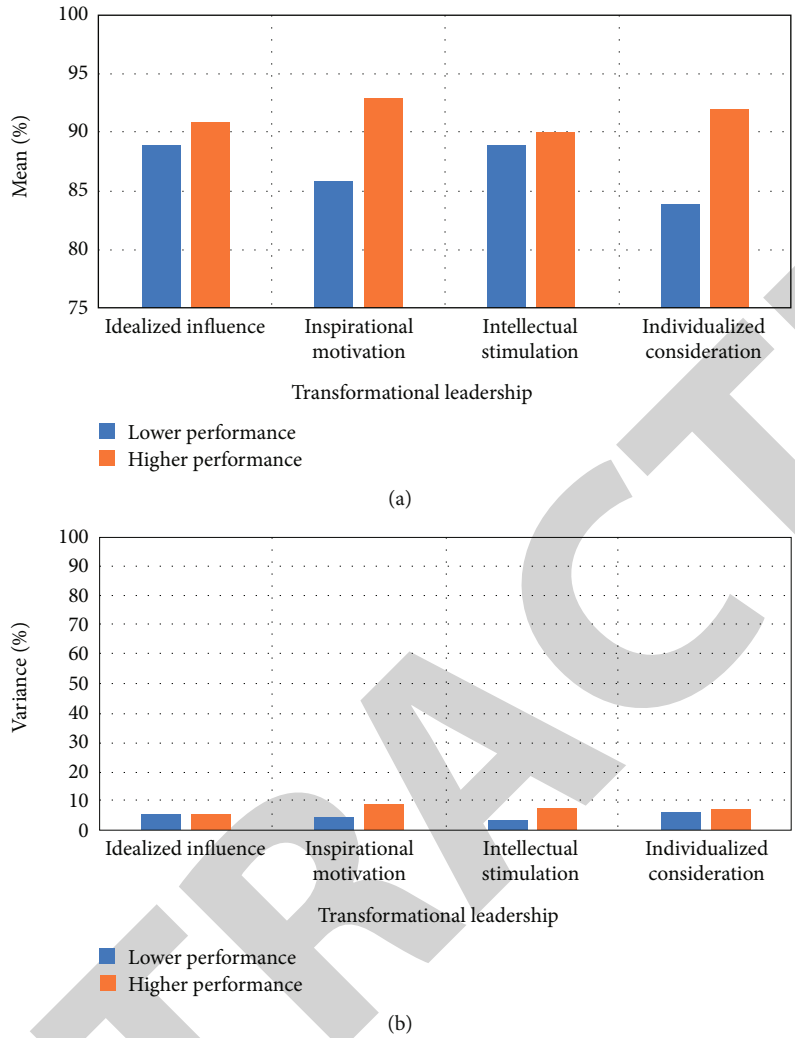



Figure 7: (a) Mean analysis of transformational leadership. (b) Variance analysis of transformational leadership.



While diverse leadership practices and styles yield different benefits for stakeholders in teacher management, personal characteristics are crucial. Therefore, the technique of successfully mixing them has better results. This is consistent with other research that concludes that influential leaders must be able to modify their approach depending on the scenario and environment to get the desired effects. Leaders must be conscious of their fields of expertise, including those who need to grow or partner with someone whose style complements their own.

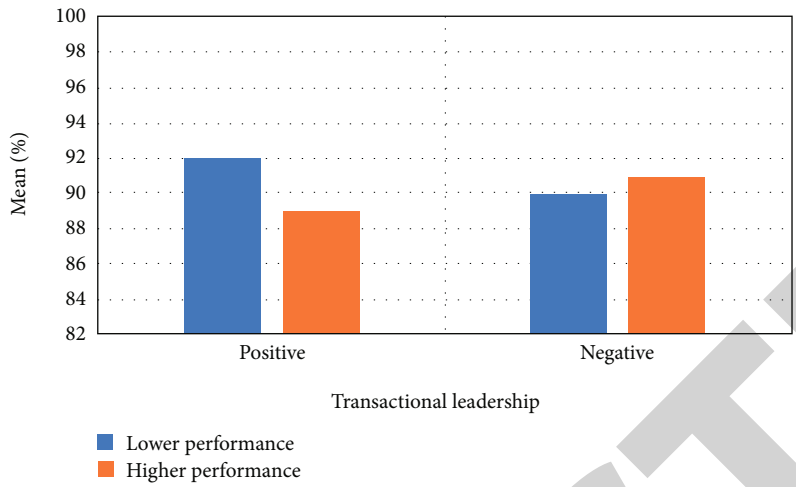
All education providers, including students, educators, and admin, would be able to evaluate the comparative and correlative significance among each other of the leader's features, management styles, and behaviors regarding organizational outcomes. This is sensible and researches in the field on the composition and layout of a particular survey. The relative importance of every individual component's involvement in the results of leader behavior is explained by an assessment method that was appropriately applied to an original sample of all these receivers.

The research focuses on finding the students' education leadership quality using a big data algorithm, fuzzy C-means model for cluster optimization, and environmental factors for improving the leadership quality. The different influencing factors, recommendations, and future implications are discussed in this section. The outcomes and findings of the system are enumerated in Section 4.

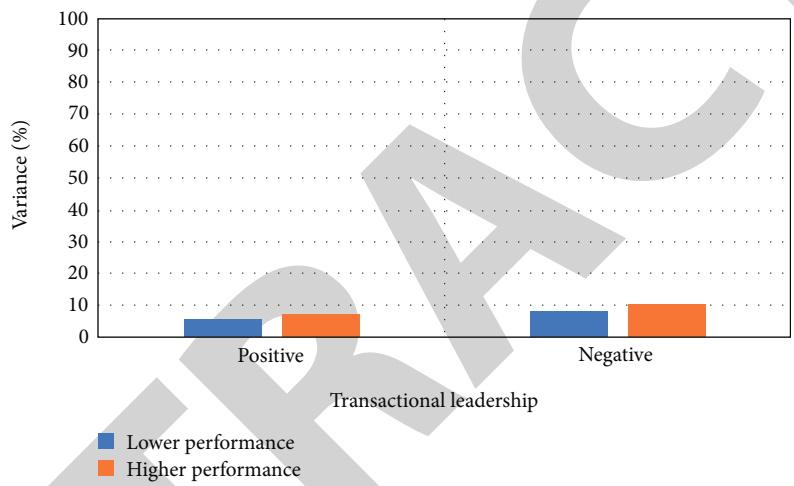
## 4. Outcome and Findings

Three hundred participants with 200 men and 100 women participants are considered for the analysis (https://data.world/datasets/school-leadership) [21]. The upgraded education method is used in the intervention class. In contrast, the standard online learning model has been used in the group: the different environmental factors and big data model with FCM help to improve the effectiveness of the ELM-BDA [22]. Students from other colleges in China conduct the survey, and the overall results are analyzed in this section.

The survey data characteristics are analyzed and shown in Table 2. The participants are selected from different colleges in China which include 200 boys and 100 girls. The students are chosen from the age of 20 to 30. The education




(a)




(b)

Figure 8: (a) Mean analysis of transactional leadership. (b) Variance analysis of transactional leadership.



qualification of the students varies from higher education and postgraduate. The ratio of the higher education and postgraduate is selected as 60 : 40. The leadership position of the students is chosen as lower, middle, higher, and superior with the ratio of 40 : 27 : 23 : 10. The education leadership using big data are analyzed for the different students, and the influencing factors which affect the administration are analyzed [23, 24].

The student leadership score analysis of the ELM-BDA system is depicted in Figure 5. Equation (10) is used to compute the student's educational leadership skill, and the different influencing factors are directly linked to the student's score.

$$F(S, t) = \prod_{i=0}^{N-1} \rho_{xy} + \frac{1}{P(C_y)}. \tag{10}$$

The student selected is indicated as $S$, and the present time is shown as $t$. $\rho_{xy}$ is expressed the available different environmental factors which affect educational leadership. The student's progress is indicated $P(C_y)$. And it is improved using different big data modules.

There are four different students randomly selected from the available participants. The other environmental influencing factors such as class preview, classroom performance, attendance, out-of-class activities, operation, and final education leadership scores of the students are computed and shown. The student's education leadership is directly related to the environmental factors and the big data analytical module. The ELM-BDA system effectively analyses the system outcomes with score prediction and a mathematical model with a lesser computation error [25].

The influencing environmental factor analysis of the ELM-BDA system is shown in Figure 6. The different factors include teaching activities that help to directly impact the student leadership, an evaluation system that is used to analyze the student's leadership level and which can be further enhanced, a platform function to showcase their leadership quality, social aspect to express the education leadership outside the campus, and learning emotion factor to test the proposed ELM-BDA system. The data for the analysis is

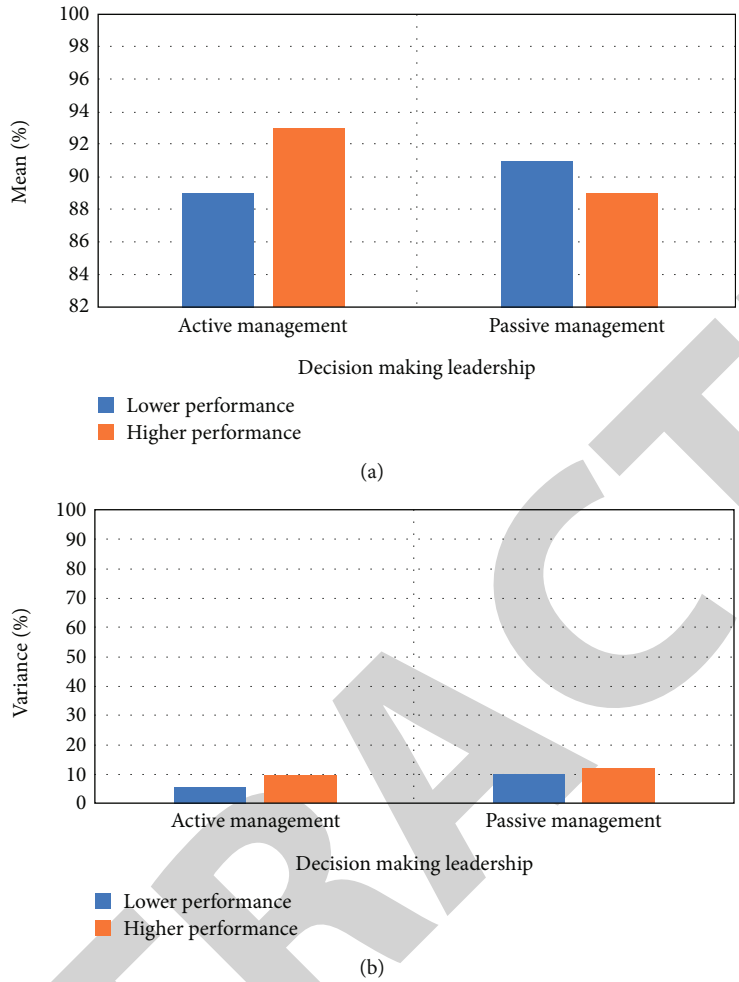



Figure 9: (a) Mean analysis of decision-making leadership. (b) Variance analysis of decision-making leadership.

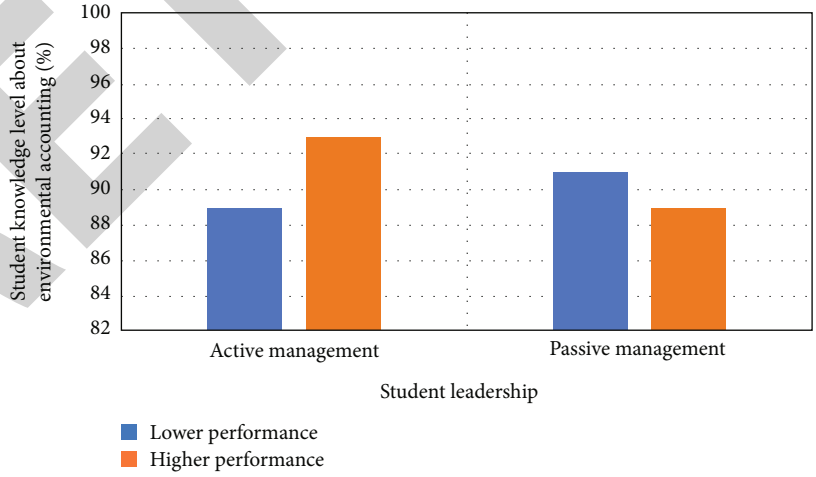



Figure 10: Student knowledge level about environmental accounting

gathered from the site (https://data.world/datasets/school-leadership). It includes student achievement, student progress, student leadership level, discipline referral, attendance rate, satisfactory factor, influence factor, etc., for the analysis.

Equation (11) is used to find the influencing parameter matrix, and the environmental factors $\beta_{xy}$ are directly linked to the student's predicted score.

$$F(S, i) = \prod_{i=0}^{N-1} \beta_{xy} \times \frac{P(C_y)}{N+1}. \tag{11}$$

The different available environmental factors like classroom atmosphere, friends, teachers, available facilities in the school, management support to teachers and students, and teaching methods are considered for the analysis. The environmental factor is indicated as $\beta_{xy}$. The progress factor is indicated as $P(C_y)$. And the total number of influencing factors that affect education leadership is shown as $N$. The proposed system with a big data algorithm helps to identify the education leadership quality present in the students and helps to motivate and improve them through different environmental factors and training [26, 27].

The mean and variance analyses of transformational leadership are analyzed using different transformational leadership factors such as idealized influencing factor, inspirational motivation factor, intellectual stimulation factor, and individualized consideration factor. Equation (12) is computed the leadership function $F(S, m)$ where $m$ is the transformational leadership skills, and the outcomes are linked to the progress function $P(C_y)$.

$$F(S, m) = \prod_{i=0}^{N-1} \frac{P(C_y)}{N+1} + \prod_{i=0}^{N-1} \propto_i. \tag{12}$$

The progress function of a particular student is computed as $P(C_y)$. The total number of transformational leadership skills is denoted as $N$. The environmental factor which affects the transformation of leadership skills is expressed as $\propto_i$. The results are plotted in Figures 7(a) and 7(b). The student performance of education leadership is computed according to the different transformational leadership, and the mean and standard deviation values of other factors are analyzed and plotted for minimum and maximum educational leadership quality among the students.

The mean and variance analyses of the transactional leadership quality are analyzed, and the results are shown in Figures 8(a) and 8(b), respectively. The transactional leadership quality is analyzed according to idealized influence and inspirational motivation factors. Equation (13) analyzed the leadership function $F(S, d)$ where $d$ is the transactional leadership skills, and the transactional leadership factors are computed with optimum function $O_f$.

$$F(S, d) = \frac{1}{\sum_{x=0}^{N-1} (\mu_d / N) + S_d}. \tag{13}$$

The learning attribute for the decision-making skill of the student is indicated as $\mu_d$. The total skills considered for the decision-making is denoted as $N$, and the decision-making ability of the student is indicated as $S_d$.

The students' educational leadership quality is enhanced using the students' leadership score prediction and big data analytical model. The minimum and maximum education leadership students are selected, and their performance is evaluated using different transactional leadership factors. Results are compared with each other with mean and standard deviation values.

The decision-making skill of the students is analyzed, and it is directly linked to education leadership. The students' decision-making skills are analyzed based on the idealized influence factor and inspiration leadership skills motivation factors, and the comparison results are shown in Figures 9(a) and 9(b), respectively. The education leadership skills of the student $F(st', x)$ are analyzed using equation (9), where $x$ is the decision-making skills, and the outcomes of the progress are indicated using the function $P(C_y)$. Using equation (8), the students' education leadership quality can be increased mainly by decision-making skills. The ELM-BDA system with the big data algorithm and leadership score prediction model using different influencing environmental factors ensure the ELM-BDA system's effectiveness in improving the participants' le.

The ELM-BDA system is analyzed in this section to showcase the education leadership and the impacts of the different environmental influencing factors and big data algorithms. The leadership score prediction model with mathematical expression helps to reduce the error and help the student to develop their educational leadership skills at any point.

Figure 10 shows the student's knowledge level of environmental accounting. The research model recommends that the environmental accounting and educational leadership were given to learners with primary accounting education have an influence on the level of knowledge about the environmental laws, environmental data, and environmental accounting of the students and thus constitutes an ecological realization in the learners. There is an association between students who received environmental accounting education and knowledge about ecological data, environmental accounting, and environmental law. Correlation is a statistical technique utilized to identify the degree and direction of the connection between variables, regardless of whether the variables are dependent or independent.

The ELM-BDA system is analyzed in this section to showcase the education leadership and the impacts of the different environmental influencing factors and big data algorithms. The leadership score prediction model with mathematical expression helps to reduce the error and help the student to develop their educational leadership skills at any point.

## 5. Conclusion and Findings

This study presents the educational leadership model based on big data algorithm (ELM-BDA) to explore student leadership performance considering the environmental

accounting notion. Big data tools assist school administrators' decision-making in the proper and timely manner. Big data might shape a cutting-edge, dynamic sch. The decision-making challenges that educational leaders experienced in the past will not exist in the new phase of "Big Data." They would be capable of making it faster and more precisely. However, to fully benefit from big data, school administrators must adapt to mastering new big data techniques.

Colleges must deal with the vast amount of educational material that must be processed to maintain development, and they urgently need to improve the intelligence of their educational management. The study suggests an educational leadership model based on big data algorithm (ELM-BDA) to analyze the student leadership performance that relies on cooperative filtration and fuzzy C-means (FCM) and big data. This research evaluates the environmental factors and their impact on students' leadership skills.

Additionally, level curriculum ranging this big data to make smart decisions enables school administrators to enhance classroom instruction. By merging various information and telecommunication platforms, big data facilitates efficient decision-making for the school system and improves students' leadership skills. The future need for developing more learning control systems by academic institutions increases due to this trend to efficiently use big data for decision-making.

Moreover, there is an opportunity for improving the offered algorithm's operational efficiency. The issues mentioned above will be resolved through further research. This study is aimed at providing crucial technical assistance so that higher education administration can be more innovative, waste less labor, and enhance the student's leadership skills.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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*Retraction*

# Retracted: Strategies of Ice and Snow Tourism to Optimize Ecological Environment and Economic Growth from the Perspective of Sustainable Development

**Journal of Environmental and Public Health**

Received 25 July 2023; Accepted 25 July 2023; Published 26 July 2023



This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] X. Cheng and D. Zhang, "Strategies of Ice and Snow Tourism to Optimize Ecological Environment and Economic Growth from the Perspective of Sustainable Development," *Journal of Environmental and Public Health*, vol. 2022, Article ID 9577859, 14 pages, 2022.

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*Research Article*

# Strategies of Ice and Snow Tourism to Optimize Ecological Environment and Economic Growth from the Perspective of Sustainable Development

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Due to the successful holding of the Winter Olympics, China's enthusiasm for ice and snow sports has soared, and its enthusiasm for ice and snow tourism has also been further stimulated. At present, most of China's ice and snow tourism (IST) attractions are concentrated in the three eastern provinces. At the same time, due to the increasingly harsh environment, the natural landscape of IST is also shrinking. Therefore, this paper aims at studying the strategies of IST to optimize the ecological environment and economic growth from the perspective of sustainable development. First of all, this paper makes a certain introduction to the current situation of IST. After that, the current IST resources in China were analyzed, and the three northeastern provinces were taken as the research objects, and the distribution location, traffic conditions, and development trends of IST resources were studied in detail. Then, the autoregressive model is used to fit the tourism resources and tourist growth with the economic growth, and combined with the trend shown by the economic growth model, a strategy for the sustainable development of IST is proposed. The experimental results of this paper prove that the regional system attribute of IST resources and economic growth model is between 3 and 5, and the average is about 3.6, which shows that the growth of tourism resources has a positive correlation with economic growth. Therefore, from the perspective of sustainable development, the economic growth of the IST industry should also focus on the protection and humidity development of natural ice and snow landscapes.



## 1. Introduction

Due to the early development time, North America and Europe have become the first regions in the world to develop IST. This has brought a series of influences, including a general consensus among people in the world. After turning the field of vision to the country, it is found that the development characteristics of the domestic IST industry are somewhat different from those of foreign countries. The three northeastern provinces with Heilongjiang as the core in China are the regions that developed ice and snow tourism earlier. With the passage of time, in the past 50 years, North China, Northwest China, and Southwest China have also begun to develop ice and snow tourism, and gradually formed a trend. China's winter ice and snow tourism industry is on the right track, and the ice and snow tourism market continues to heat up. In recent years, the improvement of material conditions has made people's awareness of sports continue to increase. Sports awareness is the forerunner of healthy life, and the people's enthusiasm for participating

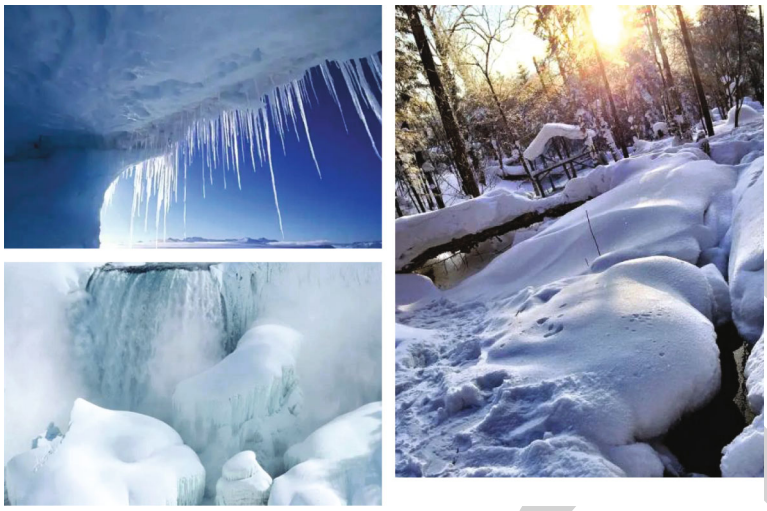


Figure 1: The natural state of ice and snow.


Figure 2: Rich IST projects.

Figure 3: The world-renowned Harbin Ice Sculpture.

in sports activities is getting higher and higher. When there is demand, there will be supply, and various festivals based on sports activities have begun to enter people's lives. Taking ice and snow sports as an example, the ice and snow festivals based on ice and snow sports in various places have developed with the growth of people's sports awareness and

enthusiasm. The holding of these ice and snow festivals has become a business card for local cities. They play a role in stimulating economic development, enriching urban culture, promoting the popularization of related ice and snow sports, improving people's physical fitness, and enriching people's spiritual and cultural life. Therefore, based on the perspective of sustainable development, it is necessary to study the strategies of IST to optimize the ecological environment and economic growth.

IST has always been a tourism project that people yearn for and have been trying, and the proportion of IST in the tourism economy is on the rise. In this regard, more and more scholars have studied the economy and industry of IST. Wen studied the economy of the IST industry based on the perspective of the Olympic Games. He used the enthusiasm for ice and snow sports brought by the Winter Olympics as a variable to establish a model that IST promotes the growth of the ecological environment [1]. Taking 832 impoverished counties in China as a sample, Hong-Min et al. proposed the Integrity Suitability Index (ISI) based on natural and socioeconomic factors to evaluate the suitability and potential of IST in impoverished counties [2]. Ziegler et al. aimed to explore whether ecotourism work alters local people's perceptions, attitudes, and behaviors toward key species and their habitats, and if so, whether the type of tourism influences these outcomes [3]. Falk and Vieru studied the local climate; that is, the time and amount of snowfall in winter and the influence of tourists' overnight accommodation. His research data model shows that the impact of natural snow conditions on overnight stays varies by country of origin [4]. Li et al. took the integrated development of the ice and snow industry and the health industry in Tieli and Genhe as examples. The necessity and basic conditions for the integrated development of the ice and snow industry and the health industry were discussed, and the "ice and snow+health" product system was initially designed [5]. However, their analysis of the IST market is more of a macroanalysis from the policy aspect and lack of specific analysis of specific regions.

The ice and snow economy is also an economy based on natural ice and snow landscapes. How to achieve sustainable development based on ecological environmental protection is also a problem that many scholars study. Liu developed a new sustainability index that emphasizes environmental justice to better classify and assess ecocities [6]. ZiYi et al. proposed the Ecological-Living-Productive Land (ELPL) classification system, which aims at guiding China's land pattern to take an ecologically centered path, and the development model will shift from a single function to a more comprehensive multifunctional land use [7]. Thiers et al., taking the Portland metropolitan area as an example, studied the trend of the ecological environment under urban development and studied the role of state government policies in shaping and supporting different institutions [8]. Based on the principle of minimizing environmental and ecological impacts, Chen established an ecological economic system model to conduct research on China's industries [9]. However, their research did not make an in-depth discussion of the key word of ice and snow economy but only studied the coupling relationship between the environment and the economy in the general environment.

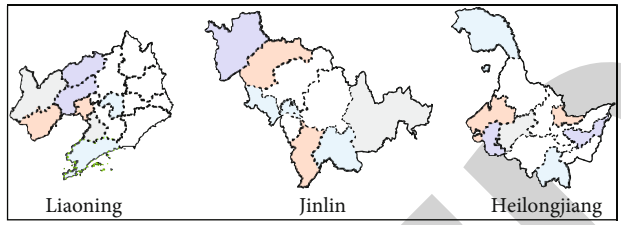



Figure 4: Distribution of tourism resources in the three northeastern provinces.

The innovation of it is that, according to the data of China's IST economy, tourism resources and number of tourists, through the long-term tracking of the study area, people can grasp the internal connection between economic growth and the natural ecological environment. China's IST economy is constantly developing, and the economy of IST is also changing. With the rapid growth of the IST market economy, various contradictions between the traditional growth mode and the ecological environment are intertwined. To achieve the coordinated development of sustained economic growth and natural ecological environment will inevitably become the top priority for China's economic development for a long time in the future. In addition, while conducting theoretical and methodological research, it pays more attention to serving the practical needs of sustainable economic development.

## 2. Sustainable Development of IST Industry

*2.1. IST Industry.* Based on the natural environment, ecological environment and cultural environment of ice and snow are needed to have a deep understanding of the meaning and research objects of ice and snow culture. According to the literature review and its characteristics, the specific definition of ice and snow culture is summarized:

The production of ice and snow culture originates from the natural and human environment. People use ice and snow as the basic elements to transform the ice and snow ecological environment, resulting in a life formed with ice and snow connotations, as shown in Figure 1 [10].

In recent years, the three northeastern provinces have been striving to build IST brands, making use of the region's unique, natural, and geographical advantages to vigorously develop IST. Heilongjiang takes the "Crown of Ice and Snow, Cool Longjiang" as its brand to promote the creation of IST themed products, involving a number of tourism industries including ice and snow sports, landscape, hunting, hot springs, and study tours. As shown in Figure 2, it is a variety of IST projects [11].

In the winter of 2018-2019, more than 20 million tourists from outside the province were received and the number of tourists received by the ice and snow tourist attractions also increased by a considerable amount. Taking Harbin Ice and Snow World as an example, the year-on-year

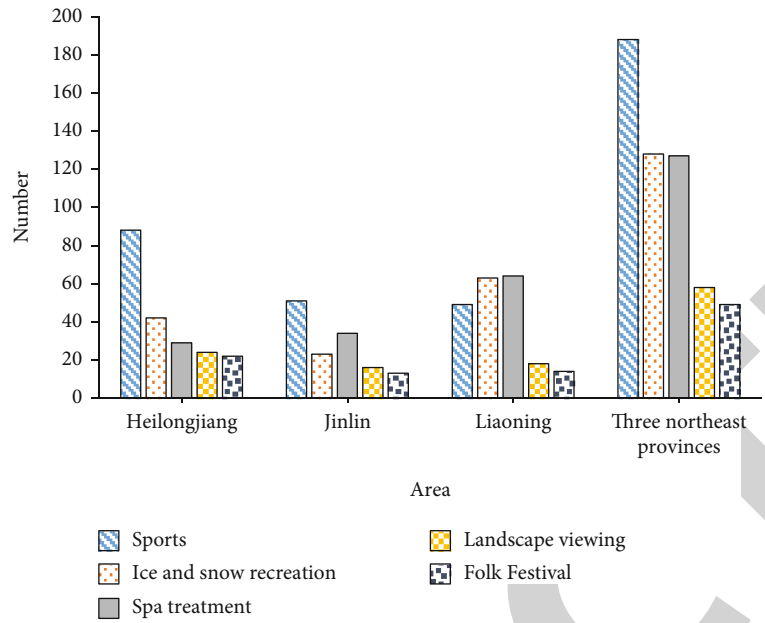



Figure 5: Type distribution of IST resources in the three northeastern provinces.

increase has reached 17.00%. Jilin Province has actively held ice and snow summits, food festivals, developed ice and snow sports, opened cross-regional ice and snow trains, and a series of ice and snow policies to innovatively solve the problems of IST [12]. In the 2017-2018 snow season, the province received 72.6389 million tourists, a year-on-year increase of 17.18%, and realized ice and snow tourism revenue of 142.181 billion yuan, a year-on-year increase of 22.57%, accounting for 36.85% of the province's average total tourism revenue. During the Spring Festival of 2018 alone, Liaoning Province received 20.32 million tourists, and the tourism revenue reached 14.5 billion yuan. Many large ski resorts received an average of nearly 2,000 tourists per day, a significant increase over the same period last year. As shown in Figure 3, for the famous Harbin Ice Sculpture, there are many tourists who go to Harbin for the Ice Sculpture Festival every year.

*2.2. Ecological Sustainable Development.* In the context of rapid global population growth, increasingly scarce resource management and further deterioration of the ecological environment, the theory of sustainable development emerged. The "Our Common Future" report is the first to put forward the theory of sustainable development and define sustainable development as development that meets current development needs without jeopardizing the ability of future generations to meet their needs. Sustainable development involves economy, resources, environment, population, etc. and follows the principles of fairness, continuity, and commonality. From the perspective of marine economic geography, the sustainable development of the marine economy emphasizes the importance of the relationship between people and the sea. By coordinating the relationship between man and sea, economy and environment, and contemporary and future we can realize the coordinated and balanced development between man and sea and society [13]. In the field of marine research, the basic idea of sustainable development mainly includes three aspects: First, pay attention to marine resources and quality. The growth of the marine economy should take into account the coordinated development of quality and quantity and change the growth mode of the marine economy. That is, relying on scientific and technological innovation and progress, improving the quality of production management elements and labor productivity to expand the scale of production and operation for analysis and transformation. Secondly, natural resources and environmental carrying capacity are the basis for the development of marine economy; third, it emphasizes the comprehensive and healthy development of human society [14].

*2.3. Vector Autoregression (VAR) Model.* Vector autoregression model (VAR) is a commonly used econometric model, which is widely used to explore the dynamic relationship between variables. The two-dimensional p-order VAR linear model constructed in this paper is as follows [15]:

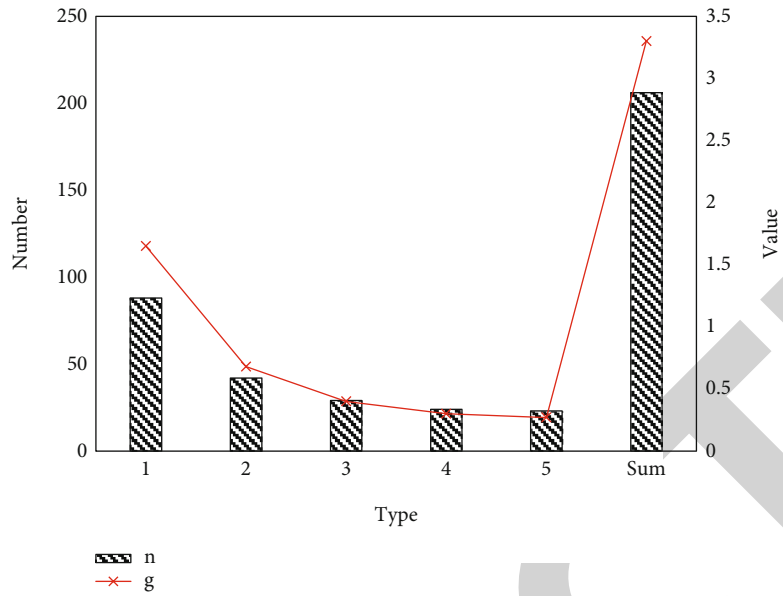
$$Z_t = v + z_{t-1} \cdot \delta_1 + \cdots + z_{t-q} \cdot \delta_p + \beta_t. \quad (1)$$

In the formula:

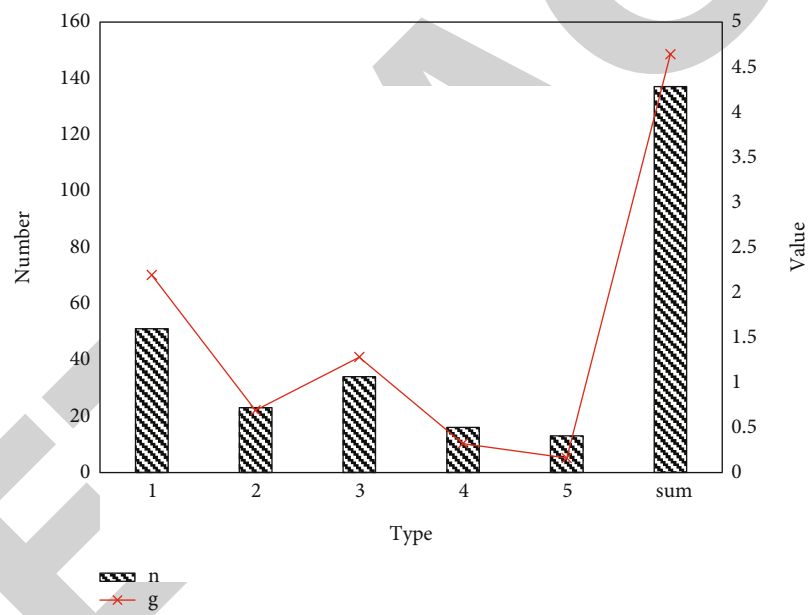
$$z_t = (y_{1t}, y_{2t})'. \quad (2)$$

In the formula, $z_1$ is the IST resource variable, $z_2$ is the economic variable, $\delta_1, \cdots, \delta_p$ is the regression coefficient, and $\beta_t$ is the error term.

When the regression coefficient and mean value of the main error distribution in Formula (1) are assumed to be constant constants, the autoregressive model's description of the relationship between economic growth and IST resources

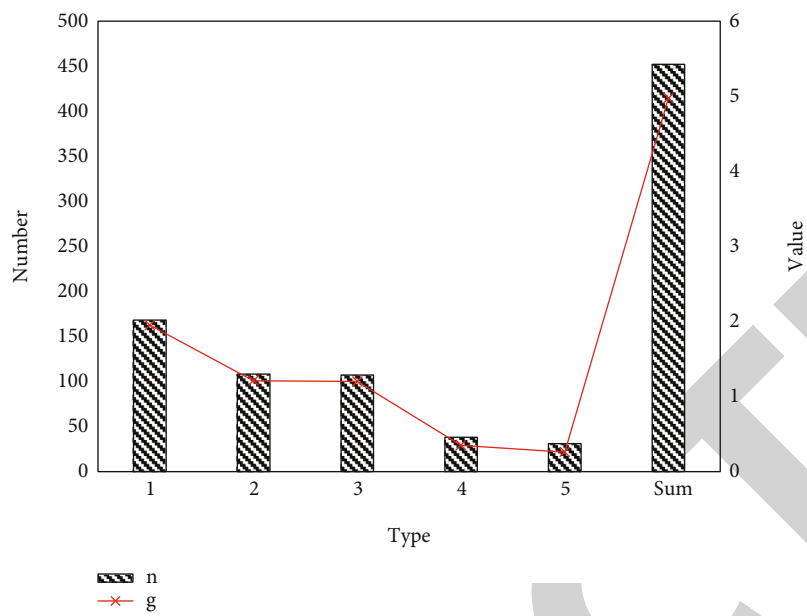



(a) Heilongjiang Province




(b) Jilin Province

Figure 6: Continued.




(c) Liaoning Province

Figure 6: The scale index of IST resources.

exhibits the properties of time series stationarity. However, the structure of the model adjusts if the time series' structure changes abruptly at various points. The latent nonlinear properties of the time series of endogenous variables cannot be reliably shown by Formula (1), which can only express the linear connection [16]. Therefore, in order to accurately describe the internal relationship between economic growth and ice and snow tourism resources, this paper introduces a nonlinear "regional system transfer" factor and assumes that the parameters of the model change with the regional system transfer of the economic system. Markov's zoning transition model is as follows:

$$Z_t = \mu(S_t) + \sum_{i=1}^{q} \varphi_i(S_t) z_{t-q} + \varepsilon_t, \quad \varepsilon_t \middle| I_{t-1} \sim iidN\left(0, \sigma_{S_t}^2\right). \tag{3}$$

In an MS-VAR model, the Markov chain generates $S_t$ as follows:

$$p_r\left[S_t \middle| \{S_{t-1}\}_{i=1}^{\infty}, \{Z_{t-1}\}_{i=1}^{\infty}\right] = p_r\{S_t | S_{t-1}; \rho\}. \tag{4}$$

Among them, it is assumed that $S_t$ has m zoning states; that is, $S_t \in \{1, 2, \cdots, m\}$ and $\rho$ contain probability parameters. Definition $p_{ij}$ the transition probability from state $i$ at time $t-1$ to state $j$ at time $t-2$, namely

$$p_{ij} = p_r(S_t = j | S_{t-1} = i), 0 < p_{ij} < 1, \quad \sum_{j=1}^{m} p_{ij} = 1. \tag{5}$$

Therefore, the transition probability matrix of $p_{ij}$ has the following form:

$$p_{ij} = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1m} \\ p_{21} & p_{22} & \cdots & p_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ p_{m1} & p_{m2} & \cdots & p_{mm} \end{bmatrix}. \tag{6}$$

According to the AIC and SC information criteria, the MS-VAR model [17, 18] containing two regional systems is adopted, namely

$$Z_t = \begin{bmatrix} Z_{1t} \\ Z_{2t} \end{bmatrix}, \quad Z_t = \begin{bmatrix} \mu_1, S_t \\ \mu_2, S_t \end{bmatrix} + \sum_{i=1}^{q} \begin{bmatrix} \varphi_{11}, s_t & \varphi_{12}, s_t \\ \varphi_{21}, s_t & \varphi_{22}, s_t \end{bmatrix} \begin{bmatrix} Z_{1t-q} \\ Z_{2t-q} \end{bmatrix} + \begin{bmatrix} \varepsilon_t \\ \omega_t \end{bmatrix}. \tag{7}$$

Among them, $z_{1t}$ represents the variable of IST resources and $z_{2t}$ represents the economic variable, namely

$$z_t = (\text{solid}_t, \text{eco}_t)', \quad z_t = (\text{liquid}_t, \text{eco}_t)'. \tag{8}$$

Among them, $\text{solid}_t$ represents the time series of the growth rate of the ice and snow resources, while $\text{liquid}_t$ represents the time series of the growth rate of the tourism industry using the ice and snow resources. The name for random disruption is $\varepsilon_t, \omega_t$, assuming that the state-dependent nature of the model's parameters and their

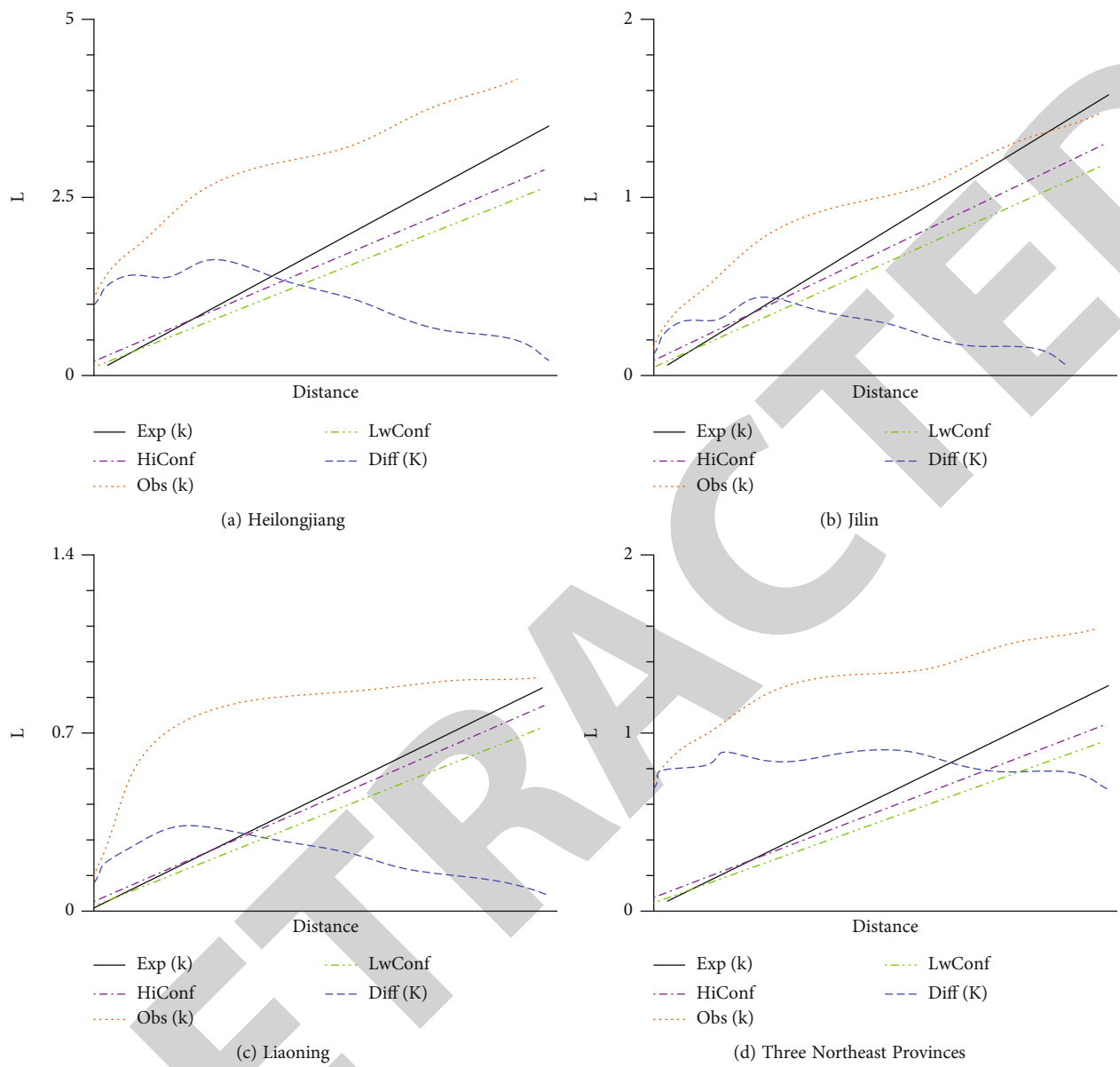



Figure 7: Ripley's $K$-function curve of IST resources in the three northeastern provinces.



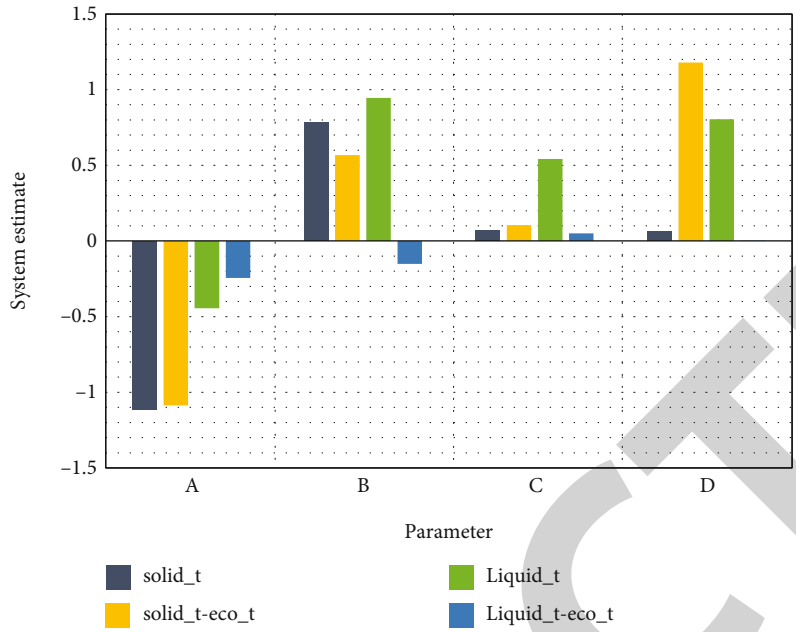
dependence on the $S_t$ zoning state variable. The model's zone state variable transition probability matrix has the following shape since the transition probability between the two zones simultaneously fulfills the first-order Markov chain:

$$p = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix}. \tag{9}$$

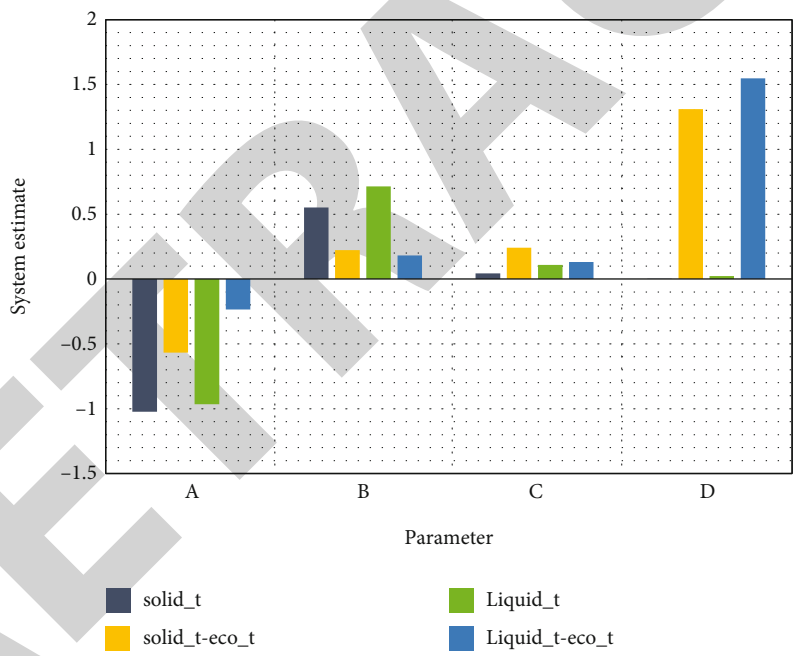
The Expectation Maximum (EM) algorithm is an optimization algorithm based on the Maximum Likelihood Estimation (MLE) theory.

## 3. IST Resources in the Three Northeast Provinces

As of April 2019, the statistics of the number of IST resources in the three northeastern provinces are shown in Figure 4. The darker the color, the more abundant the tourism resources are. The interprovincial distribution of IST resources in the three northeastern provinces is quite different. Heilongjiang and Liaoning have the same number, accounting for nearly 40%, and Jilin Province has only half of the other two provinces [19]. Comparing the number of ice and snow tourism resources in each province with the average of the three provinces, Jilin Province is far below the average, while Heilongjiang and Liaoning provinces are both above the average, but the difference in quantity is not obvious.

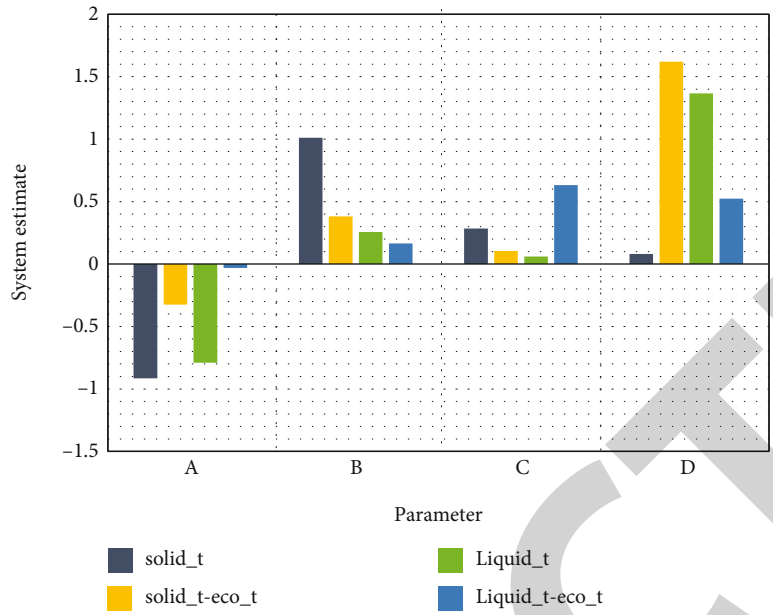



(a) System parameter values in Heilongjiang Province




(b) Jilin Province System Parameter Values

Figure 8: Continued.




(c) Liaoning Province System Parameter Values

Figure 8: Estimated results of model parameters for the three northeastern provinces.

According to the five categories of sports, ice and snow recreation, folk festivals, landscape viewing, and hot spring recuperation, the types of IST resources in the three northeastern provinces are classified and counted, as shown in Figure 5. The types of IST resources in the three northeastern provinces are dominated by sports, accounting for about 34.2% of the total; landscape viewing and folk festivals are less, accounting for 10.5% and 8.9% of the total, respectively. The number of ice and snow amusement and hot spring recuperation is in the middle, accounting for about 46.4% of the total.

The tourism scale index can show the specific situation of the quantity and quality of the ice and snow tourism resource scenic spots in each region from a macroperspective, which is of great value for understanding the development and evolution of the research site. The scale index is the ratio of the number of regional scenic spots to the regional area [20]. The calculation formula is as follows:

$$G_i = \frac{n_i}{A_i}. \tag{10}$$

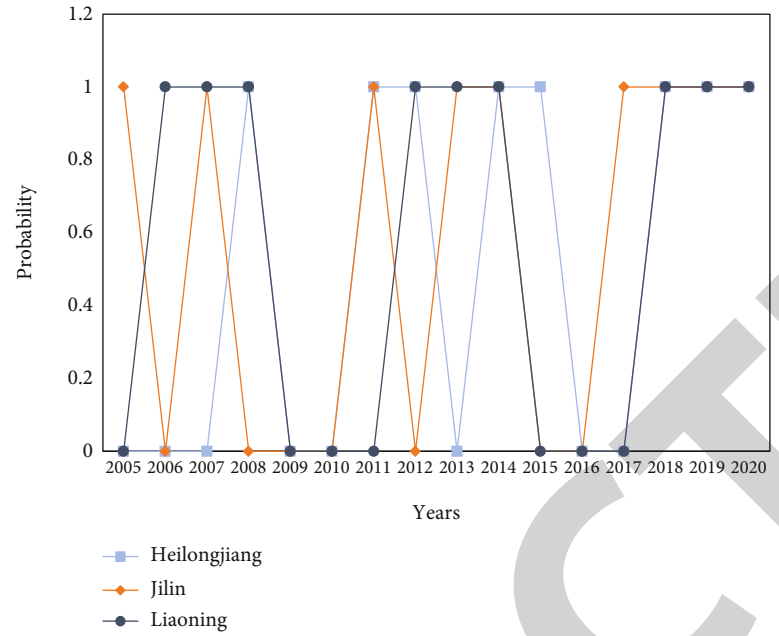
$G_i$ is the scale index; $i$ is the $i$-th study area (prefecture-level city/province); $n_i$ represents the number of IST resources in the $i$-th study area; and $A_i$ represents the area of the study area. It can be seen from the formula that when the area of the study area is fixed, the scale degree index is positively correlated with $n_i$. The larger the scale degree, the more relative the quantitative advantage of IST resources in this area. Calculated according to Formula (10), the scale index of IST resources in the relevant area can be obtained, and the result is shown in Figure 6.

Overall, Liaoning Province has the largest scale of IST resources, twice the scale of the three northeastern provinces. The scale of IST resources in Heilongjiang and Jilin provinces is lower than the overall scale of the three provinces and far lower than that of Liaoning Province. Comparing the scale of IST resources by type, no matter what kind of IST resources, the scale of Liaoning Province ranks first in the three eastern provinces and is significantly higher than the overall scale of the three provinces. In addition, although the overall scale of Heilongjiang Province is smaller than that of Jilin Province, the scale of ice and snow tourism resources of folk festivals and festivals is slightly higher than that of Jilin Province. According to the scale degree index, although the IST resources in Heilongjiang Province have an advantage in quantity, due to the vast territory, the scale degree has been reduced. Among the smaller Liaoning and Jilin provinces, although the number of IST resources in Liaoning Province is in the middle, it has the highest scale. Although Jilin Province has the least amount of IST resources, the scale degree has been fluctuating in a small range up and down the overall scale degree.

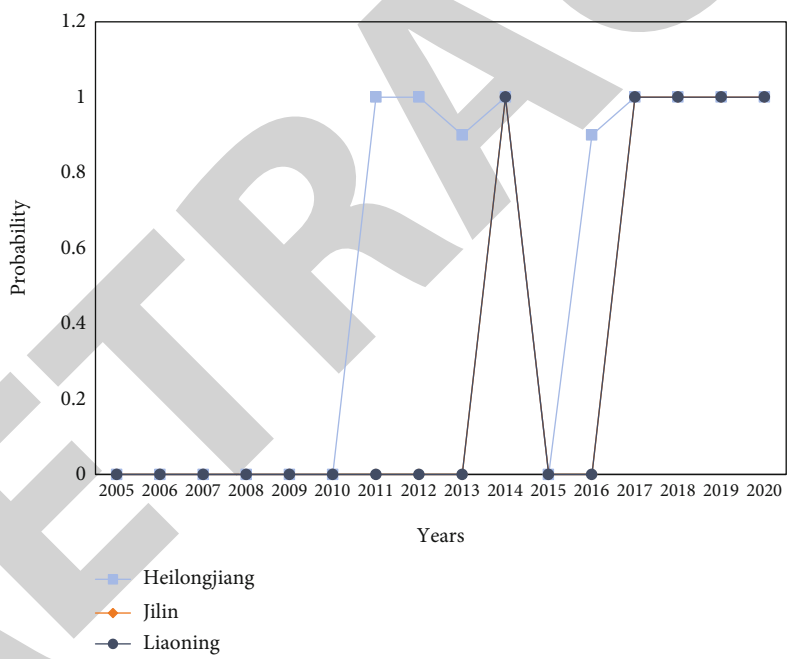
The nearest neighbor analysis method refers to the geographical index of the proximity of point-like objects in geographical space. It can reflect the agglomeration degree of the spatial distribution of tourism resources within a certain area and is widely used in the study of tourism spatial structure. Calculated as follows:

$$r_E = \frac{1}{2\sqrt{n/A}} = \frac{1}{2\sqrt{D}}, \qquad R = \frac{r_i}{r_E}. \tag{11}$$

Kernel density can be used to analyze the spatial distribution and aggregation of IST resources in the three northeastern provinces. It is centered on a specific point, expands outward according to a specific search radius,




(a) "solid$_t$ – eco$_t$" System Smoothing Probability




(b) "liquid$_t$ – eco$_t$" System Smoothing Probability

Figure 9: System smoothing probability.

Table 1: solid$_t$ – eco$_t$ System Intrinsic Relationship Coefficients.

| solid$_t$ – eco$_t$ | Low growth zoning | | High-speed growth zone | |
|---|---|---|---|---|
| | solid$_t$ | eco$_t$ | solid$_t$ | eco$_t$ |
| solid$_t$ | 1 | -0.365 | 1 | 0.357 |
| eco$_t$ | -0.3650 | 1 | 0.357 | 1 |

searches for other points within the radius, and finally stops when the point density is 0. Kernel density analysis can clearly reflect the aggregation form of IST resources in a specific geographical range through intuitive graphic patterns. The calculation formula is as follows:

$$f(x) = \frac{1}{\mathrm{nh}} \sum_{i=1}^{n} K\left(\frac{x - x_i}{h}\right). \tag{12}$$

In order to obtain a more credible kernel density

Table 2: $\text{liquid}_t - \text{eco}_t$ System Intrinsic Relationship Coefficients.

| $\text{liquid}_t - \text{eco}_t$ | Low growth zoning | | High-speed growth zone | |
|---|---|---|---|---|
| | $\text{liquid}_t$ | $\text{eco}_t$ | $\text{liquid}_t$ | $\text{eco}_t$ |
| $\text{liquid}_t$ | 1 | 0.468 | 1 | -0.189 |
| $\text{eco}_t$ | 0.468 | 1 | -0.189 | 1 |

Table 3: The zoning transition probability matrix and zoning attributes of the 2005-2020 "$\text{solid}_t - \text{eco}_t$" system.

| $\text{solid}_t - \text{eco}_t$ | | Zoning transition probability matrix | | Zoning attribute |
|---|---|---|---|---|
| | | High-speed growth zone | Low growth zoning | Average duration |
| Heilongjiang | High-speed growth zone | 0.678 | 0.186 | 3.564 |
| | Low growth zoning | 0.325 | 0.881 | 5.367 |
| Jilin | High-speed growth zone | 0.698 | 0.189 | 3.471 |
| | Low growth zoning | 0.286 | 0.816 | 5.638 |
| Liaoning | High-speed growth zone | 0.765 | 0.179 | 3.112 |
| | Low growth zoning | 0.238 | 0.796 | 4.652 |

measurement bandwidth $h$, this paper uses Ripley's $K$-function and uses the multidistance spatial clustering analysis tool in ArcGIS to first conduct a statistical analysis of the spatial distribution of IST resources in the three northeastern provinces. In the calculation of the multidistance spatial clustering tool, Ripley's $K$-function is commonly transformed. The transformed calculation formula is as follows:

$$\mathrm{L(d)} = \sqrt{\frac{A\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N} k(i,j)}{\pi N(N-1)}} \tag{13}$$

In Ripley's $K$-function curve figure, Exp is the expected value curve of the randomly distributed $K$ function, and Obs is the observed value curve. When the confidence level is 99%, LwConf is the lowest confidence value curve, HiConf is the highest confidence value curve, and the middle is the confidence interval. When $\mathrm{L(d)} > \mathrm{HiConf}$, it is spatial clustering; when $\mathrm{L(d)} < \mathrm{LwConf}$, it is spatially discrete. As shown in Figure 7(a), taking Ripley's $K$-function curve of IST resources in Heilongjiang Province as an example, according to the curve, it is found that the Obs curve of the observed value has been on an upward trend. The difference curve Diff between the observed value and the expected value continues to rise in the distance unit of 0-0.8. When the distance unit is greater than the interval of 0.7-0.8, it shows a clear downward trend. After careful analysis, it is found that the dividing line of the curve change is 0.74. This is consistent with the clustering and discrete changes of the L(d) function curve in the confidence interval. When the distance unit is lower than 0.74, $\mathrm{L(d)} > \mathrm{HiConf}$ is spatial clustering, otherwise it is spatially discrete. Therefore, when carrying out the nuclear density analysis of Heilongjiang Province, 0.74 is used as the bandwidth value, and then the nuclear density analysis is carried out. Similarly, as shown in Figures 7(b) and 7(c), the core density bandwidth of IST resources in Jilin Province should be 0.27, that in Liaoning Province should be 0.35, and the overall core density bandwidth of the three northeastern provinces should be 0.94.

In order to further understand the location of the spatial distribution of IST resources in the three northeastern provinces, the standard deviation ellipse model was used. The standard deviation ellipse takes the average center of each data point in the study area as the starting point and calculates the standard deviation of the abscissa and ordinate coordinates of all data points to obtain the long and short axes of the standard deviation ellipse, and then creates the ellipse of these data points. Through the standard deviation ellipse, it can be intuitively seen whether the distribution of point elements in the study area has a specific direction, which provides a certain reference value for the spatial distribution direction of IST resource points. The calculation formula is as follows:

$$\begin{aligned} \mathrm{SDE}_x &= \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \bar{X}\right)^2}{n}}, \\ \mathrm{SDE}_y &= \sqrt{\frac{\sum_{i=1}^{n}\left(y_i - \bar{Y}\right)^2}{n}}. \end{aligned} \tag{14}$$

Among them, $\mathrm{SDE}_x$ and $\mathrm{SDE}_y$ are the major and minor axes of the standard deviation ellipse and $n$ is the number of all points; $x_i$ and $y_i$ are the abscissa and ordinate of the $i$ point and $\bar{X}$ and $\bar{Y}$ are the average center of all points, that is, the center of the standard deviation ellipse.

## 4. Deconstruction of Tourism Resources and Economic Growth Model

This paper uses the ADF test method to test the stationarity characteristics of the time series. The results show that the economic growth rate and the growth rate of ice and snow

Table 4: The zoning transition probability matrix and zoning attributes of the 2005-2020 "$liquid_t - eco_t$" system.

| $liquid_t - eco_t$ | | Zoning transition probability matrix | | Zoning attribute |
|---|---|---|---|---|
| | | High-speed growth zone | Low growth zoning | Average duration |
| Heilongjiang | High-speed growth zone | 0.836 | 0.539 | 5.112 |
| | Low growth zoning | 0.198 | 0.463 | 1.855 |
| Jilin | High-speed growth zone | 0.690 | 0.297 | 3.015 |
| | Low growth zoning | 0.326 | 0.705 | 3.365 |
| Liaoning | High-speed growth zone | 0.874 | 0.173 | 7.961 |
| | Low growth zoning | 0.127 | 0.833 | 5.993 |

tourism resources are stable at the 1% significant level. And according to the AIC and SC information criteria, the nonlinear MSMH(M)-VAR(p) model with the number of zoning systems of 2 and the lag order of 1 is constructed by GUASS software.

The model of IST resources and economic growth adopts the vector autoregressive model. After input and analysis of multiple data, the MSMH(2)-VAR(1) model is determined. And the model is divided into two systems, namely the tourism resource growth and economic growth model, the $solid_t - eco_t$system and the tourist growth and economic growth model, the $liquid_t - eco_t$ system. Estimated results of model parameters for the three northeastern provinces are shown in Figure 8.

Figure 9(a) shows the smoothed probability values for each year when the "$solid_t - eco_t$" system is in the "slow economic growth" and the "stage of rapid economic growth." It can be seen that the transfer of the regional system in Heilongjiang is relatively concentrated, the transfer of the regional system in Jilin is relatively stable, and the transfer of the regional system in Liaoning is more frequent.

Heilongjiang and Jilin were in the "slow economic growth" in 2005-2009, 2010-2015, and 2018-2020, and the average smoothed probability was 1.000. Under the state of "stage of rapid economic growth", increasing the number of IST resources and increasing the number of tourists can only unilaterally improve the ecological level of the natural environment. It will not produce a positive feedback of linkage effect on economic and social development, but will slow down the height of market economic growth.

Figure 9(b) shows the smoothed probability values for each year when the "$liquid_t - eco_t$" system is in the "slow economic growth" and the "stage of rapid economic growth." The transfer of the regional system in Liaoning is more frequent, and it has been in the "stage of rapid economic growth" since 2005. The transfer of the regional system in Heilongjiang is relatively concentrated, and the transfer of the regional system in Jilin is relatively stable.

The relationship between "economic growth and IST resources" in the "slow economic growth" and "stage of rapid economic growth" was further discussed in order to further explore the internal connection between the economic growth of IST and the resources. This was done on the basis of the analysis of the nonlinear periodic change law of the internal connection between China's IST economic growth and IST resources. The association coefficients between "economic growth and IST resources" in various growth zone systems are displayed in Tables 1 and 2.

By observing the correlation coefficient of the "economic growth and ice and snow tourism resources" system listed in Table 1, it is found that when the "$solid_t - eco_t$" system is in the "low-speed growth zone system", the growth rate of ice and snow tourism resources is negatively correlated with the economic growth rate. While in the "high-speed growth zone system", the growth rate of ice and snow tourism resources is positively correlated with the economic growth rate.

By observing Table 2, it can be found that there is not only a "sustainable and healthy development" economic growth model between China's IST economic growth and natural ecological environmental protection but also an economic development phenomenon of "exchange pollution for growth". Moreover, the internal connection between China's economic growth and IST resources will change with the transition of different regional systems.

Tables 3 and 4 show the results of the zoning attribute of the "Economic Growth and IST Resources" system.

Table 3 shows that with the continuous development of social economy, the IST resources of IST are in a state of continuous decline, which is consistent with the previous research results. In general, the green development model vigorously promoted by China has increased the growth of tourists, enabling IST to maintain stable economic growth while reducing environmental pollution.

From the trend analysis in Table 4, it can be seen that under the background of the continuous innovation and development of China's IST social economy, the growth rate of IST resources has accelerated. There is an economic development phenomenon of "promoting growth through pollution" among China's IST. There is a significant positive correlation between the destruction of the natural landscape of ice and snow and the mode of economic growth. On the whole, the "$liquid_t - eco_t$" system has a high probability of being in the stage of rapid economic growth, indicating that the damage to the natural ice and snow landscape in the northeast is on the rise with economic development. Under the background of the hot development of IST, the pressure of tourists on the natural ice and snow environment has gradually become prominent, and the green development of the natural ecological environment is still facing enormous pressure.

## 5. Conclusions

From experience description to process simulation is the trend of geography development. This paper is based on the "$\text{solid}_t - \text{eco}_t$" system composed of the growth rate of IST resources and the economic growth rate. The "$\text{liquid}_t - \text{eco}_t$" composed of the tourist growth rate and the economic growth rate, using a two-stage nonlinear Markov zone transfer model. The analysis results of the zoning system attributes of the "economic growth and IST resources" system show that the probability of maintaining the original growth zoning system for each subsystem is greater. With the development of the economy, the number of IST resources gradually decreases, while the number of tourists increases with the development of the economy. It demonstrates that China's IST economy and natural ecological environment have a development trend in the direction of coordinated and symbiotic development in the process of economic development.

## Data Availability

This article does not cover data research. No data were used to support this study.

## Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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*Retraction*

# Retracted: Effective Strategies to Promote the Cultivation of Public Legal Consciousness from the Perspective of Social Psychology

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] L. Yi and T. Li, "Effective Strategies to Promote the Cultivation of Public Legal Consciousness from the Perspective of Social Psychology," *Journal of Environmental and Public Health*, vol. 2022, Article ID 8275938, 12 pages, 2022.

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*Research Article*

# Effective Strategies to Promote the Cultivation of Public Legal Consciousness from the Perspective of Social Psychology

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In order to build a harmonious economic society, show the legal function in the society, enable people to live and work in a better environment, and increase people's practicality in the legal society, it needs to be analyzed from the perspective of social psychology. This paper comprehensively analyzes the current public legal knowledge, uses a deep neural network model, and implements the cultivation of public legal awareness. On this basis, it integrates the data and information before and after 2020, uses the method of book case distribution training, constructs a legal framework, relies on the data distribution technology, constructs a web legal awareness training system, and increases the conditions for promoting the cultivation of public legal awareness based on the background operation of the integrated website. It can be seen that in the perspective of social psychology, the importance of the cultivation of public legal awareness can be achieved through new algorithms, so that people can pay attention to the cultivation of legal awareness, which can provide corresponding protection for the operation and maintenance of the legal system.



## 1. Introduction

The rule of law is an important achievement of human social civilization, and governing the country by law is the socialist development path emphasized by China. The grand goal of governing the country by law requires the public to have a corresponding understanding of socialist law and have a sound legal awareness. Especially for high school students, they should not only put an end to their own illegal acts but also use legal weapons to protect their own rights and interests, and the cultivation of legal awareness has become the key to the construction of the rule of law. This article focuses on the current situation of public legal consciousness and explores the rationalization countermeasures to improve the legal consciousness of high school students, so as to lay the national foundation for the rule of law in China.

Legal consciousness is a kind of social consciousness [1]. It is the individual's subjective state of legal phenomena, the high school students' cognition of the law, their emotions and attitudes towards the law, etc., in view of the differences between the high school students' groups, each high school student's subjective attitude towards the law also varies, which will eventually form differences in legal consciousness. Public legal consciousness is the social public's attitude, psychology, and understanding of the real law. And the evaluation sum of various elements such as beliefs, values, habits, and so on. The function of legal consciousness is mainly reflected in four aspects: first, cognitive function. It mainly aims at understanding the role, nature and characteristics of law. It is the primary embodiment of legal consciousness; second, prediction function [2]. It mainly refers to the individual's experience of predicting the legitimacy of events according to legal norms and whether the prediction behavior is subject to legal sanctions; third, regulation function. Based on the individual's understanding and evaluation of the law, they will adjust their own behavior with the law; fourth, communication function. Legal consciousness will spread through multiple channels and ways and generate corresponding positive energy, which will be carried forward

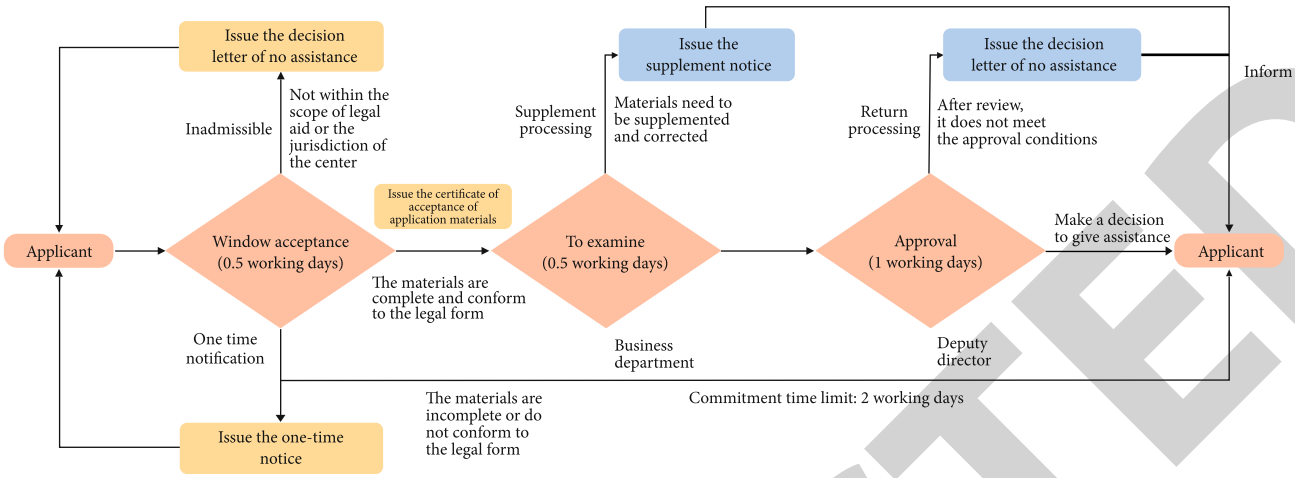


Figure 1: Approval chart of legal consciousness cultivation from the perspective of social psychology.

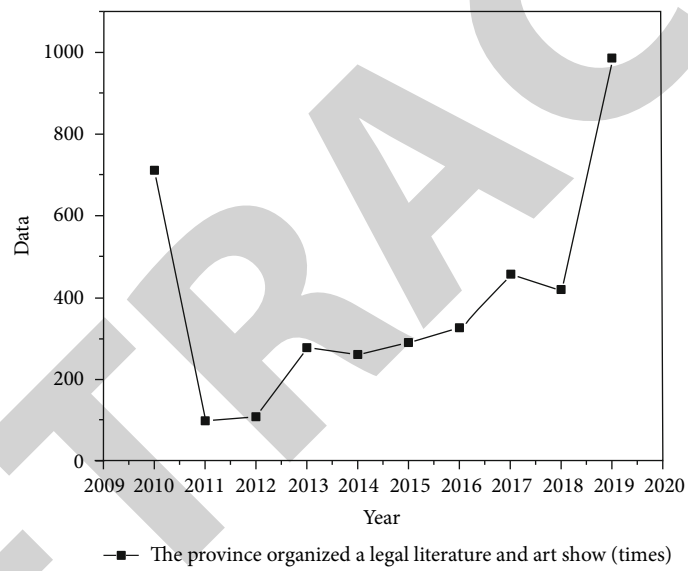


Figure 2: 2010-2019 provincial legal literature and art exhibition.

in social groups. Figure 1 shows the identification diagram of legal awareness cultivation from the perspective of social psychology.

## 2. Current Situation of Public Legal Awareness

*2.1. Achievements in the Construction of Chinese Public Legal Awareness.* With the rapid development of China's social economy, China's politics, law, culture, and other aspects are also making rapid progress. The improvement of material living standards also promotes the public to pay more attention to spiritual literacy [3] and generate relevant legal awareness. Since the 1980s, China has focused on law popularization education, especially for high school students. It is hoped that through education, high school students can contact, understand, and apply the law. Throughout more than 30 years of law popularization education, Chinese citizens in the 21st century have a deeper understanding of basic legal knowledge, legal knowledge, and legal culture [4]. In particular, high school students can adjust their thinking and behavior based on the law and become law-abiding citizens, as shown in Figure 2.

According to relevant data, the crime rate of Chinese high school students has been significantly reduced, which is inseparable from the improvement of legal awareness of high school students [5]. At the same time, most high school students in China can use the law as a weapon to protect their legitimate rights, apply the law to life and study, and protect their own rights and interests with the law. On the premise of the continuous improvement of high school students' legal awareness, the number of criminal cases of high school students shows a downward trend, while the number of rights protection cases is on the rise. Under the domination of legal awareness, high school students use the law to protect their own legitimate rights and interests, which is also the greatest achievement in the construction of Chinese

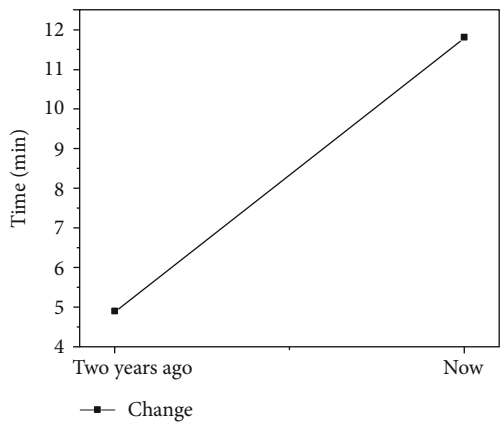


Figure 3: Self legal rights and interests protection chart based on the perspective of social psychology.

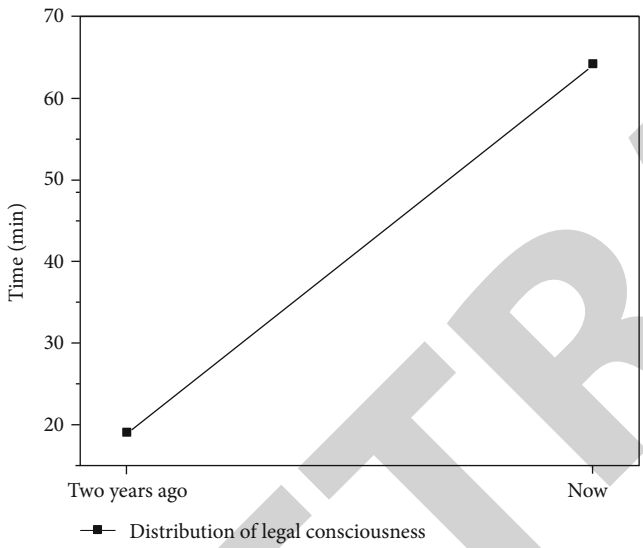


Figure 4: Distribution of high school students' legal awareness.

public legal awareness. Figure 3 shows the protection of their own legitimate rights and interests based on the perspective of social psychology.

*2.2. Main Problems of Chinese Public Legal Consciousness.* Although China has made some achievements in legal awareness [6, 7], there are still many problems. Compared with the development of other fields of consciousness, the development speed of legal consciousness is relatively slow, and there is a certain gap between legal consciousness and the pace of development of the times. Specifically, it is mainly reflected in the following aspects: first, the gap between social public legal consciousness is relatively large. In more than 30 years of law popularization education, high school students have developed legal awareness and know how to use the law as a weapon to protect their own rights and interests, but there are still some high school students with weak legal awareness and do not know how to protect their own rights and interests with the law, and some will also have the phenomenon of fighting and injury, especially in economically backward areas, which is more obvious. Secondly, legal consciousness is framed. Figure 4 shows the distribution of high school students' legal awareness.

The legal consciousness of Chinese high school students has been negatively influenced by culture for a long time. It hinders the emergence and development of modern legal consciousness and limits the legal consciousness of high school students within the framework. Thirdly, the cultivation of Chinese legal awareness through online channels needs to be improved, as shown in Figure 5 [8].

Although the law popularization education in China has been carried out for more than 30 years, there are still problems of incomplete training, and some legal loopholes are too many and not perfect, which has caused huge obstacles to the cultivation of legal awareness (as shown in Figure 6) [9].

Finally, the legal consciousness of high school students is slowly renewed. Legal consciousness is constantly changing. According to the content of CI system, legal consciousness will be updated with the development of the times and social progress. China's social development is fast, but the renewal of people's legal consciousness is very slow, and there is a large gap between legal consciousness and social development. (as shown in Figure 7) [10].

## 3. Cultivation and Development of Public Legal Consciousness

*3.1. Gradually Improve the Market Economy System.* China should gradually improve the market economic system and promote the legal awareness with economic development. When the mass material base is met, the spiritual needs will be effectively improved. Using a good market economic system to create greater wealth for the society, through the static inspection system helps to enhance the public's legal awareness. (as shown in Figure 8) [11].

On the one hand, to improve the economic level and promote the consciousness of the public in the application of law [12], the government and society should advocate a free economy and allow the public to widely participate in market economic activities. Once the public participates in the market economy, they will face various contradictions and need to solve the contradictions with the help of the law, as shown in Figure 9 [13, 14].

At this time, relevant departments should use legal means to help the public solve contradictions and guide the public to actively study relevant laws, especially high school students, until the public can skillfully use the law as a weapon to protect their own rights and interests (see Table 1 for details) [15].

On the other hand, to cultivate the formation of public legal concepts, the market economic environment requires the public to have the concept of rights, social contract, and law. The government and society should actively cultivate a legal environment. Clear laws and regulations should be used to solve practical contradictions and make the public aware of the importance of law in social life. For example, the government should abandon the traditional mandatory

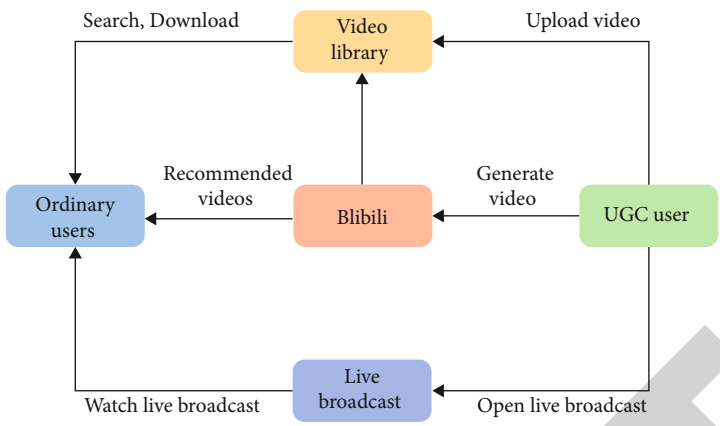


Figure 5: Cultivation of legal awareness of online channels from the perspective of social psychology.

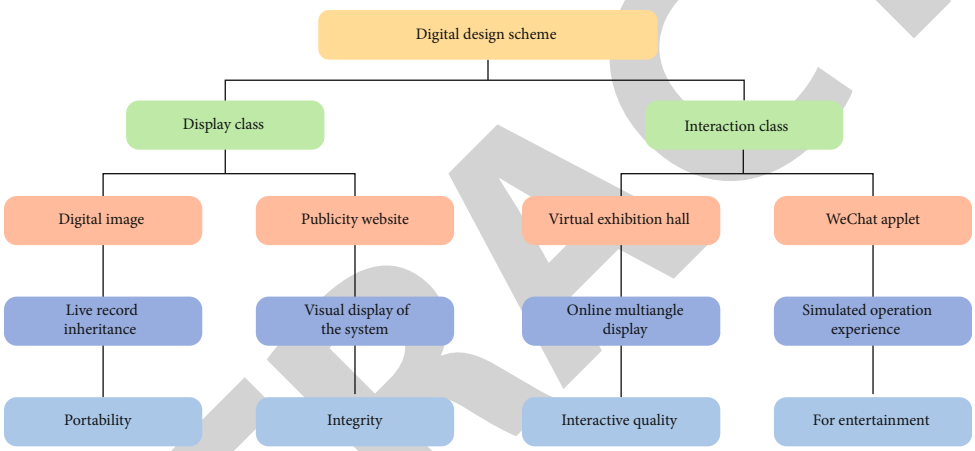


Figure 6: Distribution of legal consciousness barriers based on social psychology.

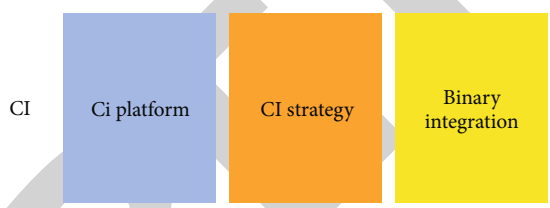


Figure 7: CI system content legal awareness creation diagram.

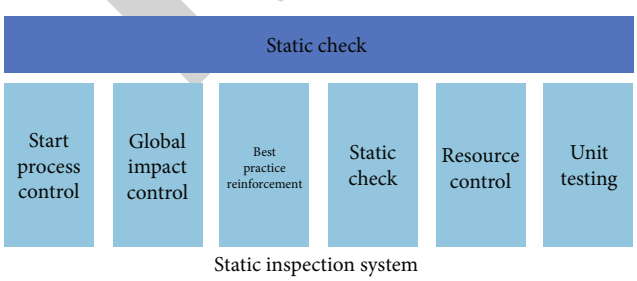


Figure 8: Flow chart of static inspection system based on social psychology.

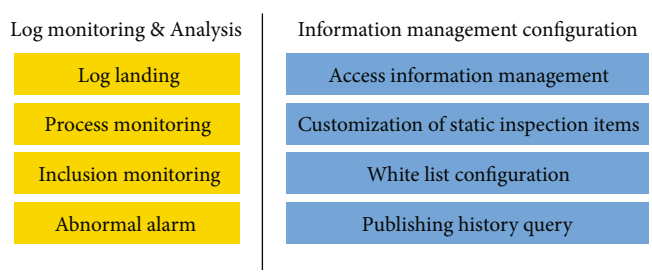


Figure 9: Planning diagram for solving legal contradictions based on the perspective of social psychology.

management method and use legal means to manage enterprises. Enterprises also need to carry out corresponding business activities in accordance with the law, and the majority are in enterprises for a long time. With often use of the law to deal with problems, the legal concept will naturally gradually form (the specific questionnaire is shown in Table 2) [16].

*3.2. Improve the Socialist Democratic System.* The social democratic system is closely related to public legal consciousness. A society ruled by law cannot be without

Table 1: List of weight matters of legal consciousness cultivation based on the perspective of social psychology.

| Code | Setting basis | Type of power | Applicable object |
|---|---|---|---|
| 1 | Articles 3, 5, and 33 of the law of the People's Republic of China on the administration of tax collection. | Administrative expropriation | Company |
| 2 | Article 9 of the provisional regulations of the People's Republic of China on property tax. | Administrative expropriation | Personal |

Table 2: Legal consciousness questionnaire based on social psychology.

| Number | Survey questions | Reply and proportion |
|---|---|---|
| 1 | Do you think national security has a lot to do with you | A lot/75% |
| | | Not much/25% |
| 2 | Whether to attach importance to current affairs and politics | Follow/80% |
| | | Not concerned/20% |

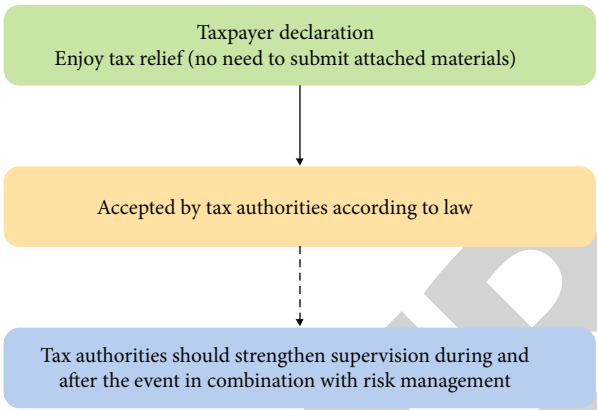


Figure 10: Flow chart of activities required by laws and regulations.

democracy, which is the foundation of a society ruled by law. On the one hand, to improve China's democratic system, the democratic system can effectively ensure the public to participate in management activities, ensure the formulation of corresponding laws and regulations in accordance with the interests of the public, and allow the public to participate in the formulation of laws and regulations, thus the public will be more willing to accept the corresponding legal constraints so as to better comply with laws and regulations and carry out activities in accordance with the requirements of laws and regulations. As shown in Figure 10 [17].

In this case, the public's legal awareness will be improved, and they will know how to use the law to protect democratic rights, especially the high school students with high quality [18]. On the other hand, to create a good democratic environment with the development of society, the government has a key influence in social life. The government should create a good democratic environment and supervise the application of rights. Avoid the abuse of judicial power and unfair law enforcement. In a good democratic and legal environment, the public's legal awareness will be further improved, and they will believe more in democracy and the rule of law, as shown in Figure 11 [19].

*3.3. Enhance the Public's Sense of Legal Security.* Law enforcement and strict law enforcement are the key to enhancing the public's sense of legal security. The public's legal awareness is only an understanding of the law in their minds. The transformation of this understanding into reality must rely on strict law enforcement. By only having a high-quality law enforcement team and using the law to protect the legitimate rights and interests of the public, we can enforce the law strictly and fairly, so that the legitimate rights and interests of the public can be effectively protected, so as to enhance the public's sense of trust and security in the law [20, 21]. Once the public has a corresponding sense of security for social law and trusts the protection of their own rights and interests by law, this trust will react on legal awareness and promote the further improvement of public legal awareness, as shown in Figure 12 [22].

*3.4. Improve the Legal Education Mechanism.* Law popularization education is the most direct way to improve public legal awareness, and has been verified in practice. On the one hand, law popularization education is carried out in a diversified way [23]. We should make full use of law popularization education to improve public legal awareness, especially for high school students. To make use of multiple channels and ways to make the public access to legal knowledge, we should not only pay attention to the construction of traditional legal education channels but also use network information channels to carry out legal education, and use websites, WeChat, Weibo, and other tools to carry out legal publicity, so that the public can access legal education anytime and anywhere. On the other hand, close links between law popularization education and life. Law popularization education should pay attention to the update of relevant legal knowledge and content and pay attention to the organic combination with real life. By learning law popularization education, we can solve the practical legal problems and make the public aware of the close connection between law and life, so as to improve their legal awareness, as shown in Figure 13 [24].

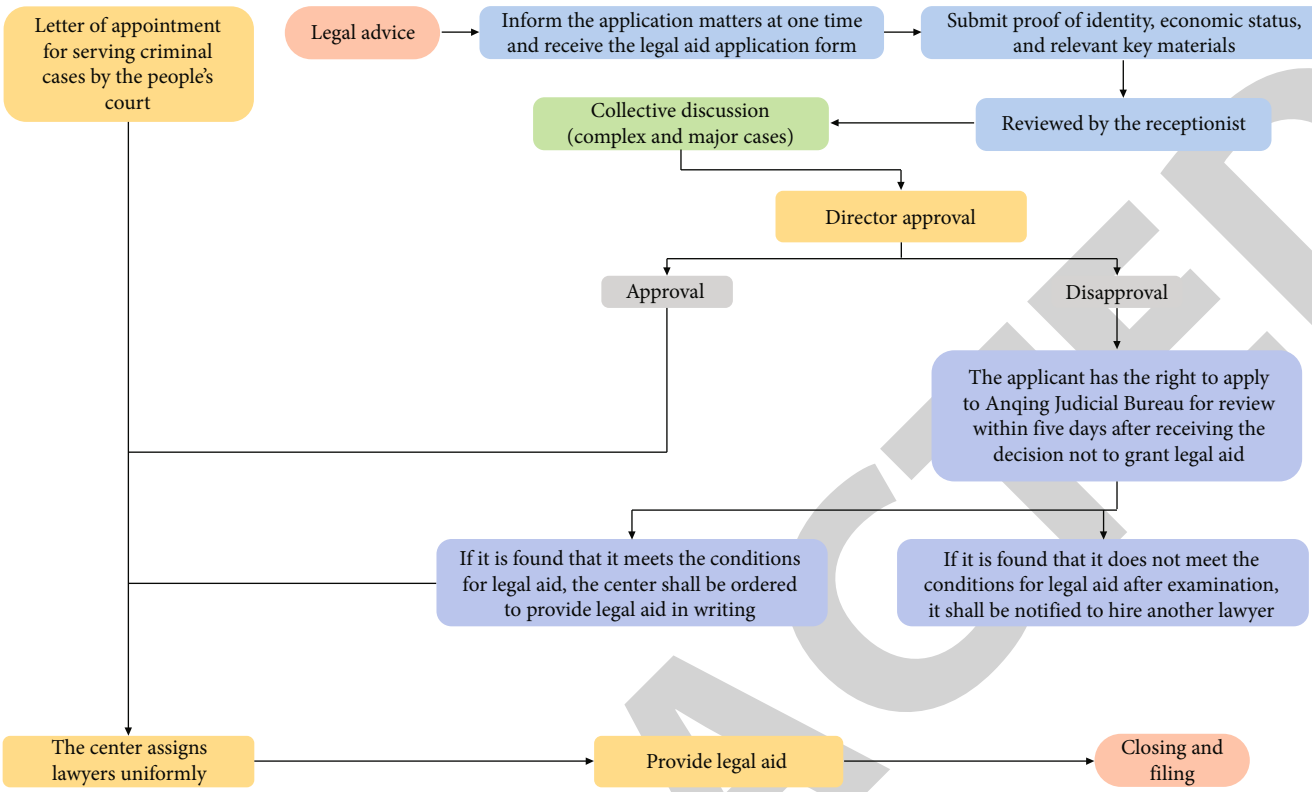


Figure 11: Legal consciousness assistance from the perspective of social psychology.

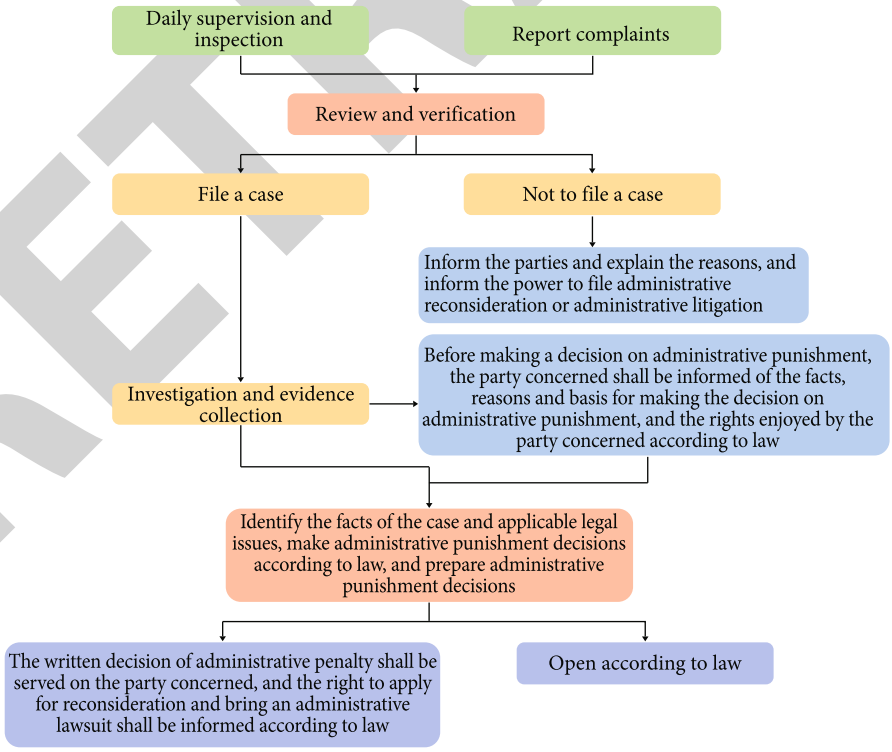


Figure 12: Punishment chart for illegal acts of grassroots legal service workers.

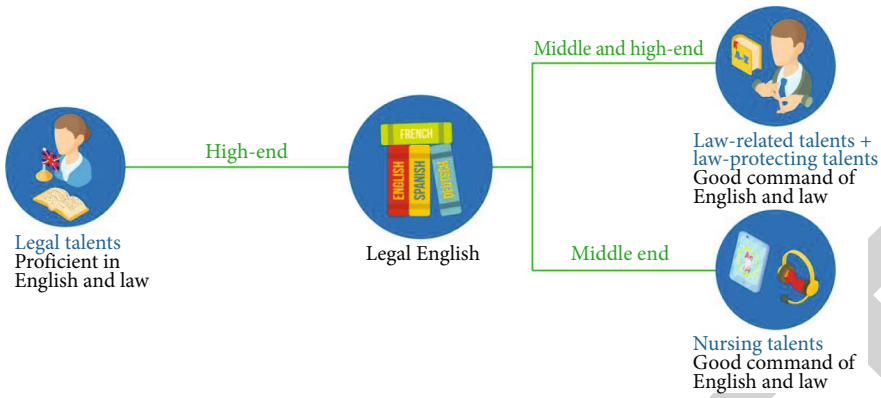


Figure 13: Cultivation of legal consciousness.

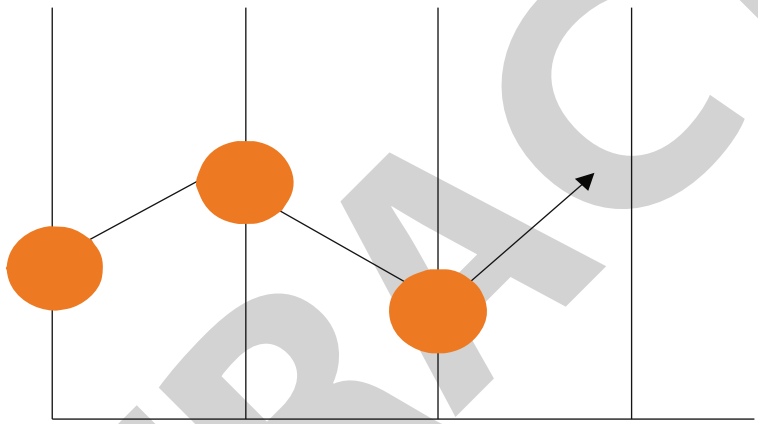

Figure 14: Change chart of legal thinking ability to think and solve practical problems.

## 4. Practical Training Strategies for College Students' Legal Awareness of Innovation and Entrepreneurship

*4.1. Focus on Building and Improving the Innovation and Entrepreneurship Education Curriculum Education System.* In view of the lack of legal awareness-related training courses in the current innovation and entrepreneurship education curriculum system, colleges and universities should correctly understand the relationship between legal awareness and entrepreneurial behavior, think from the perspective of students and comprehensively think about the legal problems that students may face in the practice of innovation and entrepreneurship. On this basis, reasonably determine the content of innovation and entrepreneurship legal education, realize the further improvement of the innovation and entrepreneurship education curriculum system, and truly integrate legal education into innovation and entrepreneurship education, so as to help students master the relevant legal knowledge involved in innovation and entrepreneurship practice and enable students to have the ability to think and solve practical problems by applying legal thinking in innovation and entrepreneurship practice. As shown in Figure 14 [25].

Specifically, colleges and universities need to integrate legal issues and legal cultural knowledge in the fields of innovation and entrepreneurship financing, secured loans, fixed asset leasing, administrative examination and approval, intellectual property rights, and other related fields into innovation and entrepreneurship education, combined with specific examples to help students understand so that students can clarify the relationship between legal knowledge and innovation and entrepreneurship practice. At the same time, colleges and universities should help students understand the contents related to innovation and entrepreneurship activities in the company law, contract law, guarantee law, bill law, and other relevant laws and further enhance students' legal awareness and legal thinking. According to students' professional differences, teachers should pay attention to the application of different cases to help students understand legal knowledge and effectively improve the pertinence and effectiveness of legal awareness training [26].

*4.2. Cultivate Professional Teachers with Legal Awareness of Innovation and Entrepreneurship.* Because the cultivation of legal awareness of innovation and entrepreneurship involves many complex legal knowledge and laws and regulations, teachers who carry out the cultivation of legal


Figure 15: Organization chart of legal awareness training activities based on the perspective of social psychology.

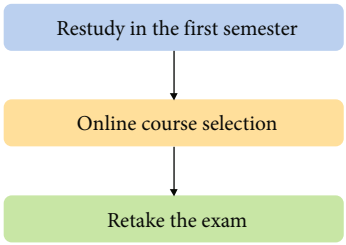


Figure 16: Legal consciousness cultivation from the perspective of social psychology.

awareness must have good legal literacy, otherwise they will be difficult to help students understand the relevant legal knowledge and legal provisions in teaching practice, and they will also be unable to thoroughly understand the content of legal knowledge involved in real cases of innovation and entrepreneurship, as shown in Figure 15 [27].

Therefore, in view of the current lack of professional teachers in the legal awareness training of College Students' innovation and entrepreneurship education, colleges and universities should carry out legal knowledge theme training for teachers. Through training, help them master the legal knowledge related to innovation and entrepreneurship practice, enhance their legal knowledge teaching ability, and ensure that they can truly combine theory with practice in the process of cultivating students' legal awareness so as to effectively help students form a deep understanding and mastery of legal knowledge. At the same time, colleges and universities should pay attention to the introduction of high-quality talents with legal knowledge related professional background and comprehensive practical ability so as to optimize the teaching staff of innovation and entrepreneurship education and effectively improve the level and effectiveness of legal awareness training of innovation and entrepreneurship education, as shown in Figure 16 [28].

*4.3. Construction of Innovation and Entrepreneurship Legal Services and Legal Aid Base.* For college students, even if they have some legal knowledge, they still need to rely on professional legal services and legal aid personnel once they encounter legal problems in the practice of innovation and entrepreneurship due to the lack of legal professionalism. Therefore, colleges and universities need to build innovation and entrepreneurship legal services and legal aid bases, through which students can be provided with free or low-cost legal services and legal aid. In this process, students' legal awareness can be further enhanced, and students can realize the important value and significance of law in resolving risks and solving practical problems. For example, when college students begin to practice innovation and entrepreneurship, due to their lack of corresponding funds, there is often a funding gap when they need legal services, resulting in their inability to obtain effective legal support and assistance. In view of this situation, colleges and universities can strive for the help of social resources, and pay attention to tapping their own resources so as to ensure that college students can obtain sufficient legal services and legal assistance, help them resolve the problems and risks in the practice of innovation and entrepreneurship, and effectively enhance the effectiveness of legal awareness training. At the same time, as China's current judicial assistance system has been relatively perfect, colleges and universities can strive to extend the judicial assistance system to college students' innovation and entrepreneurship practice so as to further ensure that college students can effectively solve the legal problems and risks faced in the process of innovation and entrepreneurship, as shown in Figure 17.

*4.4. Design and Carry out Practical Application Activities of Innovation and Entrepreneurship Legal Knowledge.* Practice is the source of knowledge. In order to effectively cultivate students' legal awareness in the practice of innovation and entrepreneurship education, teachers must pay attention to the design and implementation of practical application activities of innovation and entrepreneurship legal knowledge, so that students can truly understand the practical application fields and specific processes of legal knowledge and master legal knowledge in practice. Therefore, teachers should reasonably carry out the design of practical application activities of legal knowledge from the specific teaching content and the actual characteristics of students, strive to fully mobilize the enthusiasm of students' participation, and promote students to truly form an understanding and mastery of relevant legal knowledge in the process of participating in practical activities. For example, teachers can carry out mock court activities and create situations with the help of real cases related to innovation and entrepreneurship. In this process, students can play different roles in the mock court so as to mobilize students to actively apply relevant legal knowledge. For example, when teaching the contract law, teachers can introduce practical cases about economic contract disputes, let students carry out role-playing and mock court sentencing activities, and enhance students' understanding and mastery of this part of legal knowledge in this process. As shown in Figure 18.

## 5. Based on Legal AI Data and Algorithms, Cultivate Public Legal Awareness

*5.1. Algorithm Transparency.* In the practical application of internal legal AI, the algorithm is usually in a "black box" state for judicial workers. For the accuracy of the algorithm,

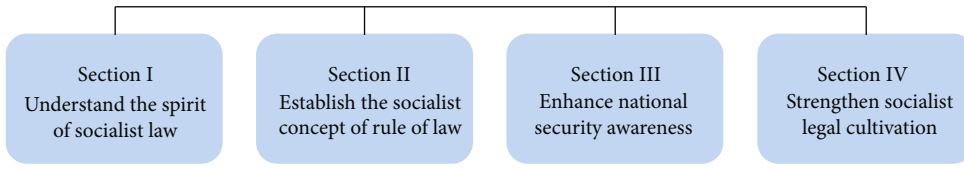


Figure 17: Legal issues and risk aversion diagram based on the perspective of social psychology.

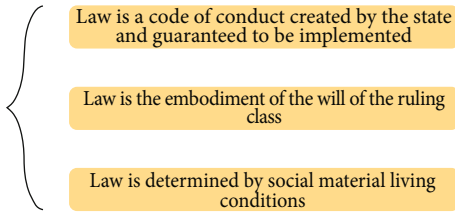


Figure 18: Legal teaching plan based on the perspective of social psychology.

even in different application scenarios, developers will evaluate their models through F1score, rouge and other indicators, but it seems that they can always find a suitable way to prove the efficiency of their models. The generalization ability of a model needs to be tested by practice. There are many unknowns whether the model developed based on past cases is applicable to current and future cases. For the algorithm itself, developers are often vague about the description of the algorithm, or overestimate it. For the protection of its technical intellectual property rights, developers often do not fully disclose the algorithm, and the fierce market competition has led to legal technology companies often treat their core algorithm or main content confidentially, and the confidentiality of the algorithm may even be supported by the law. In the case of Wisconsin v. Loomis, the defendant believed that there was algorithm discrimination in the algorithm of compass system and requested that the algorithm be made public However, the final decision of the Federal Supreme Court held that the system was neutral and exempted the algorithm developers from the obligation of disclosure. For example, the formula for calculating the compensation amount of medical expenses:

$$A = C + V + B. \tag{1}$$

In Formula (1), TCM treatment fee is $A$, the hospitalization fee is $B$, the treatment fee is $C$; and the actual medical cost obtained is $V$. The formula for calculating the compensation amount of work delay is:

$$z = r\left(\frac{\text{yuan}}{\text{day}}\right) \times t(\text{day}). \tag{2}$$

In Formula (2), the compensation amount of delay fee is $z$; the victim's salary is $r$; and the delay time is $t$.

*5.2. Open Algorithm Source Code.* Because there are usually random processes in artificial intelligence algorithms, even if the algorithm is completely transparent, researchers may have many unpredictable changes in the final model results when reproducing the algorithm with different data sets, different parameters, and different training environments. Even if a unified data set, parameter set, and exactly the same training environment are used, the results may be inconsistent due to the internal uncertainty of the algorithm Therefore, some people believe that the requirement of algorithm transparency is superfluous. However, the author believes that the objective difficulties of algorithm recurrence in the above practice should not be the legitimate basis for algorithm nondisclosure. At present, algorithm transparency has become an objective requirement in many scenarios of AI practice. In order to regulate the power of the algorithm and make the developers and users of the algorithm bear relatively balanced risks, the principle of transparency has been paid more and more attention in algorithm development. Because it is difficult to completely eliminate the information asymmetry between developers and users, the principle of transparency can make up for the "digital divide" between decision makers and counterparts, reduce the algorithm monopoly and information monopoly caused by information asymmetry to a certain extent, and then protect the rights of users. For example, the formula for calculating the compensation amount of nursing expenses:

$$G = n\left(\frac{\text{yuan}}{\text{day}}\right) \times t(\text{day}) * f. \tag{3}$$

In formula (3), the compensation for nursing expenses is $G$; the nursing standard is $n$; the nursing period was $t$; the compensation for nursing fee is $f$, and the algorithm flow of the intermediate processing process from input to output is made public so that the decision-making object can fully know and recognize the legitimacy and rationality of the algorithm. Or it can be calculated by:

$$G = \frac{-n \pm \sqrt{t^2 - 4f}}{2n} \tag{4}$$

According to the public policy committee of the American computer society, it further refines the transparency of algorithms and puts forward more detailed provisions, such as the principle of knowing, the principle of inquiry and appeal, the principle of algorithm responsibility identification, the principle of interpretation, the principle of data source disclosure, and the principle of auditability. The EU is also actively exploring in this field. According to Article 71 of the General Data Protection Regulation (GDPR), "in any case, appropriate safeguards should be taken, including the right to provide specific information to the data subject

and the right to human intervention, so as to express the views of the data subject, obtain the right to interpret the decision and question the decision after evaluation." It can be seen that how to ensure the transparency and openness of algorithms in practice has become the focus of attention of all countries. The law, which takes the pursuit of fairness and justice as the primary value, will inevitably put forward stricter requirements for the transparency of artificial intelligence algorithms.

*5.3. Interpretable Legal AI Algorithm.* If interpretability is the basic guarantee of the credibility of a legal AI algorithm, then the transparency of the algorithm is the way to realize its credibility. For public authorities such as the court, the transparency of the algorithm is the objective requirement for determining the allocation of responsibility and risk. For researchers, even if there is only a theoretical possibility for the complete reproduction of the model, this does not mean that the need for algorithm transparency is nothing. In addition to the recurrence of the algorithm, the transparency of the algorithm provides a practical basis for others to demonstrate the usability of the algorithm and also facilitates other researchers to conduct more in-depth research on this basis. For the general public, the transparency of the algorithm obviously does not enable them to understand the specific methods adopted by the model and the advantages and disadvantages of the methods, but the legal artificial intelligence technology applied in the public domain, as its users, obviously has the right to know its algorithm. Therefore, the transparency of artificial intelligence judgment algorithm is the key factor for it to obtain the support of the public, courts, and researchers and constantly update and iterate. It shows a series of different graphs of the relationship between the development process of knowledge and structure and uses visualization technology to describe knowledge resources and their carriers, mining, analyzing, constructing, drawing, and displaying knowledge and the relationship between them. Specifically, knowledge atlas is a large-scale, visual semantic network rich in concepts, entities, and relationships, which draws complex domain knowledge through data mining, information extraction, and other technologies. A knowledge map requires a higher degree of granulation of data and models. The finer the model, the more detailed the data, the better the effect of knowledge map. Take dangerous driving cases as an example. Although the cause of action of such cases is simple and the number is huge, the degree of graininess in the knowledge map is still very high, and there are quite a number of factors to be considered, such as death caused by driving after drinking. If this point is ignored, it is difficult to obtain the desired effect by using the knowledge map with low degree of granulation to predict the result of the case.

Knowledge mapping technology can effectively structure legal data, which is also the mainstream direction for many researchers to study the structure of judicial data. However, the development of knowledge atlas involves the intersection of legal knowledge and computer knowledge, and a large number of manual annotations are needed in the early stage of development. At present, when developing the legal knowledge map, relevant institutions often need to recruit a large number of personnel with legal background to manually label, which is also the crux of the current legal knowledge map technology that makes it difficult to achieve leapfrog development. If more scientific and effective research can be carried out in the future and more efficient annotation methods can be adopted, it is reasonable to believe that knowledge atlas technology can enable the structure of legal data so as to promote the leapfrog development of legal artificial intelligence. In the process of developing algorithms, researchers usually give priority to improving the accuracy and rationality of algorithms, or the development idea is "effect oriented".

The legitimacy of this approach lies in if the artificial intelligence algorithm with a large difference in the matching degree with solving practical problems (such as data set mismatch) is rashly used in judicial practice, the final training result may be an "under fitting" inaccurate model. Such artificial intelligence cannot improve the efficiency of judicial practice, but may interfere with the normal judicial process and affect judicial justice. On the other hand, high accuracy does not mean that the effect must be good but only indicates that the parameters of the training model are more suitable for the characteristics of the test set data. Because the existing artificial intelligence effect evaluation standards mostly rely on the predesigned test set, in a more general scenario, the actual performance of the model may be far from the test results, or even produce errors, that is, it may produce "over fitting" of the model. In the application scenario of legal AI, the "over fitting" of the model means that the mapping law fitted by the model is far more complex than the law familiar to legal experts, which makes it difficult to visualize the correlation between input and output. How to balance the accuracy and rationality of the model in order to get the ideal result is a problem that the developers of artificial intelligence in the field of justice should pay attention to before large-scale application of algorithms.

## 6. Conclusion

In a word, the positive role of developing legal awareness in college students' innovation and entrepreneurship education in promoting students is to form good legal thinking, respect for the law, abide by the law and apply the law, and improve students' comprehensive innovation and entrepreneurship practice ability. Colleges and universities should strengthen their ideological understanding and face up to a series of problems existing in the current innovation and entrepreneurship education, such as the failure to pay due attention to the cultivation of legal awareness, the failure to build a sound innovation and entrepreneurship education curriculum system, and the lack of professional innovation and entrepreneurship legal awareness training in teachers. By implementing a series of strategies, such as building an innovation and entrepreneurship education curriculum education system including legal courses, building innovation and entrepreneurship legal awareness, cultivating professional teachers, carrying out innovation and entrepreneurship legal services, building a legal aid base, and designing

and carrying out innovation and entrepreneurship legal knowledge practical application activities, we can effectively promote the solution of the problems and strive to cultivate students to form good legal awareness, legal thinking, and legal literacy so as to promote their innovation and entrepreneurship practice in an orderly manner and promote the full realization of their personal values.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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*Retraction*

# Retracted: The Protection for Personal Information Based on IoT Network Management and Data Sharing in Big Data Era

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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*Research Article*

# The Protection for Personal Information Based on IoT Network Management and Data Sharing in Big Data Era

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A few decades ago, the protection of personal information was basically in the state of none, with more and more problems due to personal information, such as the use of information to achieve fraud and the use of false information to publish bad information, causing great property losses to people's lives. People only began to have awareness of the protection of personal information. After this, the civil law protection of personal information in IoT management has been developed. In this paper, we present a comparative analysis of the application of data sharing and protection of personal information based on the Internet of Things (IoT) management, as well as the sharing mechanisms used in data information, the protection of information security, and the drawbacks, which explains the safety information analysis of personal information in the case of data sharing and the calculation method used by the IoT in data sharing. A comparative study found that on the basis of IoT management, the security and concealment of personal information have been improved by about 20%. In practical application, IoT also brings great convenience in information data sharing. It increases the efficiency of operation, reduces losses, and to a certain extent guarantees the security of people's individual information.



## 1. Introduction

With the establishment of the socialist system in China, the Chinese Communists have been relentlessly exploring the concept of economic and social development. Broadly speaking, the development philosophy of the CPC has undergone a transformation from economic development, which focuses on the growth of material wealth, to scientific development, and then to shared development. The concept of shared development is a new development concept introduced in response to the current real-life problems that need to be solved in China, reflecting the maturity and perfection of China's development concept, which is a new leap in China's development concept.

The degree of data sharing reflects the information construction status of a region or a country, and the more channels for data exchange, the higher the information construction status. To achieve data sharing, it should first created a unified set of rules for data exchange; there are standard data schemas, rules for creating data usage, and the scope of data usage, data transmission channels, etc., with standardized data patterns, so that users can use the prescribed data templates as much as possible. Secondly, it needs to create data usage rules and formulate corresponding data copyright protection, property rights protection regulations, and sign data usage agreements between relevant departments, so as to break through the information shelter between departments and regions and achieve true information interoperability.

Data is an asset of the enterprise, especially the enterprise through the use of data skills, which will allow the enterprise to find newer resources and capital in addition to traditional resources such as labor, goods, and property, which promotes the acceleration of the digital transformation of the enterprise. There are two points in helping enterprises digital transformation: one is a set of core applications within the enterprise, as a daily use operation; secondly, it has to effectively control and communicate with the outer customers and the merchants responsible for supply, using various skills to collect a large amount of data from the real world and analyze it to achieve

information exchange and resource sharing. In this paper, it integrated the relevant social needs, conduct business interactions, and use data to confirm and make decisions to achieve data innovation for the One Economy template.

## 2. Related Work

Due to the changing sensitivities and guidelines described in technical regulations, there is a growing interest in environmental respect among consumers, regulators, and researchers. In this case, the European Union (EU) Directives 2002/96/EC and 2003/108/EC control the management of electrical and electronic equipment (WEEE). Gamberini, Gebennini, and Grassi proposed an innovative model for restoration network management, including a case study [1]. Much effort has been invested in building fast and adaptive management solutions to support self-help, self-managed networks. Considering the high complexity of today's network environment, with little credentials for its use in practical management solutions to achieve autonomous networks, Ayoubi et al. is the latest advancement in network softwareization and programmability through SDN and NFV [2]. Reconfigurable computing systems, intelligent automated systems, and cognitive and parallel programming systems that use very complex resources or patterns for communication require a well-structured and carefully implemented system. Modieginyane, Malekian, and Letswamotse implemented a software-oriented networking environment through a software-defined wireless sensor network (SDWSN) approach combined with discrete event, simulation (DES), and a highly scalable software-defined network (SDN) controller [3]. Mykhaylenko, Waehrens, and Slepniov discussed operational strategies related to the link between configuration and capabilities, especially with regard to internationalization [4]. Traditional server-client MCS architecture often suffers from high operational cost of centralized servers and poor scalability; Changkun proposed a new P2P-based MCS architecture in which sensing data are stored and processed in local user devices and shared among users in a P2P manner [5]. According to the current situation of the medical industry, it is difficult to validate, store, and synchronize clinical data, and there are many limitations for doctors and even researchers to access and share data. Xue, Fu, and Wang proposed a blockchain-based medical data sharing model with the advantages of decentralization, high security, collective maintenance, and tamper-proof [6]. Sanderson et al. assessed the willingness to participate in biobanks using different data sharing models, which showed that the willingness to participate in biobanks and other large research projects would be higher in more rigorous situations. He also assessed perceived benefits, concerns, and information needs [7].

## 3. Relationship between Domestic and International Data Sharing Profiles and Civil Law

*3.1. Overview of Data Sharing at Home and Abroad.* Data sharing is a cumbersome system that has generated questions and research that has spanned a wide range of countries; the questions are as follows: how to make the information shared by the data become concealed and authentic, how to ensure the authenticity of the information in the transmission of information, and how to ensure the safety of citizens' property has become a major issue of common concern in the world. From the status of global data sharing presentation, their research data deposition, preservation, and utilization are characterized by the following: research data deposition and management become current grassroots tasks, which are shared by various observatories supported by the government; data precipitation and inquiry programs are carried out simultaneously: data obtained from important scientific research projects supported by the state are provided for sharing after the personnel of the project have first thought about the research for a certain period of time, and a perfect specification template is developed to open a discussion on the concepts and methods of data sharing; the introduction of high technology has led to the use of data so that data resources can play their proper role in the advancement of science and social and economic development [8].

From the 1950s onwards, data sharing spread globally to accommodate the need for extensive research. Developed countries and many international teams are planning and acting to create systems for the management, research, and use of scientific data in order to stimulate progress in scientific research and major issues such as resources and the environment. It is mainly aimed at the questions brought by globalized data sharing and the drawbacks in data sharing, which is conducive to the development of data sharing by scientific and technological personnel to get more use; for example, in the late 1960s, ICSU created the Global Data Center (WDC), in which many countries participate and have grown to nearly 50 disciplinary centers, making information collection and storage exchange to global internationalization. It has become a national center for all disciplines and is responsible for the performance of the national data research and service center in this discipline, as well as a member of the International Data Core. The current direction of global development is to create a global and territorial data network and to build a part of the core data and information sites in other developing countries under the premise of observing data rules. It is mainly to collect and preserve information, to improve and strengthen the information network, to increase the volume, and to use the national data network board. After a period of struggle, the basic conditions for modern data sharing have been established in each sector, as well as the establishment of its own information network [9]. Through these information networks, a simple data analysis and application organization has gradually been formed, which provides favorable conditions for interscientific and interdisciplinary data sharing in China, and also gives a guarantee for the realization of the project. At the same time, with the help of the state, we have further created a system of application and data analysis that can provide services to domestic and foreign users, and we have shown our value in the development of scientific progress and international information interaction.

To further create a scientific data research system and sharing system and lay a solid theoretical foundation for development. Existing major systems mainly focus on adopting, integrating, using, and exchanging. Each system has a group of experienced technicians in data management and analysis. They have rich data management experience, and basic

knowledge, and they all have computer instruments of different grades. Many systems come with client servers and LAN systems, and some have gone into the Internet [10]. For example, the public communication network and combined data exchange network of the Ministry of Posts and Telecommunications established by the state and the blueprint of the information superhighway proposed by the state have made remarkable contributions to the technology on data exchange, and sharing is shown in Figure 1.

*3.2. Data Sharing and Personal Information Security Based on Civil Law.* In the information age, network sharing is entering people's lives and their lifestyles are changing, and network instruments have greatly facilitated our lives and work [11]. However, there is a connection between network sharing and people's personal information. Using network technology, the dissemination of information is accelerated, fraud text messages on mobile phones, authorization information of various APPs, and various unknown phone calls received, and even some fraudulent text messages are directly related to our bank card information, and network data is slowly invading our personal information and threatening our information security. Because of the virtualization of the network, if the network information leakage caused by fraudulent behavior, it is difficult to trace the individual, but also for the network information, security brings a certain risk. In the context of data sharing, the sources of network information have obvious falsity and instability, and the content is relatively complex, with strong differentiation and diverse complexity [12]. Because of the special nature of data sharing, the structure and characteristics of data sharing are obviously different, and the data structure and data type are no longer enough to judge the desecurity factor compared to the traditional network, and the database of resources is not easy to find. In terms of traditional data content, most of them are read through intelligent analysis and judgment of the source of the information, and the relevant technical staff can obtain rational analysis of the resources from the network technology to determine the source of the data. The dissemination channels of network information are shown in Figure 2.

The difference between traditional network data and modern network data lies in whether the data are integrated and analyzed through new network data and new network structures to form a relatively large database [13]. The content of the database is relatively cumbersome, and the user orientation can be quite diverse. It is not necessarily necessary to extract data from the structured network, but it is possible to obtain information from the unstructured network. This has led to the development of the entire network data slowly to the terminal, into a whole network, in the era of data interoperability. It can be accessed through the data terminal to check the information needed; the scope of access is relatively wide; the normal basic information of citizens can be accessed. Through the investigation, it is found that half of the information in the database in the network structure is incomplete and lacks logic, and the rigor and integrity are not perfect, so it is easy to lead to information leakage, which is also its disadvantage. Because this information sharing is public and open, it also leads to the information of citizens being public and not confidential. In the case of data sharing, accidents caused by information leakage can easily occur, and the public property and health of citizens may be spied on by unscrupulous people, which can lead to crimes, and this is also a disadvantage in the case of data sharing [14].

*3.3. Relationship between Network Data Security and Citizens' Personal Information Security.* There are many ways of data sharing in the data system, such as electronic terminal mobile terminal, intelligent terminal, and other methods. Moreover, some of the contents on the network information belong to the real information, which makes it easy to have dangerous accidents. There are many unscrupulous people who steal personal information through the virtual environment of the network and provide false information to customers by providing services, which causes harm to citizens' money. In this way, the enterprise through the platform reserved telephone information and then communicate with customers; it is easy to lead many citizens to be cheated and seriously affect the green public network environment [15]. Unscrupulous elements mainly focus on fraudulent money; they also analyze and understand through the network information platform to determine the daily behavior of most citizens and places of access, as well as the consumption situation. Moreover, unscrupulous people can learn about users' daily behavior, consumption, geographic location, etc., through various channels. Therefore, for the sharing of network data and information leakage, there is a relatively large risk for users. Cyber crooks can use this information to process citizen data and then analyze it accurately, leading to the exposure of citizen information [16]. We also need to protect citizens' personal information according to the law, as shown in Figure 3.

*3.4. Data Sharing and the Sharing Mechanism of Cloud Data.* Under the premise of cloud computing, data information is widely used, and the capacity of data is gradually expanded to form decentralized storage. Cloud computing is scattered, malleable, and practical in analyzing data, all of which are outstandingly demonstrated in cost forecasting [17]. In the decentralized data system, the most prominent characteristic of it is to have data redundancy under regular circumstances. The problem of redundant data configuration in decentralized storage under cloud computing is of great significance to ensure the robustness of data and also forms a hot topic for deep investigation by related scientists at present. Previously focused on the problem of redundant data mass configuration for big data, it mostly using support vector machine algorithms as the main approach. This method specifies the fragmentation update factor and dynamic cost factor. Based on the selection of the minimum cost of data movement nodes, it uses parameter iteration to estimate the cost of segments from scratch to nodes and mostly uses dynamic class core allocation to classify big data. One of them is to categorize the redundant data in the decentralized storage of big data in cloud computing, and the other is to divide the redundant data paragraphs after classification. This improves the configuration accuracy and configuration efficiency of redundant data, which is then transformed

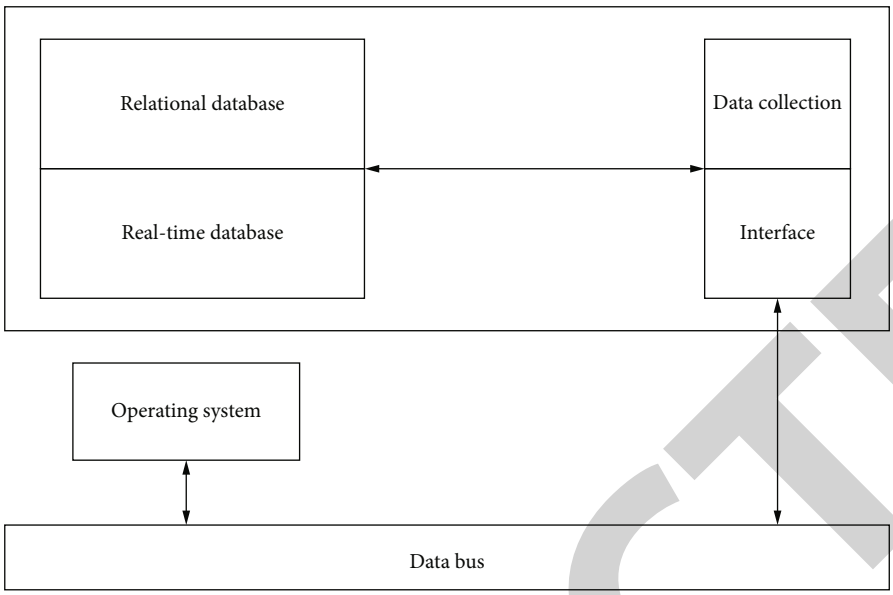


Figure 1: Framework diagram of IoT database.

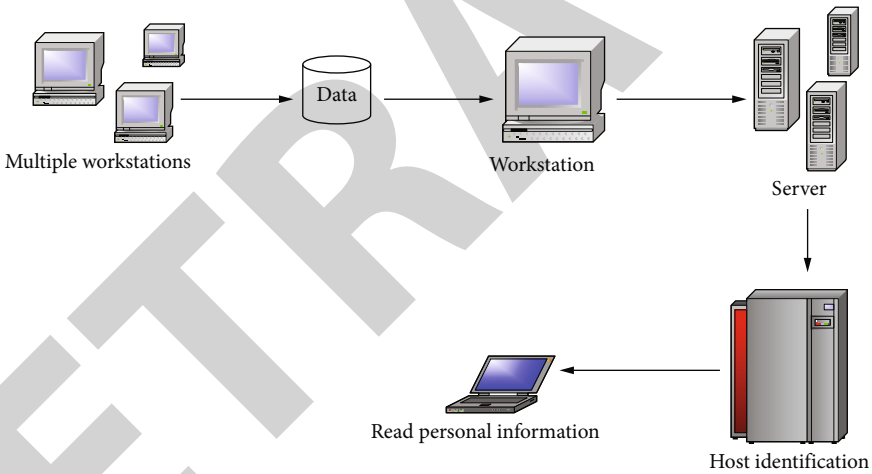


Figure 2: The dissemination path of network information.

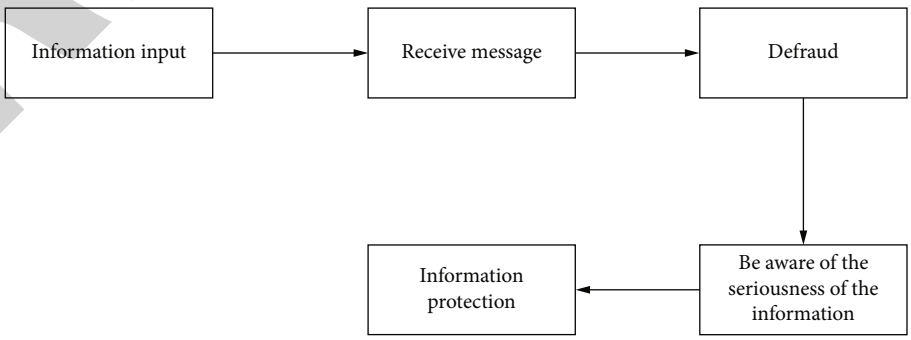


Figure 3: Protection of personal information according to law.

into finding the best solution to the plane problem after the categorization operation in the data.

$$R(\beta) = \sum_{j=1}^{p} \beta_j - \frac{1}{2} \sum_{j,k=1}^{p} \beta_j \beta_k Z_j Z_k \left( y_j \bullet y_k \right), \tag{1}$$

where $R(\beta)$ is the bilevel definition function, $y_j \bullet y_k$ is the vector product, and $Z$ is the categorical definition value; $Z_j$ and $Z_k$ are the categorical definition values of the two vectors $y_j y_k$, respectively; $\beta$ is the proportional mechanism vector; and $\beta_j \beta_k$ denotes the proportional weights of the two vectors $y_j y_k$, respectively. $p$ is the core maximum, and the following conditions must be observed for the plane to find the optimal solution.

$$\sum_{j=1}^{p} Z_j \beta_j = 0, \tag{2}$$

$$\beta_j \geq 0, j = 1, 2.., p. \tag{3}$$

Assuming that the redundant data in the distributed storage of big data under cloud computing causes special nonlinear transformation, it is required to use the inner product $L(y_j \cdot y_k)$ to replace the product in the optimal classification function; then, the optimal classification plane solution problem is transformed into the objective formula:

$$R(\beta) = \sum_{j=1}^{p} \beta_j - \frac{1}{2} \sum_{j,k=1}^{p} \beta_j \beta_k Z_j Z_k L\left( y_j \cdot y_k \right). \tag{4}$$

Assuming that Formula (5) is the best categorization function of Formula (4), then:

$$g(y) = \operatorname{sgn} \left( \sum_{j=1}^{p} \beta_j Z_j L\left( y_j \cdot y_k \right) + c' \right). \tag{5}$$

In the formula, $g(y)$ is the optimal classification function, and $c$ is the type attribute. Through this function, redundant data paragraphs can be obtained. The optimal classification plane algorithm can classify two types with differences. However, the redundant data in the distributed storage of cloud computing big data belongs to multiple categories, so it is necessary to first convert the redundant data classification in the distributed storage of cloud computing big data into a variety of optimal classifications, and then solve them one by one, and finally obtain the classification results of redundant data in the distributed storage of big data under cloud computing. Currently, the two classifications are generally single-to-multiple or single-to-single classification [18]. Because the configuration of redundant data of big data under cloud computing is not small, and the special values of redundant data are too many, it is necessary to use a single-to-single classification method, to run the transformation measures of redundant data classification in the distributed storage of big data under cloud computing. Figure 4 shows the flow chart of redundant data configuration for distributed storage of big data under cloud computing:

The above mainly solves the configuration process of a redundant data segment in the distributed storage of cloud computing big data, establishes configuration strategies and estimation criteria, and obtains the optimal redundant data configuration strategy. The cost formula is to combine the unified information of each item to estimate the communication value of redundant data. Its value formula is:

$$sum \cos t = g(y) \sum_{F} \operatorname{cost}\left( F_j \right). \tag{6}$$

In the formula, $sum \cos t$ represents the communication cost corresponding to the overall data configuration strategy, $g(y)$ is the classification result of redundant data in the distributed storage of big data under cloud computing in the previous section, and $\cos t(F_j)$ is the communication value corresponding to the configuration strategy in data paragraph $F_j$.

$$\cos t\left( F_j \right) = T_Q\left( F_j \right) + T_U\left( F_j \right). \tag{7}$$

$Q, U$ in the formula represents the classification corresponding to the configuration strategy of different data paragraph $F_j$, and the communication value is expressed by $T_Q F_j$, $T_U F_j$, and their calculation formulas are:

$$T_Q\left( F_j \right) = \sum_{Q} \sum_{S_k} delay(S_k, S_c)_{\min}, \tag{8}$$

$$T_U\left( F_j \right) = \sum_{U} \sum_{S_k} \left[ \sum_{S_c} delay(S_k, S_c) \right]. \tag{9}$$

Among them, $S_k$ is the site where things Q and U appear, and the storage section $F_j$ is set to $S_c$ in the configuration policy. If the configuration strategy has redundancy, $S_c$ is changeable, and the corresponding value of $delay(S_k S_c)$ is also changeable. In formula (7), $dalay(S_k S_c)_{\min}$ is the corresponding minimum value, and $\sum_{S_c}(delay(S_k S_c)$ is the algebraic sum of the values.

According to the above classification results and classification process, it is concluded that the redundant data configuration strategy implemented in this paper is as follows:

(1) Set the evolution coefficient

According to the essential problem, reasonably set the evolution coefficient of redundant data given in advance; for example, $np, ng$ represents the number of redundant data populations and the stop evolution coefficient, respectively.

(2) Encoded into a string of bits

The result of the problem, as the configuration of paragraph $F_j$ in the data, is expressed in binary, assuming that $F_j$ is classified as station $S_k$, and the $k$th number in the structure is obtained. Suppose it is "1," if the corresponding digital structure is not obtained in the structure, then it is

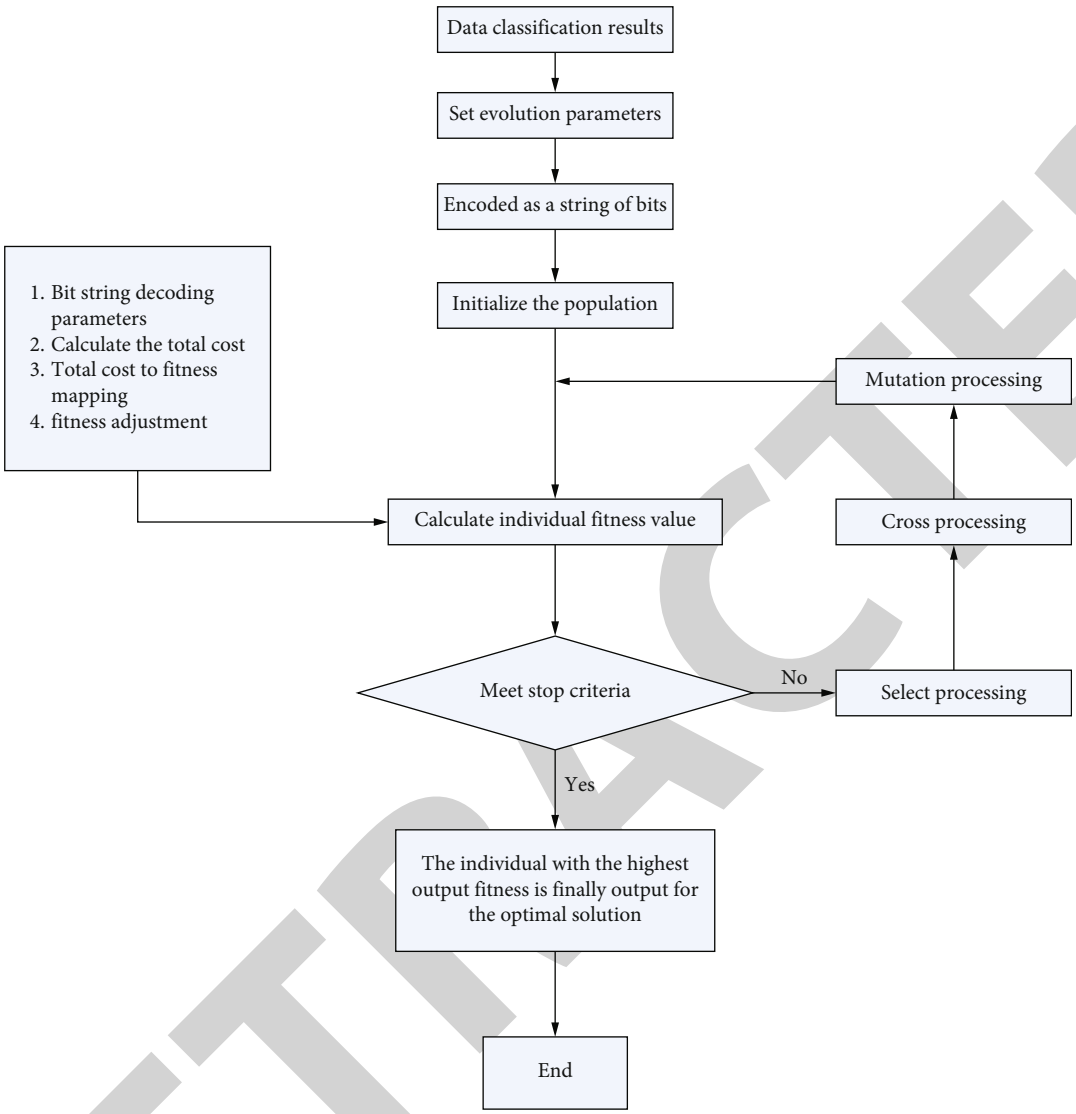


Figure 4: Flowchart of big data distributed storage redundant data configuration under cloud computing.

"0." It is calculated that there are $(2^m - 1)$ kinds of corresponding structures in paragraph $F_j$, and the estimated total value of string bits is $\cos t(F_j)$, and the number of added data paragraphs is $q$. Then, in this overall structure, it can be turned into a $q$-row $m$-column table, a total of $(2^m - 1)$ types, and each type has a different and special total communication value.

(3) Initialize the group

Due to the characteristics of the original group of *sumco* and efficiency redundant data, the breeding method is used in the redundant data allocation algorithm of the genetic algorithm to implement the originalization. In the first step, $np0$ individuals are randomly formed, and in the second step, $np$ individuals with the smallest corresponding communication value are selected to form the original population. This method can ensure that the original internal individuals of redundant data reach a higher level.

(4) Calculate the individual fitness value

Formulas (7), (8), and (9) obtain the communication value corresponding to each individual in the redundant data group one by one, and the reciprocal of the value is the value of the individual's fitness.

(5) Selection processing

The redundant data allocation algorithm based on genetic algorithm combines the best storage and data selection to implement individual sampling selection processing. When the fitness of the best individual in the offspring is not as good as that of the parent, the best individual in the parent is used to replace the worst individual in the offspring to ensure the stability of the algorithm. In order to establish a relatively stable selection process and prevent a special individual from being excessive in the group, the fitness of individual individuals is judged to obtain a probability value to determine whether it

can be run [19]. The careful steps are as follows: the data distribution of the obtained fitness in the computer data is sorted in order, and the amount of data is $np$; secondly, important parameters need to be set, $p_0$ is $1/np$, and then, the order of individuals is obtained according to the probability. Then, each individual serial number can be expressed as $j_0$, with:

$$p_j = \frac{p_0(1-p_0)^{j-1}}{1-(1-p_0)^{np}}. \tag{10}$$

(6) Interspersed processing

*GA*2 Using the single-point interleaving method under the general constant probability $p_c$ can enhance the running probability of the algorithm.

(7) Alienation treatment

The lack of mature convergence is relatively common in genetic algorithms and belongs to a high probability event. In the previous genetic algorithm, the generally selected value is relatively small, and the probability of alienation is also reduced accordingly. If there is early convergence, it will be difficult to obtain the local optimal solution. In order to implement and automatically become multiple new individuals, the redundant data allocation algorithm of the genetic algorithm can quickly increase the complexity of the redundant data group and help the group to get rid of the premature convergence, so as to obtain the expected results. Using the method of alienation processing, it is possible to check whether the maximum fitness value and the average fitness meet the standard, and whether to converge, $f_{\max} < f_{vag}$. Assuming that the density factor is $t$, it represents the mean situation, between 0 and 1. If the value is close to the median, the probability of alienation will be too high. After reaching the numerical requirements, select a probability $p_{\max}$ that is 5 times greater than $p_m$ from the numerical values and perform alienation processing. If not, the alienation process will be implemented according to the original probability of $p_m$. If $p_{\max}$ increases, it can also indicate that the operation is stable, and an appropriate reduction in the convergence rate can be used. If $p_{\max}$ is 0.5, the system will convert to random query [20].

(8) Judging whether the stopping criterion is met

If evolutionary algebra *gen* is less than evolutionary algebra *ng*, the system will return to the previous step and re-selection. If *gen* is not less than *ng*, then get the last system data, then jump to the last step. The individual with the highest final fitness of the decoded data will finally obtain the optimal configuration method of data segment $F_j$. Aiming at the problem of slow exercise rate of large-scale experimental samples, a center calculation method for the vertical bisector of the center line segment is proposed. According to the distance samples from each experimental data to the vertical bisector, save the samples to obtain a new training book. The new training book is used to replace the original training book, and SVM training is implemented to achieve the purpose of improvement [21]. In the support vector machine algorithm, different hyperplanes need to be solved for the classification and solution of the training book. In order to implement this operation, the planes are first normalized. Let $\zeta = 1$, so that the closest vector samples satisfy the following conditions (equal when $\zeta = 1$):

$$\left(\omega^T x^*\right) + b \geq +1, y = +1, \tag{11}$$

$$\left(\omega^T x^*\right) + b \leq -1, y = -1, \tag{12}$$

In the formula, $\omega$ is the data vector of the system plane, $b$ is the numerical item of the rule function, $y$ is the type sample item, and $x^*$ is the purpose support vector.

If the distance between the hyperplane and the target support vector is $1/\|\omega\|$, then the original problem can be transformed, so that the solution of $y$ is a convex programming problem.

$$Min\Phi(\omega) = \frac{1}{2}\|\omega\|^2, \tag{13}$$

$$s.t. y_i\left(\omega^T - b\right) - 1 \geq 0, i = 1, 2, \cdots \tag{14}$$

Bring it in and get $W = \sum_{i=\Omega_{SV}} \alpha_i^* y_i x_i$. After judging the plane of vector $\Omega_{SV}$, it satisfies the system space of the vector in its interior, and after operation to Lagrange $\alpha_i^*$, the value of the support vector is not 0. By calculating the value of the purpose support vector, it is judged whether the available classification surface can be constructed [22]. After running the classification algorithm, classifying through the classification surface, and then substituting the formula into the above formula, the indicator function in the following formula can be obtained:

$$f(x) = \text{sign}\left[\sum_{i\in\Omega_{SV}} y_i \alpha_i^* (x_i, x) - b^*\right]. \tag{15}$$

It can be seen that the training book of the support vector machine is only related to the support vector and has nothing to do with the nonsupport vector. The support vector is often at the edge of the sample, so the boundary vector can be extracted as a new training book for testing while ensuring the classification ability of the support vector machine, thereby improving the classification probability. To solve the "curse of dimensionality" problem, a new concept function kernel function is introduced. By solving the kernel function $K(x_i, x)$, the product of $x_i$ and $x$ in the actual problem of *wolfe* is replaced by $K(x_i, x)$. By introducing a new kernel function $K(x_i, x)$, the discriminant function can be:

$$f(x) = \text{sign}\left[\sum_{i\in\Omega_{SV}} y_i K(x_i, x) - b\right]. \tag{16}$$

By introducing a kernel function, the original problem can

be extended to a high-dimensional space by means of a product in the calculation process.

*3.5. Disadvantages of Data Sharing.* The disadvantages of data sharing include high difficulty in data control, instability of data storage parties, wide range of data sharing fields, and data security risks. Data sharing covers a wide range of people, and it controls a large number of people. Data sharing relies on the control of data. However, the instability of the data storage party increases the difficulty of data control and reduces the data ontology's ability to control data. In addition, data sharing has high technical requirements for data controllers; data controllers should have the capabilities of data storage, security assurance estimation, skill processing, etc.; and the data sharing ontology has certain verification tasks for information recipients to prevent data problems [23]. However, due to prescriptive financial considerations and lack of positive incentives, most data controllers often ignore data risks and share data. When the data is shared beyond the original amount of data storage, most of them are reluctant to obtain the approval of the data ontology again. The sharing of privacy policies on 100 platforms is shown in Figure 5:

Data sharing accelerates the generation of data rationality errors and data discrimination. Data is more rational, but data is not necessarily conclusive, and data discrimination caused by data errors is more difficult to change. Based on the judgment of "data portrait," most of the enterprises will become the situation of big data killing, price financing contempt, and so on. Even when the relevant data of the data ontology has changed, the data portrait still exists, making it difficult to solve the "data problem."

## 4. Comparative of IoT Management Based on Data Sharing

As information becomes more and more shared and simplified, we will gradually show some problems in the management of the Internet of Things, such as the risk of personal information leakage on the platform, the lack of concealment of the platform's own information, and the imperfect management of the Internet of Things. Personal information is no longer safe, which is also a concern for many people. In the case of data sharing, it is also necessary to strengthen the confidentiality and confidentiality of personal information. Under the same circumstances, whether the information of the Internet of Things is trustworthy, will it be more secretive and secure. The experimental comparison of this result is shown in Figure 6:

Through comparative research, it is found that in the management of the Internet of Things, the safety factor between groups and enterprises is higher, with an increase of about 20% year-on-year. In the case of data sharing, enterprises and the masses will become more secure between individuals, and you can rest assured that there will be a layer of protection in the transmission of information. At present, problems caused by personal information leakage are also generally increasing. Strengthening personal information and protecting oneself is also a major task of IoT information management.

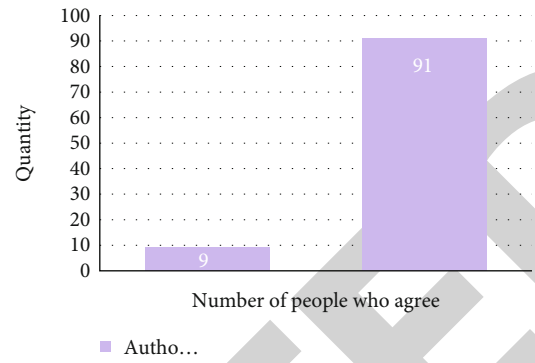


Figure 5: 100 platform privacy policy sharing and utilizing special authorization.

The era of data sharing has indeed brought great convenience to people's lives, but it has also made a lot of information public. More and more people do not carry cash but pay through a treasure, a letter, etc. But it does not take into account why you need your location to turn on the phone's lighting or read your address book when you turn on the phone's radio. Many apps even automatically read your mobile phone information, positioning, etc., by default, which undoubtedly makes the information transparent. We have also become "transparent people," and then, our own information is exposed on major data platforms, followed by telecommunication fraud, privacy invasion, telephone harassment, advertising push, etc. These leaked information, on average, everyone has four pieces of relevant information, which makes people shudder, and the economic losses caused by them are also immeasurable. A comparative analysis of this aspect and IoT management is made, as shown in Figure 7:

In contrast, IoT management reduces the incidence of accidents and minimizes economic losses. The economic loss from telecommunication fraud has been reduced by about 25%, the incidents of privacy violations have also been reduced by 15% in the same year, and the amount of harassment by phone and text messages has also been reduced by 20%. It is not difficult to see that the management of the Internet of Things does help a lot in information security, but there are still many that have not been completely eliminated. To reduce people's daily troubles at the social level, in the era of data sharing, we should not be greedy for petty cheap, do a good job of self-economic prevention awareness, learn more knowledge, and minimize unnecessary economic losses.

In modern transportation, there are many traffic incidents every day. In the case of data sharing, information communication can be used to solve problems in a timely and effective manner, which brings great convenience to the traffic police. From the integration of data, the information of the upper and lower departments can be effectively unified, and the information of the relationship layer is more closely connected. In the collection of resource information, various data can be submitted and judged at almost the same time, and the traffic police can handle it according to the current situation. To be fair, just and timely, the interoperability of the national traffic police network has strengthened the exchange of information and the handling of special matters, and the mutual

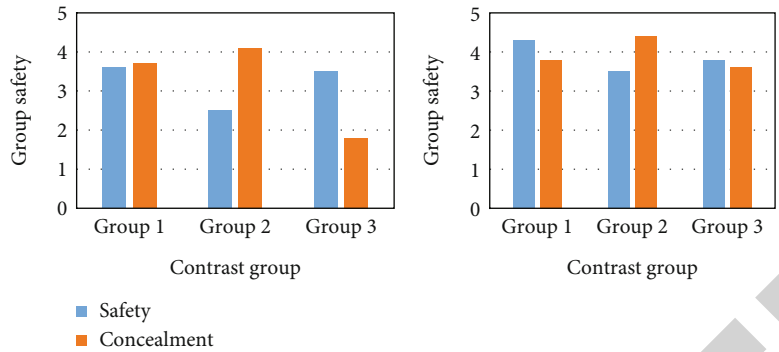


Figure 6: Personal information security comparison.

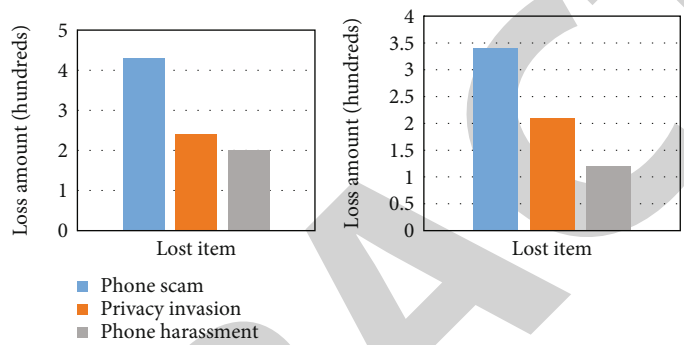


Figure 7: Comparison of economic losses under IoT management.

sharing ability has been improved. As shown in Figure 8, the efficiency improvement of data sharing in transportation is compared.

Through data comparative analysis, it can be found that the data collection efficiency has increased from the previous 55% to 75%. In terms of information integration, it has increased from 67% to 88%, and the overall improvement is still very good, with an increase of about 20%, which reduces the time for information traffic and avoids long-term processing of special problems. The benefits brought by data sharing are still visible. Compared with the situation without sharing, the improvement will be greatly reduced.

Hospitals have a close relationship with people's daily life and play an extremely important role. However, the current medical situation is difficult to be reassuring, and there are often patients who cannot receive timely and effective treatment. The management of the hospital itself cannot keep up with the development of the times, nor can it meet the medical needs of people in the new era. With the continuous deepening of the application of Internet of Things technology in China's medical industry, scientific and intelligent management under computer control has been truly realized. As shown in Figure 9, IoT management allows hospitals to intelligently arrange numbers, establish a communication platform, and compare the optimized management brought by real-time monitoring of drugs and equipment IoT connections.

By comparison, it is found that patients need less time on intelligent scheduling, which is 33% less than before, which also shows that IoT management has indeed brought certain convenience to the hospital and greatly shortened the waiting time. The information exchange between patients has also become faster and more synchronized, and the efficiency has increased by about 43%. Hospitals can also carry out batching, special treatment for different groups of people; distinguish the situation; and make early judgments. For the hospital itself, the use of medical equipment can be accurately controlled, as well as the situation of drugs, can be known in advance. This saves the time for checking out materials and equipment and saves one-third of the previous time compared with the previous year, which greatly facilitates patients and medical staff.

## 5. Discussion

Data sharing has become an indispensable and important technology in today's society, and it has become a beacon for the development of the information age, guiding future generations. Every technology has its pros and cons. The main thing is to improve it slowly in application and improve it gradually in practical problems. In the management of the Internet of Things, it is necessary to continuously optimize the data processing in it. Analyzing the existing problems to reduce harm to citizens, reduce the spread and packaging of false information on the Internet, can strengthen network health management, so that future data sharing will always be at the forefront of technology. In this environment, people will become more and

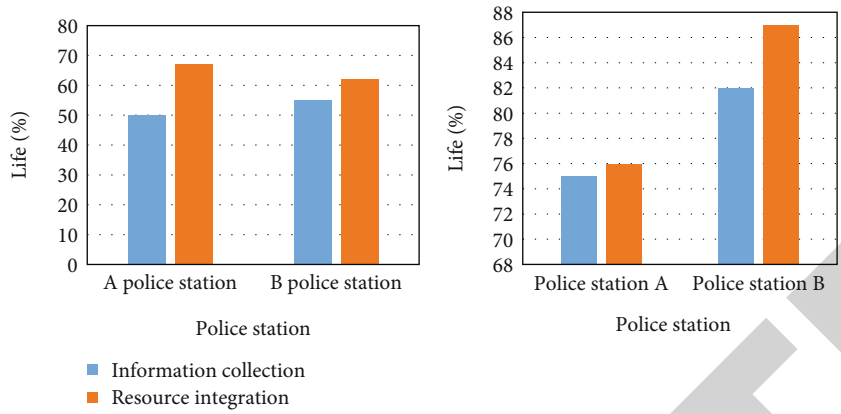


Figure 8: Comparison of efficiency improvement.

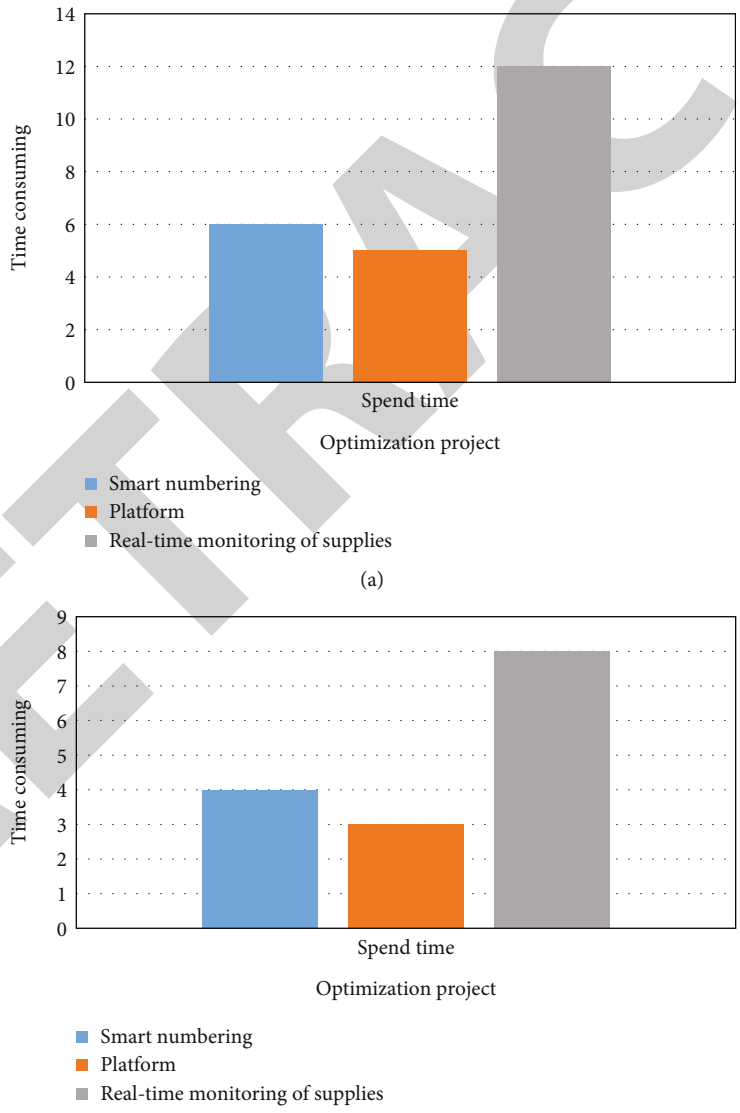


Figure 9: Comparison of management optimization of IoT in hospitals. (a) Original optimization management diagram. (b) Management diagram after IoT optimization.

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*Retraction*

# Retracted: Digital Transformation and Firm Performance in the Context of Sustainability: Mediating Effects Based on Behavioral Integration

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] W. Tang and S. Yang, "Digital Transformation and Firm Performance in the Context of Sustainability: Mediating Effects Based on Behavioral Integration," *Journal of Environmental and Public Health*, vol. 2022, Article ID 8220940, 13 pages, 2022.

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*Research Article*

# Digital Transformation and Firm Performance in the Context of Sustainability: Mediating Effects Based on Behavioral Integration

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In order to promote digital industrialization and industrial digitalization, promote the deep integration of digital technology and real economy, and enable the transformation and upgrading of traditional industries and performance improvement, the method of digital transformation and enterprise performance under the sustainable background based on the mediation effect of behavior integration is proposed. This article adopts the case study method, takes Group A as the research object, and excavates the internal and external motivation and transformation path of Group A's digital transformation by combining the theories of organizational change, process reengineering and enterprise life cycle. Combined with the relevant indicators of four dimensions of balanced scorecard, this article deeply studies the impact of digital transformation on the performance of Group A and its internal mechanism. The experimental results show that compared with Group A before digital transformation, the growth rate of gross margin in 2013 was significantly accelerated, and it has always been in a state of stable growth. However, it fell in 2017, when the year-on-year growth rate of the company's total operating revenue and costs was more than 50%, but the actual growth rate of operating expenses was about 5% higher than that of operating revenue. The comprehensive score of Group A's financial performance in 2012 was very low, which did not achieve the desired effect either in terms of growth ability or business strength. In such a situation, Company A began to implement digital transformation, the overall IT system was to carry out a comprehensive reconstruction in the inventory management mode to implement a new model of "sales to production". By 2013, the financial performance composite score had increased significantly. The comprehensive score of Group A's financial performance in 2012 was very low, which did not achieve the desired effect either in terms of growth ability or business strength. Under such circumstances, Company A began to implement digital transformation, and the overall IT system was comprehensively reconstructed. In the inventory management mode, the new mode of "sales to production" was implemented. By 2013, the financial performance composite score had increased significantly. *Conclusion*. Digital transformation drives the performance improvement of Group A. From the financial perspective, digital transformation has improved the profitability and operation capacity of Group A.



## 1. Introduction

In today's world, the Internet is spreading all over the world and digital technologies are changing faster and faster. The content of people's daily life can be transformed into information and data. In recent years, there is a "happy cloud" that has been written as "artificial intelligence" and is ready to release everything from the emergence of the Industrial Internet to the Internet itself. Scientific and technological tools that get the right information in time and solve problems quickly, smartly, and accurately are constantly updated. Based on information and modern communication network technology, this digital technology continues to enter our lives like bamboo after rain. Technology has not only made people's daily work and life better and more efficient but also started a wave of changing and renewing international business models, developing and optimizing the entire value chain, and radically changing the form of finance [1]. The Digital Economy is a business that follows the development of the times. It is obvious that the global economic

development is slow. With the development of science and technology and changes in people's lives, new elements that affect economic growth are constantly emerging. Despite the challenges and changes, the development of the digital economy remains unstoppable in many countries. As the leader of the global digital economy, the digital economy of the United States exceeded 13.1 trillion USD in 2019 and is still the world leader. In recent years, China's economy has grown rapidly, and China has attached great importance to the development of the digital economy. The scale of China's digital economy reached 5.2 trillion US dollars in 2019, ranking second in the world [2]. In addition, South Korea, India, Canada, Italy, and many others have advanced the digital economy, and the growth of the digital economy is covering the world. How to use modern technology effectively, how to change and adapt ourselves to changes in the external environment, how to improve and fix the importance of value creation, and create new ways of value creation—many problems need to be fixed urgently and need a solution [3].

## 2. Literature Review

Fu believes that digital transformation can improve the dynamic capability of enterprises, then improve the innovation performance level, and increase the R&D innovation capability of enterprises. Individual forgetting and entrepreneurship orientation play an intermediary role between digital transformation and dynamic capability of enterprises [4]. Ng and Yee Found that data-driven reform of enterprise product research and development mode can improve enterprise innovation performance and change product innovation research and development mode through data enhancement driven, data system mixed driven, and system innovation driven to achieve innovation in enterprise research and development process [5]. In terms of research on small and medium-sized manufacturing enterprises, Yin et al. studied the relationship between the implementation of digital transformation strategy and the performance of new product development [6]. With the improvement of enterprises' R&D and innovation capacity, the improvement effect of digital transformation on the performance of development is more obvious [7]. Kesavan et al. conducted an empirical study on panel data and found that enterprise innovation performance can be improved by improving the digitalization level of specific regions, and the influence of regional digitalization level on enterprise innovation performance shows an "inverted U-shaped" relationship, which also revealed that one of the ways to improve enterprise innovation performance is to improve the construction level of regional digitalization platform and strengthen the application ability of digital technology [8]. Shahbaz et al. concluded through empirical study that compared with enterprises that did not implement "Internet +", enterprises that implemented "Internet +" increased their earnings per share by 31% on average and their return on assets by about 24% [9]. With the continuous improvement of digital technology, enterprises have enhanced their capabilities in data acquisition, storage, analysis, and other aspects and created considerable sales performance [10]. Weber et al. analyzed the transformation of Customer Management of SPD Bank and found that the construction of a digital interactive platform in traditional industries fully reflects the Internet thinking, which can concentrate users and continuously interact with each other. One of the ways to improve the core competitiveness of enterprises is to force value innovation, while the transformation and upgrading of customer management in traditional industries requires the innovation mechanism of value creation [11].

## 3. Research Methods

*3.1. Motivation of Group A's Digital Transformation.* As the world economy continues to slump, coupled with the rapid development of Internet technology, many companies are eager to find an effective way to develop in today's situation. In the current domestic environment, whether it is to improve the overall quality of talents, enhance the value of products, reduce operating costs, or expand marketing channels, there is no stable profit model and there may be certain risks, so executives of enterprises dare not take risks [12]. When the digital economy boomed, digital transformation strategy was launched, which is supported by national policies as well as the successful experience of leading enterprises. Therefore, digital transformation has become a good choice for enterprises, as shown in Figure 1.

However, due to the differences in industry, development stages, and awareness level, enterprises in various industries have different reasons for implementing digital transformation. As a traditional household appliance manufacturing enterprise, Group A carries out digital transformation mainly for the following reasons:(1) to meet the needs of the development of the digital economy era, (2) support from national policies, (3) enhance the core competitiveness of enterprises, and (4) reduce product costs and meet the diverse needs of customers.

*3.2. The Process of Group A's Digital Transformation.* The nearly ten-fold growth of Group A's market value is the result of its digital transformation over a decade. So far, Group A's digital transformation has gone through five stages: digitalization 1.0, "Internet +", digitalization 2.0, industrial Internet, and comprehensive digitalization [13].

*3.3. The Path of Group A's Digital Transformation*

*3.3.1. Reconstructing the IT Architecture.* In order to realize effective control and management of the whole business process, Company A implemented digital transformation since 2012, completed the manufacturing and control of various kinds of products by using the "632" project, and gradually reconstructed the IT system. It unified all the information in the company and established six sets of different operating systems to apply to each production link of the company in order to smooth the information chain of supply, production, and marketing of the company and complete the interaction between the company and the upstream and downstream of the value chain. All the development end of the company adopts PLM technology to assist the company

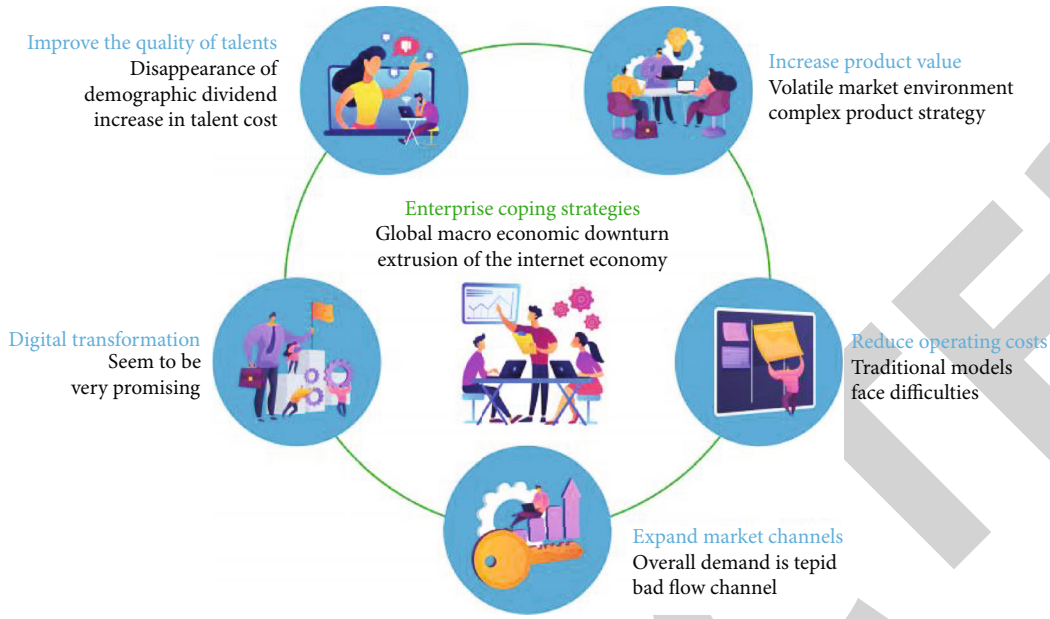


Figure 1: Motivation of enterprise digital transformation.

in completing design and technology development projects [14]. Through ERP, APS, and MES, the company's production process is controlled and optimized. Through SRM system, product supply link is implemented overall control. CRM system is used to provide after-sale service to customers, thus improving the after-sale service effect. Next, the FMS platform is used to coordinate and manage the financial data of the enterprise. And HRMS platform is used to carry out enterprise personnel management. At the same time, BI platform is used to obtain and sort out all aspects of information, thus providing some important basis for enterprise investment and decision-making. Finally, two information management portals, MIP and MDP, are used to complete the sharing of information resources within the enterprise and achieve the purpose of unified operation and management of the enterprise through the collaborative work among various departments.

*3.3.2. Change the Original Production and Marketing Mode.* The traditional manufacturing mode of home appliance industry is mainly based on channel inventory, that is, production first and then sales. In this way, due to the mismatch between production and sales, enterprises are unable to accurately predict the demand, which is prone to the phenomenon of mismatch between supply and demand, overstocking of unsalable products and shortage of best-selling goods. To this end, Company A began to focus on customers and changed mass production into targeted production according to customer needs through T+3 mode [15]. This mode of production and marketing has successfully improved the quality of product manufacturing and the degree of production automation information, realized the up-down connection of supply chain, and realized the sharing of information resources, enabling Group A to play a synergistic effect in production, manufacturing, distribution, and other links, shorten the product development cycle, reduce inventory pressure, and speed up turnover efficiency.

The T+3 order mode consists of four stages in total, as shown in Figure 2, and each stage is 3 days. T is the time when customers place orders. At this stage, merchants communicate with customers and place orders on the cloud marketing platform according to customers' requirements. T+1 is the cycle of material preparation, during which regional agents and distributors allocate and replenish raw materials through CCS channel coordination system. T+2 is the product processing cycle, in this stage, the provincial city operation center carries out flexible production and warehousing according to the order. T+3 is the cycle of logistics distribution and transportation. The logistics network established by ourselves can realize direct distribution to the manufacturing workshop and shorten the turnaround time of products in the intermediate link. T+3 customer order mode requires good cooperation in all aspects of the whole production process. In the early stage of raw material preparation, the supplier must make a timely response to the terminal demand. Group A has successfully realized the transformation from traditional production to sales.

*3.3.3. Expand Sales Channels.* In the network era, the traditional marketing methods have been unable to meet the needs of consumers. The retail industry should be driven by customer demand, the online and offline network integration should be accelerated, and the operation system of the retail industry should be reshaped according to the needs of different consumer groups. After T+3 mode, Zhaopin platform deeply promoted the reform of channel logistics, completed the implementation of the strategy of warehouse distribution nationwide, and provided strong support for expanding sales channels. The launch of cloud marketing APP further simplified the sales channel, successfully launched mobile payment, product consulting, and other

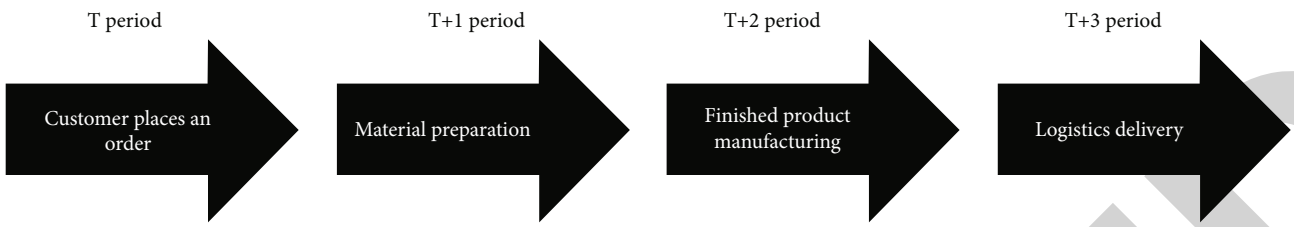


Figure 2: T+3 mode of Group A.

functions, making the information transmission channel more efficient and transparent. In the agent mode, cloud marketing APP will become the mall mobile network platform between distributors and agents so as to achieve the transparency of the whole channel information. Under the operator management mode, cloud marketing APP directly combines logistics distribution and inventory. Operators do not need to prepare goods by themselves, but only undertake channel business operation. Dealers can directly conduct financing, logistics distribution, and financial exchanges with central enterprises, thus achieving a truly flat channel level [3]. At the same time, customers' purchasing experience is enhanced, which creates an e-commerce purchasing and marketing network platform connecting upstream and downstream for tens of thousands of enterprise distribution end users, which makes the interconnection between the company and the internal sales channel more convenient, and it also helps us to quickly understand the sales and inventory situation of the channel so as to get closer to the market and improve the efficiency of the sales channel. It can realize enterprise digital distribution service management more quickly.

## 4. Result Analysis

Digital transformation refers to the use of information technology to reshape an organization's IT architecture and business architecture. In 2012, Group A reconstructed its entire IT system, abandoning the traditional "large-scale and low-cost" development mode, which can be said to be the most thorough change in the whole development process. Therefore, the chairman of Group A took 2012 as the beginning of its digital transformation. In the following years, he has been actively laying out the road of digital transformation, and has undergone great changes in production, sales, and other aspects. In order to better understand the performance changes of Group A before and after digital transformation, this article adopts the four dimensions of the balanced scorecard to select the relevant data of Group A from 2010 to 2020 for analysis. Since the effect of transformation has a certain delay, the data of Group A in 2013 is used as the watershed before and after the transformation. 2013 to 2020 is the period of digital transformation, and the impact of transformation on performance can be evaluated by analyzing the indicators of Company A [16]. Then, through horizontal comparison with the industry average level, it can be judged whether the change of Company A's performance is an industry trend [17].

When analyzing the financial dimensions of Group A before and after its digital transformation, this article selects relevant financial indicators in profitability, operating capacity, debt paying capacity, and development capacity.

*4.1. Profitability.* It generally refers to the size of the company's profit ability in a certain period of time, which is a relative concept. The higher the profit margin, the stronger the profitability, and vice versa. Company A's operating performance can be reflected from its profitability. This article analyzes the profitability of Group A by ROE and net profit rate on sales.

First, return on equity is calculated according to the following:

$$\mathrm{ROE} = \frac{\text{Net profit}}{\text{Shareholders' Equity}} \tag{1}$$

This index is mainly used to reflect the benefits generated by the use of the company's own funds in the process of operation. As shown in Figure 3, the line chart drawn based on the data shows that before 2013, the ROE of Company A was declining, but after the transformation, it began to improve from 2013. This is mainly due to the fact that Group A reconstructed the entire IT system in 2012, eliminated the traditional management mode, reduced costs, improved return on assets, and improved profitability [18]. However, in 2016, affected by the growth of market capital scale, the capital scale of Company A has exceeded 30% year-on-year growth rate for two consecutive years since 2016, leading to a decline in the growth rate of ROE. However, the growth rate declined due to the impact of the 2020 pandemic. However, in general, although the index fluctuated during the decade, the main reason for the decline was the influence of M&A factors and the temporary mismatch between revenue and earnings.

A horizontal comparison between the ROE of Group A and the industry average shows that the ROE of the home appliance industry has been growing steadily before 2014. However, the ROE of Company A declined rapidly. After 2014, the return on equity of the home appliance industry is not stable. By actively building new product research and development bases and research institutes as well as optimizing and reorganizing resources through mergers and sustainability acquisitions of some large companies, Company A has helped digital transformation. Its return on equity rose [19]. And in the following years, it has been stable at around 26%, not as volatile as the industry average. This indicates that the net assets injected by Group A after

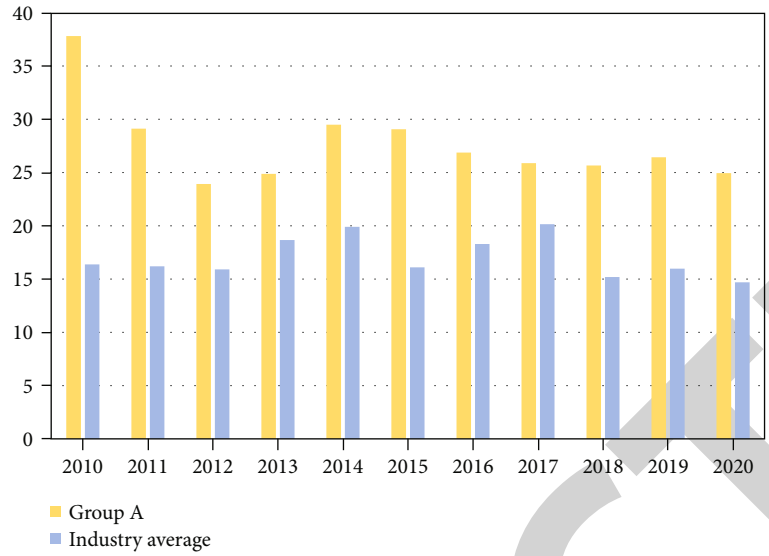


Figure 3: Comparison of ROE and industry average of Group A from 2010 to 2020.

digital transformation can obtain more stable profits, and it also indicates that digital transformation can help the company further integrate assets to a certain extent.

Secondly, net profit margin on sales refers to the comparative relationship between net profit and sales revenue, which is used to measure the ability of enterprises to obtain sales revenue in a certain period.

As can be seen from Figure 4, compared with Group A before its digital transformation, the growth rate of gross margin was significantly accelerated in 2013 and was always in a state of steady growth. However, it fell in 2017, when the year-on-year growth rate of Company A's total operating revenue and costs was more than 50%, but the actual growth rate of operating expenses was about 5% higher than that of operating revenue. There are two reasons for this phenomenon: first, in 2017, China's home appliance industry is actively seeking online marketing channels, and the iterative demand for new products promotes the increase of revenue and cost of Company A's main business [20]. The second is also influenced by acquisitions. After the acquisition, the company's main business gross profit margin is less than 15%. These two reasons together lead to Company A's gross profit margin in 2017 lower than that in 2016. In the whole range, the increase or decrease of net return rate is basically the same as the gross margin. In 2017, the price of raw materials for home appliances rose sharply. In addition, the merger and acquisition at this stage increased expenses during the period, leading to a slight increase in net profit and a year-on-year decline in net interest rate.

Then the net profit margin on sales of Company A is compared with the industry average. As can be seen from Figure 5, net profit margin on sales was always lower than the industry average before 2014. In 2014, it exceeded the industry average and opened a gap with the industry average. From 2015 to 2016, it put forward the dual-intelligence strategy, which made the net profit margin on sales rise to 9.97%, 70% higher than the same period in 2010. In 2017, it was still affected by Company A's large-scale investment and acquisition, resulting in a sharp rise in costs and a sharp drop in net profit margin on sales [21]. However, in 2018, when the overall industry average level declined, Group A did not decline, but there was a big improvement, which indicates that after the digital transformation, Group A's profit stability gradually enhanced.

*4.2. Operation Capacity Analysis.* This article analyzes the operation capacity of Group A before and after digital transformation through inventory turnover and accounts receivable turnover.

First, inventory turnover is the ability of inventory to be converted into cash. As shown in Figure 6, a longitudinal comparison shows that the inventory turnover of Company A has been greatly improved after 2013, which is mainly due to the change of production and marketing mode of Group A during this period, which greatly reduces inventory pressure and optimizes inventory management through digital transformation. From 2013 to 2016, the inventory of Company A has been maintained at about 15 billion yuan. In 2015, due to the recession of domestic economy, the inventory was reduced by one third. Therefore, the inventory turnover speed of Company A will naturally improve under the condition of small inventory scale and steady increase of operating cost [22]. Since 2017, Company A's inventory scale has been better controlled, and in 2018, under the premise of rapid increase in sales volume and expansion of business scope, Group A's inventory control level is still quite high. However, due to the influence of the previous two years, the inventory backlog in 2016 was serious, resulting in a large difference between the average inventory balance in 2017 and 2018, resulting in a decline in the inventory turnover rate. In general, the liquidity of Company A's inventory has always been far ahead in the industry. Although there are some fluctuations in liquidity purely on the surface of the data, in fact, Company A has done a good job in inventory management. Through digital transformation, Group A can maintain the balance of

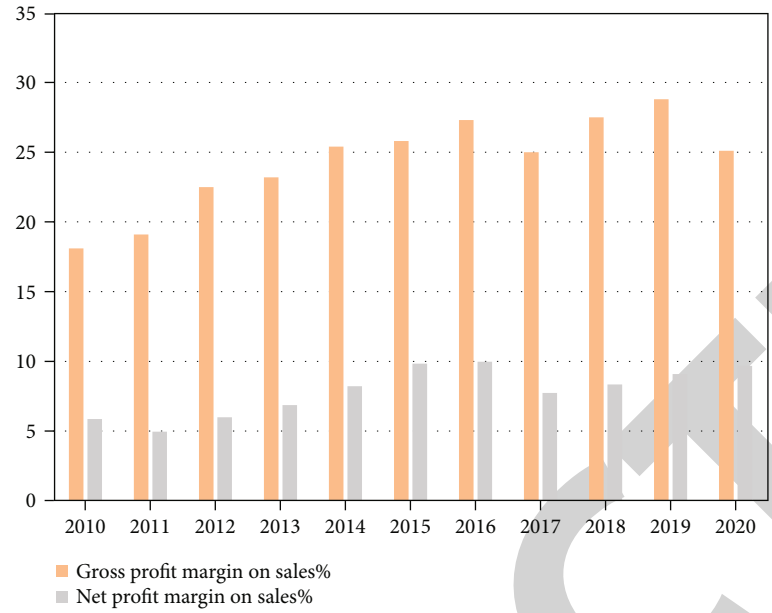


Figure 4: Changes of Group A's gross profit margin and net profit margin on sales from 2010 to 2020.

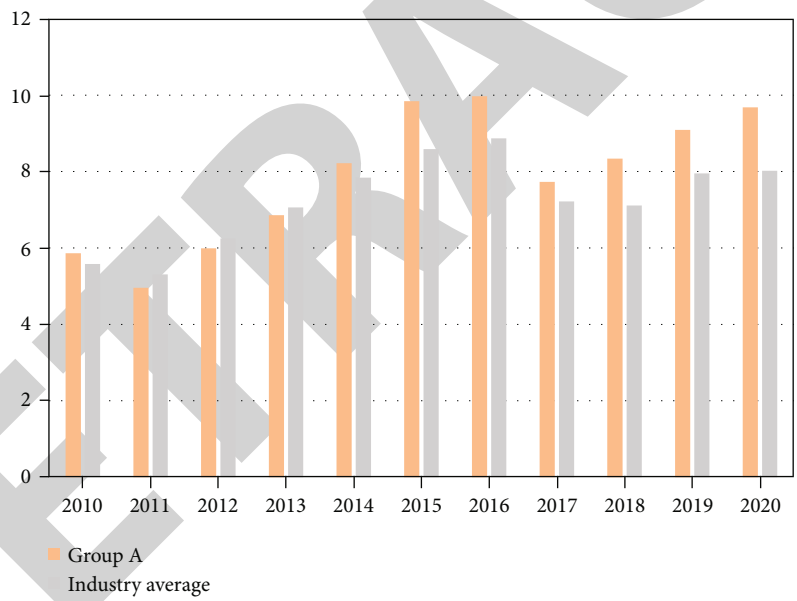


Figure 5: Comparison of Group A's net profit margin on sales and industry average from 2010 to 2020.



inventory quantity in the continuous expansion of business development and reduce the company's operational risks to a certain extent [23].

A horizontal comparison between the inventory turnover rate of Group A and the industry average shows that, as shown in Figure 7, the inventory turnover rate of Company A was always slightly lower than the industry average before the transformation. However, since 2012, Company A began to adopt the mode of "sales" in inventory management. In the case of transparent all-channel inventory and cooperative management of entity enterprises, Company A constructed all-channel inventory sharing and realized the system's autonomous adjustment of inventory level by opening up the information flow of collaborative warehouses. Through the implementation of the order management mode, its inventory turnover rate increased to 8.87% in 2016, and it gradually exceeded the average level of the household appliance industry [24]. It can also be obviously found in Figure 7 that after digital transformation, the growth range of inventory turnover of Group A gradually increases, and the difference between Group A and the industry average also gradually expands. This shows that the inventory management of Group A is optimized through digital transformation, and the inventory turnover rate is improved, thus enhancing the operating strength of the company.

Secondly, accounts receivable turnover can be used to reflect the ability of enterprises to cash accounts receivable.

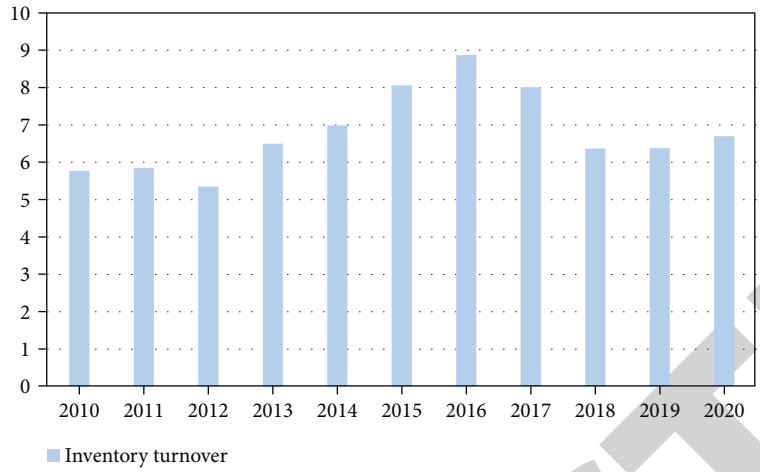


Figure 6: Inventory turnover of Group A from 2010 to 2020.

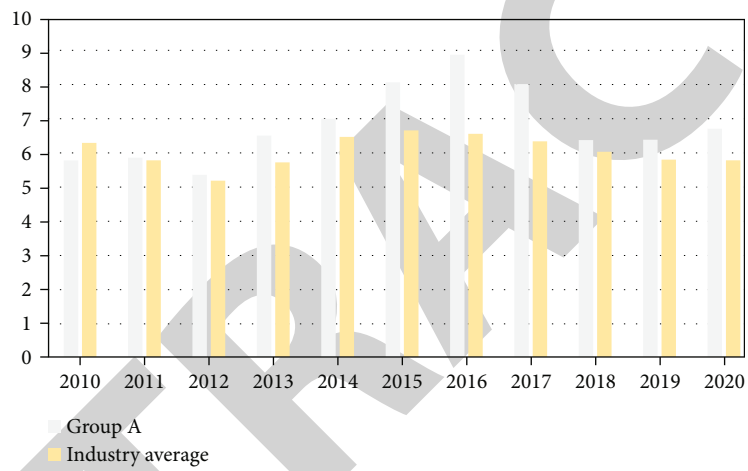


Figure 7: Comparison of Group A's inventory turnover rate and industry average from 2010 to 2020.

Through the observation of the whole range, Company A's accounts receivable turnover has a great change. In 2012, the turnover of Group A had a slight decline and was even exceeded by the industry average, but it was improved immediately after the transformation. In particular, during 2016-2017, as Company A entered the digital 2.0 stage, it effectively reduced the credit sales business through online channels. In addition, the improvement of Company A's overall operating efficiency has shortened the delivery time of products and accelerated the collection speed of enterprises, so that the cash turnover of Company A's receivables can continue to improve and maintain a leading position in the whole industry. In general, through the evaluation of Group A's accounts receivable liquidity in the whole analysis region, it is found that it has been improving to a considerable extent, which not only alleviates the company's operating financing pressure, but also improves the company's short-term repayment ability.

Then compared with the same industry. As can be seen from Figure 8, before 2013, the receivables turnover rate of Company A was not very stable, with ups and downs, and showed a trend lower than the industry average [25]. After Group A has adopted comprehensive digital sales and improved the online trading platform, the turnover speed of its receivables has exceeded the industry average, which indicates that through the application of digital technology, Group A's ability to realize receivables has been improved and the enterprise has also been promoted to develop in a better direction.

*4.3. Solvency Analysis.* This article chooses asset-liability ratio and liquidity ratio to analyze the solvency of Group A.

The asset-liability ratio mainly refers to the ratio of total liabilities to total assets. The higher the ratio, the poorer the company's ability to repay arrears. Generally speaking, the asset-liability ratio should be between 40% and 60%. Figure 9 shows that the asset-liability ratio of Group A showed a downward trend before 2017, but in the years 2017-2020, it always exceeded the average level of the industry, and almost reached 70%. In this case, it is very unfavorable for the company, because the company cannot repay the maturing debt, it needs to bear more interest costs, which damages the rights and interests of shareholders. Meanwhile, the company will face more risks, and the

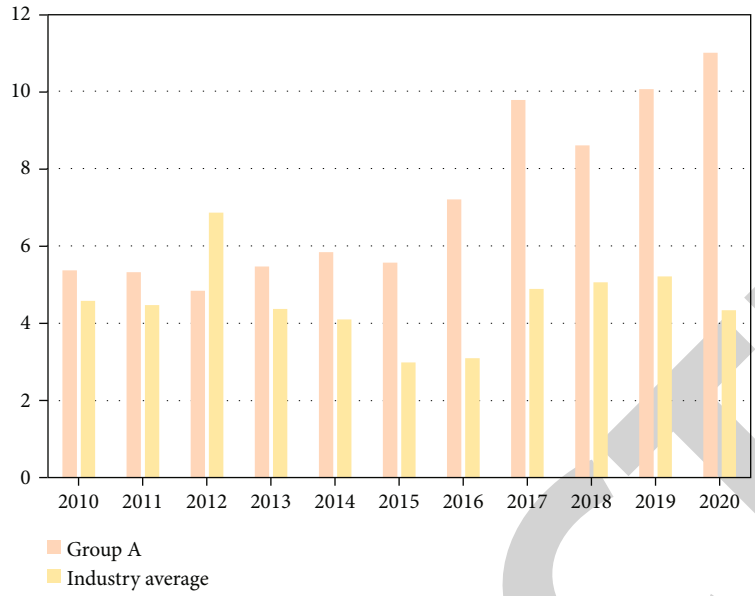


Figure 8: Accounts receivable turnover rate and industry average of Group A from 2010 to 2020.

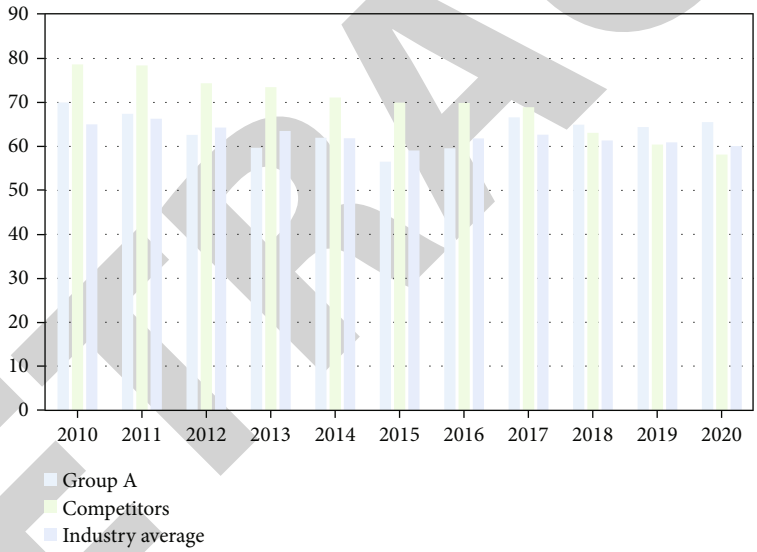


Figure 9: Comparison of the average asset-liability ratio of Group A, its competitors, and the industry from 2010 to 2020.



maturity of debt at different times will directly affect the company's capital flow. High debt ratio will make it difficult for the company to use debt financing to meet the needs of funds.

A horizontal comparison of Group A's asset-liability ratio with its competitors and the average value of the industry shows that the asset-liability ratio of Company A before 2016 is generally lower than the average value of the industry. In addition, the enterprise is still in the period of continuous development, and its asset-liability ratio can be maintained below 60% for a long time, which to some extent reflects the good capital chain operation of Company A. Since 2016, the average asset-liability ratio of competitors and the industry has been declining, indicating that its asset structure is optimizing. However, Company A keeps rising after the acquisition, and the corresponding financial risks also rise. Therefore, it can be seen that Company A's digital transformation has not kept its long-term solvency in good condition. All in all, there is still a lot of room for improvement in Company A's long-term solvency.

Second, the current ratio is used to show a company's ability to repay short-term debt. Generally speaking, the higher the ratio, the stronger the liquidity of the assets, and the stronger the short-term solvency.

As can be seen from Figure 10, the growth trend of liquidity ratio and quick ratio of Group A in the whole range is roughly the same. There was a slight decline in 2011-2012. Subsequently, in 2013, due to the continuous expansion of online channels, the credit sales business gradually decreased, and the working capital of enterprises increased,

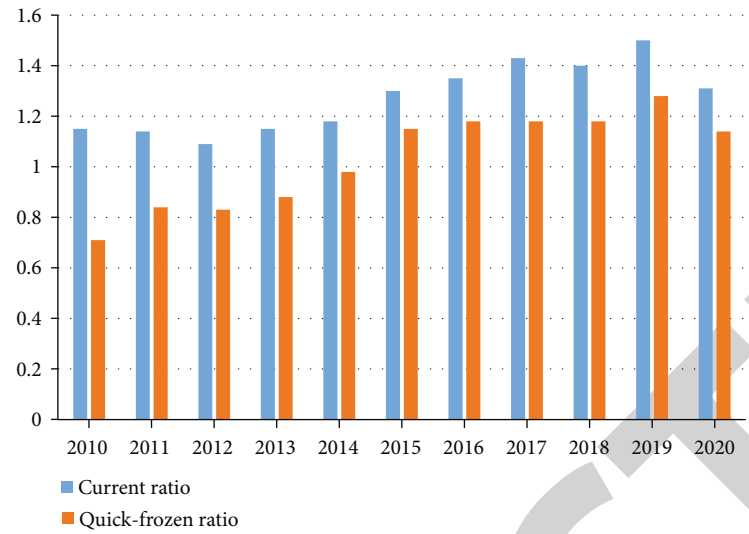


Figure 10: Current ratio and quick ratio of Group A from 2010 to 2020.

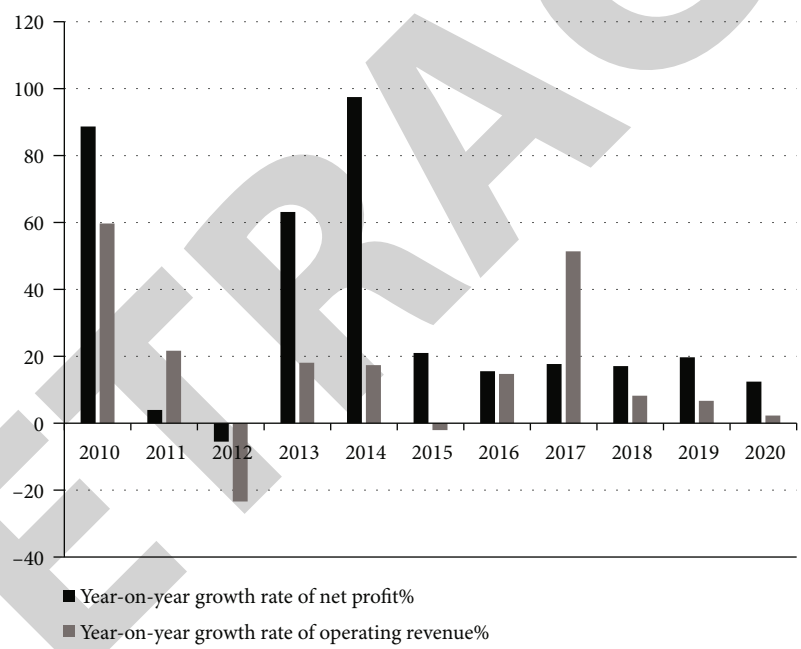


Figure 11: Year-on-year growth of Net profit and operating revenue of MideGroup A from 2010 to 2020.



which almost showed a steady growth in the following years [26]. Meanwhile, by comparing the liquidity ratio between Group A and the industry average, it is found that Company A has not reached the industry average level before 2015. With the improvement of the time and intensity of digital transformation, the business performance improved [27]. After 2015, it began to exceed the industry average and gradually separated. In general, the short-term solvency of Company A has improved after digital transformation.

*4.4. Growth Ability Analysis.* This article selects the growth rate of net profit. The larger the index value is, the better the future development prospect of the enterprise is.

As far as shareholders are concerned, net profit can better reflect their own investment reporting. Figure 11 shows that during the whole period, its net profit grew faster than its operating income. Especially after the digital transformation, the growth rate of net profit increased significantly. Despite the economic downturn, fierce competition in the home appliance industry and corporate acquisitions, the year-on-year growth rate of net profit was maintained at about 17%. From this point of view, Group A's adaptability to the outside world has been continuously enhanced in the transformation process, and the company's internal management system has also been improved to some extent, which helps the sustainable development of the enterprise.

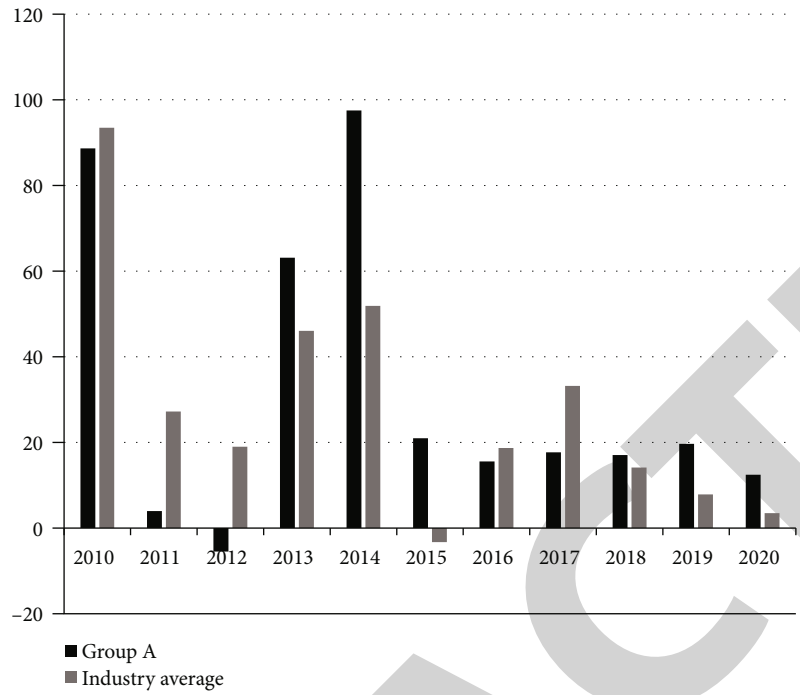


Figure 12: Group A's net profit growth rate and industry average from 2010 to 2020.

Meanwhile, the net profit growth rate of Company A is compared with the average level of the industry. As can be seen from Figure 12, the growth rate of Company A's net profit dropped sharply from 88% to negative value before 2013. After digital transformation, IT systems are restructured, administrative costs are reduced, and operating revenues are increased. The net profit growth rate of Group A has risen in a fluctuating manner and has exceeded the average of the household appliance industry, which means that the digital transformation of Company A is playing a positive role in the profitability of the enterprise, but it is not stable enough. After 2015, the growth rate of Company A's net profit has been hovering between 16% and 17%, mainly because it has reached a saturation level in the traditional business sector and the profit space is not large, which is also an important reason for Company A to take the initiative to carry out digital transformation. In 2017, Group A increased investment in research and development, improved research and development capabilities, and increased investment in robotics, intelligence, and other sectors. However, the current profitability is not known, and it takes time to integrate and verify. In general, the digital transformation of Company A is beneficial to the growth and development of the enterprise, but the effect is not obvious, and more time is needed to test.

It is difficult to obtain a comprehensive evaluation by analyzing the effect of digital transformation separately from various indicators of financial dimension. Therefore, through comprehensive analysis of financial performance, this article combines all indicator systems together to comprehensively evaluate the digital transformation of Group A.

First, establish the company's comprehensive financial performance analysis system and measure it. In the four ability data of company debt paying, operation, profitability and growth, two typical indicators are selected to conduct comprehensive evaluation and analysis on the digital transformation case of Company A. Then, according to the Operation Rules for Company Performance Evaluation (Revised Edition), weight is given to the selected index system to establish Company A's exclusive comprehensive evaluation framework. The indicators after the transformation are evaluated comprehensively to determine the final score. The specific basis for selecting the index system is as follows: in terms of solvency, the asset-liability ratio and current ratio are selected to measure. In terms of operating capacity, accounts receivable turnover and inventory turnover rate indices are selected to measure. In terms of profit level, the article selects the return on equity which can reflect the effective use effect of the owner's investment funds and the

Table 1: Comprehensive analysis index table of MideGroup A financial performance.

| Evaluation index | Selected indicators | Weight (%) |
|---|---|---|
| Debt paying ability | Asset-liability ratio | 12 |
| | Current ratio | 8 |
| Operation ability | Accounts receivable turnover | 9 |
| | Inventory turnover | 9 |
| Profitability | Return on equity | 25 |
| | Net profit margin on sales | 13 |
| Growth ability | Growth rate of operating income | 12 |
| | Net profit growth rate | 12 |

Table 2: Index values of Group A from 2012 to 2020.

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Asset-liability ratio (%) | 37.8 | 40.31 | 38.02 | 43.49 | 40.43 | 33.42 | 35.06 | 35.6 | 34.47 |
| Current ratio | 1.09 | 1.15 | 1.18 | 1.3 | 1.35 | 1.43 | 1.4 | 1.5 | 1.31 |
| Accounts receivable turnover (times) | 4.84 | 5.47 | 5.84 | 5.57 | 7.21 | 9.77 | 8.61 | 10.05 | 10.99 |
| Inventory turnover (times) | 5.35 | 6.5 | 6.99 | 8.06 | 8.87 | 8.01 | 6.37 | 6.38 | 6.7 |
| Return on equity (%) | 23.92 | 24.87 | 29.49 | 29.06 | 26.88 | 25.88 | 25.66 | 26.43 | 24.95 |
| Net profit margin on sales (%) | 5.99 | 6.86 | 8.22 | 9.84 | 9.97 | 7.73 | 8.34 | 9.09 | 9.68 |
| Growth rate of operating revenue (%) | -23.41 | 18.06 | 17.36 | -2.08 | 14.71 | 51.35 | 8.23 | 6.71 | 2.27 |
| Net profit growth rate (%) | -5.5 | 63.15 | 97.5 | 20.99 | 15.56 | 17.7 | 17.05 | 19.68 | 12.44 |

Table 3: Average index value table of home appliance manufacturing industry from 2012 to 2020.

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Asset-liability ratio (%) | 35.74 | 36.51 | 38.14 | 40.95 | 38.18 | 37.34 | 38.67 | 39.07 | 39.92 |
| Current ratio | 1.28 | 1.28 | 1.29 | 1.27 | 1.25 | 1.3 | 1.32 | 1.32 | 1.32 |
| Accounts receivable turnover (times) | 6.86 | 4.37 | 4.1 | 2.99 | 3.1 | 4.89 | 5.06 | 5.21 | 4.34 |
| Inventory turnover (times) | 5.18 | 5.72 | 6.47 | 6.66 | 6.56 | 6.34 | 6.03 | 5.8 | 5.78 |
| Return on equity (%) | 15.91 | 18.66 | 19.91 | 16.1 | 18.29 | 20.15 | 15.2 | 15.98 | 14.7 |
| Net profit margin on sales (%) | 6.25 | 7.06 | 7.84 | 8.59 | 8.87 | 7.22 | 7.11 | 7.95 | 8.02 |
| Growth rate of operating revenue (%) | 1.53 | 15.47 | 15.3 | -12.54 | 18.96 | 41.59 | 18.07 | 5.33 | -2.75 |
| Net profit growth rate (%) | 18.99 | 46.04 | 51.87 | -3.28 | 18.7 | 33.19 | 14.12 | 7.86 | 3.47 |

Table 4: Index standard coefficients of Group A from 2012 to 2020.

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Asset-liability ratio (%) | 1.06 | 1.1 | 1 | 1.06 | 1.06 | 0.9 | 0.91 | 0.91 | 0.86 |
| Current ratio | 0.85 | 0.9 | 0.91 | 1.02 | 1.08 | 1.1 | 1.06 | 1.14 | 0.99 |
| Accounts receivable turnover (times) | 0.71 | 1.25 | 1.42 | 1.86 | 2.33 | 2 | 1.7 | 1.93 | 2.53 |
| Inventory turnover (times) | 1.03 | 1.14 | 1.08 | 1.21 | 1.35 | 1.26 | 1.06 | 1.1 | 1.16 |
| Return on equity (%) | 1.5 | 1.33 | 1.48 | 1.8 | 1.47 | 1.28 | 1.69 | 1.65 | 1.7 |
| Net profit margin on sales (%) | 0.96 | 0.97 | 1.05 | 1.15 | 1.12 | 1.07 | 1.17 | 1.14 | 1.21 |
| Growth rate of operating revenue (%) | -15.3 | 1.17 | 1.13 | 0.17 | 0.78 | 1.23 | 0.46 | 1.26 | -0.83 |
| Net profit growth rate (%) | -0.29 | 1.37 | 1.88 | -6.4 | 0.83 | 0.53 | 1.21 | 2.5 | 3.59 |

Table 5: Score table of Group A's four competencies and comprehensive performance from 2012 to 2020.

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Solvency score | 19.52 | 20.4 | 19.28 | 20.88 | 21.36 | 19.6 | 19.4 | 20.04 | 18.24 |
| Operational capability score | 15.66 | 21.51 | 22.5 | 27.63 | 33.12 | 29.34 | 24.84 | 27.27 | 33.21 |
| Profitability score | 49.98 | 45.86 | 50.65 | 59.95 | 51.31 | 45.91 | 57.46 | 56.07 | 58.23 |
| Growth ability score | -187.08 | 30.48 | 36.12 | -74.76 | 19.32 | 21.12 | 20.04 | 45.12 | 33.12 |
| Solvency score | 19.52 | 20.4 | 19.28 | 20.88 | 21.36 | 19.6 | 19.4 | 20.04 | 18.24 |
| Comprehensive score of financial performance | -101.92 | 118.25 | 128.55 | 33.7 | 125.11 | 115.97 | 121.74 | 148.5 | 142.8 |

sales net profit which can best reflect the effect of sales revenue. In terms of growth ability, operating income growth rate and net profit growth rate are adopted. Based on the above analysis, the selected indicators and weights are sorted into a table, as shown in Table 1.

The comprehensive financial performance evaluation in this article selects 2012 to 2020 as the evaluation period, and the index values are shown in Table 2 below:

This article uses the average evaluation index data of the household appliance industry as the reference value, as detailed in Table 3.

Divide Table 2 and Table 3 to obtain the standard coefficient relative to each financial index of Group A from 2012 to 2020. See Table 4 for the specific data.

The standard coefficient value of the above table is multiplied by the given scoring weight to calculate the data of

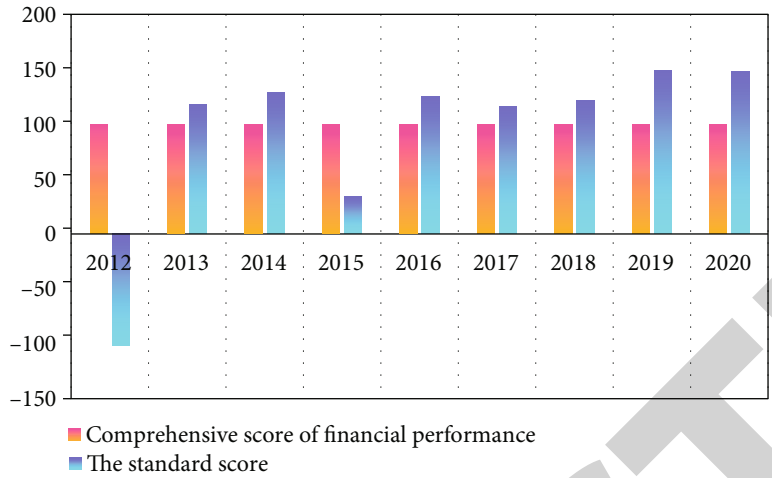


Figure 13: Change trend of A Group's comprehensive score of financial performance from 2012 to 2020.

eight evaluation items, and the data results are all added up. See Table 5 for the specific data.

Then, the comprehensive score of financial performance is analyzed. As can be seen from Figure 13, the comprehensive score of Group A's financial performance in 2012 was very low, and neither the growth ability nor the business strength achieved the desired effect. Under such circumstances, Company A began to implement digital transformation, the overall IT system was comprehensively reconstructed, and the new mode of "sales to production" was implemented in the inventory management mode. By 2013, the financial performance composite score had increased significantly. Although in 2015, due to the decline of net profit growth rate, the comprehensive score of financial performance fell. However, Group A immediately increased the intensity of digital transformation to recover the situation of falling profits. Since 2016, the continuous improvement of profitability and growth ability of Group A has promoted the overall positive trend of financial performance. The comprehensive score of financial performance is always above the standard score. Through the comprehensive analysis of financial performance, it is concluded that the digital transformation of Group A has been effective and the enterprise value has increased significantly.

## 5. Conclusion

In order to cope with the impact of digital technology, adapt to changes in the external environment, and ensure its own stable development, Group A, as a traditional household appliance manufacturing enterprise, uses various digital technologies to transform and upgrade its links and realize the digitalization of the enterprise as a whole. This article explores the path and mechanism of Group A's digital transformation and analyzes the performance of Group A before and after the transformation by using relevant indicators. There are four main reasons for Group A's digital transformation: to meet the needs of the development of the digital economy era, to support national policies, to enhance the core competitiveness of the enterprise, to reduce product costs, and to meet the diversified needs of customers. Digital transformation can improve enterprise performance. In this article, the performance of Group A before and after digital transformation is comparatively analyzed from the four dimensions of the balanced scorecard. The results show that since the digital transformation began in 2012, Group A has improved its profitability, operation and growth capacity, and maintained a leading position in the entire household appliance industry.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

## Acknowledgments

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*Retraction*

# Retracted: Translation and Expression of Professional Terms of Public Emergencies in External Reports

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] Z. Zhu and C. Wang, "Translation and Expression of Professional Terms of Public Emergencies in External Reports," *Journal of Environmental and Public Health*, vol. 2022, Article ID 8973525, 13 pages, 2022.

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*Research Article*

# Translation and Expression of Professional Terms of Public Emergencies in External Reports

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In order to better grasp the expression and translation methods of professional terms in the process of external reporting of public emergencies and grasp the characteristics and elements of the translation of publicity events, this study takes public emergencies as the research object and focuses on the application of English and Chinese professional terms and translation strategies in the process of external reporting. Therefore, based on the in-depth analysis of the news reporting framework of public health emergencies, this paper deeply summarizes the application skills of professional terms in publicity texts, so as to provide a certain reference for further improving the translator's ability to control the means of discourse cohesion and the level of discourse control of Chinese-English professional terms in the translation of public health events.



## 1. Introduction

Foreign news reports are more oriented to foreign and international news media to publicize domestic news content, so from the perspective of publicity, foreign news reports belong to "information language items." The main function of this kind of discourse is to spread information and provide new knowledge, report the domestic and foreign policies and all aspects of the country to foreign media and foreign audiences, and provide all kinds of information about the country, including economic development information and public event information. However, due to the particularity of public emergencies, we should grasp the expression of professional terms when carrying out external publicity and reporting, so as to avoid the distortion of news information. Therefore, we should not only express the information of public emergencies concisely but also reflect the accuracy of word meaning. This paper is based on this, to explore the translation and expression strategies of public emergencies in the publicity text in depth. Figure 1 shows the process of translating manuscripts by translation companies [1].

## 2. Literature Review

Bylina et al. pointed out that translation is essentially an act of information transformation and dissemination. Generally speaking, translation is to change one language into another while keeping the connotation of information unchanged. In the process of translation, the translator needs to have a deep understanding of the original text and be able to grasp the text as a whole from the aspects of content, style, and coherence. If you want the translation to be coherent, you have to do a good job of cohesion. Cohesion is one of the important means to achieve coherence. If there is a problem with cohesion, the small will affect the fluency of the article, and the large will change the meaning of the text [2].

Shen believes that publicity translation is to translate many information related to China from Chinese into

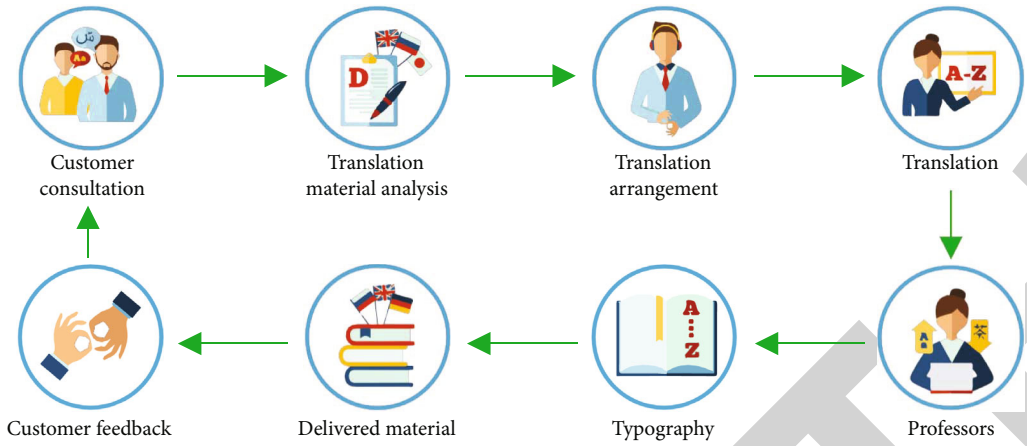


Figure 1: The process of translating manuscripts by translation companies (high-end).

non-Chinese and then spread by books, newspapers, periodicals, radio, television, Internet, and other media. Publicity translation covers many aspects including politics, economy, culture, and military. Its purpose is to objectively and truly introduce Chinese culture, national conditions, etc. At the same time, it also meets the needs of communication and is easy for foreign readers to accept [3].

Xie et al. put forward two concepts of semantic translation and communicative translation. Semantic translation maximizes the contextual meaning of the original text on the premise of the semantic structure and syntactic structure of the target language. Communicative translation is to make the target language readers and the source language readers get the same information reception effect as much as possible. Due to the different functions and audiences of each text, the focus of these two translation strategies is also different. Take publicity texts for example. When translating, we should not only reasonably adopt the strategy of semantic translation to accurately convey the factual information in the original text but also adopt the strategy of communicative translation as appropriate to make the translation easy to be accepted by foreign audiences and achieve good publicity effect [4].

Chen and Cui pointed out that the most prominent feature of publicity texts is the use of a large number of cohesive devices. The rational use of cohesive devices can make the translation more coherent, and coherence is one of the important conditions for accurately conveying the information of the translation. The commonly used cohesive devices in publicity texts include reference, substitution, ellipsis, connection, and lexical means. Due to the formality of style, publicity texts have a high standard for the logic and coherence of language, and cohesive devices are one of the important means to achieve this standard [5].

Ramesmayer et al. pointed out that cohesion is a semantic concept, which refers to the meaning relationship of idioms. If we want to understand the meaning of a component in a text, we need to refer to another component, and the cohesion relationship will arise. It also points out that there are two types of textual cohesion means, namely, grammatical means and lexical means, and textual cohesion includes intrasentence cohesion and intersentence cohesion [6].

## 3. Analysis on the External Reporting Framework of Public Health Emergencies

Take the "poison capsule incident" as an example. On April 15, 2020, it was exposed that gelatin manufacturers in cities A and B used industrial gelatin with excessive chromium to manufacture capsules [7]. Among them, 13 batches of capsule drugs from 9 pharmaceutical factories represented by the correction pharmaceutical industry contain excessive metal chromium, which is found by relevant departments to be the most serious exceeding times the national standard. The "poison capsule incident" has become a hot topic of public discussion, causing widespread public concern about drug safety.

*3.1. Sample Survey of News External Reports.* This study takes a total of 20 days from April 15, 2020, to May 4, 2020, as the research period. During this period, CCTV news channel's "weekly quality report" column broadcast the special investigation news "secrets in the capsule" to expose the event for the first time, which was reprinted and tracked by many domestic news websites. The "poison capsule incident" instantly became a hot spot of media focus [8, 9]. Within 30 days after the "poison capsule incident" was exposed on April 15, 2020, the number of news reports on the "poison capsule incident" by major domestic media was about 107790 (including reprinted news). According to the number, they are as follows: online media (99585), newspaper media (6720), forum articles (894), and TV media (591).

According to the public opinion monitoring of the "toxic capsule incident" report (as shown in Figure 2), after the "toxic capsule incident" broke out on the 15th, the number of major media reports rose sharply and peaked the next day, and the number of reports on the 17th to 20th showed a downward trend but still remained at a relatively high level and began to fall back on the 21st. On the 23rd, a canal in city A was filled with empty capsules, which attracted attention. The amount of information rebounded, and there was a small upsurge in reporting. From the 24th to the 28th, the amount of events reported gradually fell and tended to be stable. From May 29 to May 4, the amount of media

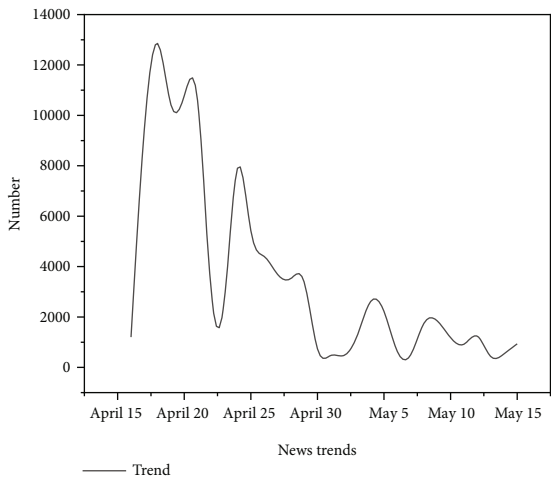


Figure 2: News trend chart.

coverage of the event has been hovering at a low level, indicating that the attention of public opinion has declined. After May 4, the amount of news coverage showed a downward trend. The event entered a dormant period of public opinion, gradually faded out of the sight of the media, and temporarily ended [10].

*3.2. Category Construction.* According to the needs of research, this study designed the following categories: report layout, report genre, report theme, source of information, report protagonist, and report position, as shown in Table 1 [11, 12].

Report page is mainly for the category set up by the sample extraction of the newspaper media "Southern Metropolis Daily," which is mainly divided into front page, important news page, comment page, domestic page, international page, economic page, local news page, and urban page.

*3.3. Content Analysis of News Reports.* As shown in Table 2, the data analysis of report layout is mainly aimed at the categories set up by the newspaper media Southern Metropolis Daily. Layout refers to the arrangement and layout of news manuscripts in the newspaper, which makes readers' first impression of news reports. Layout language is an important way for newspapers to guide public opinion [13]. Note the following: as the cover of the newspaper, the front page of "Southern Metropolis Daily" generally plays the role of reading guide. The specific content is in other pages, so the data on the front page will not be specifically analyzed.

From Figure 3, we find that the distribution of the number of news reports on the "poison capsule incident" in the page of Southern Metropolis Daily is mainly concentrated in the important news section, local news section, comment section, and economic section, of which the important news section (40.9 yuan) accounts for the largest number of reports, highlighting the importance that Southern Metropolis Daily attaches to the "poison capsule incident," and the important news section is used as "a means of newspaper speech." In the process of information transmission, readers' attention to this event has been improved [14, 15]. Secondly, the local news edition (19%) mainly includes the news reports of the Pearl River Delta covered by the Southern Metropolis Daily. The local news edition also accounts for a large proportion of the "poison capsule incident," reflecting the regional characteristics of the news reports of the Southern Metropolis Daily. The comment page (15.1%) mainly includes the editorial part of Southern Metropolis Daily, which is relatively open to express the position of Southern Metropolis Daily on the "poison capsule incident." The economic edition (10%) mainly includes relevant reports on the impact of the "poison capsule incident" on the economic field. The number of reports in this edition is also large, which is related to the distribution area and audience of Southern Metropolis Daily. Southern Metropolis Daily is mainly sold in economically developed regions such as the Pearl River Delta, Hong Kong, and Macao. Among its readers, social elites and white-collar readers account for a high proportion. Therefore, Southern Metropolis Daily has a broader perspective on the "poison capsule incident."

From Table 3 and Figure 4, it can be seen that the reporting styles of "poison capsule incident" in Southern Metropolis Daily mainly include news (56.3%), comments (18%), communications (15.2%), and popular science abstracts (6%), of which the news accounts for the largest proportion [16]. At the same time, Southern Metropolis Daily also has a large amount of comments on "poison capsule incident," which is in line with the style that Southern Metropolis Daily regards current commentary as Qixia.

Figure 5 and Table 4 show the theme distribution of "poison capsule incident" reported by Southern Metropolis Daily. It can be seen from the figure that the news theme of "Southern Metropolis Daily" is "quality inspection and problem capsule treatment" (including off shelf, shutdown, return, and destruction), accounting for the largest proportion of 30.3%, followed by "incident investigation," accounting for 24%, the "government measures and disposal of relevant responsible persons" accounting for 23%, the "others" accounting for 16.7%, the "star endorsement" accounting for 4.5%, and the case report accounting for 1.5% [17]. The topics with a large number of news are "quality inspection and problem capsule treatment," "event investigation," and "government measures and disposal of relevant responsible persons," and there is insufficient attention to "case report" and other topics.

It can be seen from Figure 6 and Table 5 that the sources of information reported by Southern Metropolis Daily on the "poison capsule incident" are relatively diverse, but the main source of information is government departments and government officials, accounting for 48.5%, followed by media reporters, accounting for 28.8%, experts and scholars, accounting for 10.6%, enterprises and principals, accounting for 6%, and others, accounting for 4.6%, while the proportion of relatively disadvantaged consumers in the "poison capsule incident" is only 1.5%. It can be seen that government officials are easier to access and use media than consumers [18, 19].

Table 1: List of news framework research categories.

| Category | Definition | Category formulation purpose | Theoretical basis for category formulation | Research questions |
|---|---|---|---|---|
| Report genre category | Expression form of report content | Different reporting genres have different functions, and choosing the appropriate reporting genres is conducive to achieve the communication effect. | Properly grasp and use the genre of news reports, and make news materials suitable for their place, without wasting materials. | What are the most used reporting genres in different types of media |
| Topic framework category | The core idea of news content | Understand that there are several news frames contained in the "poison capsule" event; positioning how different media frame the "poison capsule" event. | "News framework is the heart or main point of news content." | What are the main theme frameworks presented, and how are the reporting frameworks of different types of media "poison capsule" events different |
| Source category | General provider or providing organization of newsletters | In the "poison capsule incident" report, which sources did the three media choose, and whether there was a bias in the choice of sources. | "The news sources are the competitors of social action, competing for the initiative of speaking and discourse in the media field. These competitors mobilize resources and manpower through the organizational culture, construct the speaking content in line with the organizational framework, and try to approach the media, so as to win their acceptance of the argument, become the core and basic position of the news framework, so as to affect the public and build the mainstream trend of thought in the society." | What are the differences between different media in the choice of news sources, and the relationship between news sources and the formation of the framework |
| Report protagonist category | Key reporting objects in the news | Summarize what aspects of the "poison capsule incident" were highlighted by the three media. | Zhong Xiaowen: "the focus of every news report is to outline the essentials' it can be said that it is the theme embodiment of a news content." | What are the main reporting objects, and how are the reporting objects of different media different |
| Report position category | Is the attitude of the report positive, negative or neutral | Grasping the reporting position will directly affect the scientific disposal of public health emergencies. | Modigliani: "only with active supporters can an issue achieve social reality." | What is the reporting position? Are the reporting positions of different media the same |

Table 2: Layout of the report of Southern Metropolis Daily.

| Page | Southern Metropolis Daily | |
|---|---|---|
| | Number of reports | Proportion |
| Front page | 4 | 6.0% |
| Front page of a newspaper | 27 | 40.9% |
| Comment edition | 10 | 15.1% |
| Domestic version | 2 | 3.0% |
| International edition | 0 | 0.0% |
| Economic edition | 7 | 10.0% |
| Local news | 12 | 19.0% |
| Urban edition | 4 | 6.0% |

It can be seen from Table 6 and Figure 7 that the protagonists of the "poison capsule incident" report of Southern Metropolis Daily are mainly "government departments and officials," accounting for 33.3%, followed by "industrial and commercial enterprises and principals," accounting for 32%, followed by drug safety knowledge, accounting for 13.6%, and policies and regulations, accounting for 7.6%. In addition, consumers and stars account for 3%, respectively, and other protagonists account for 6%. It can be seen that in the report of the "poison capsule incident," Southern Metropolis Daily paid more attention to "government departments and officials" and "enterprises and principals."

It can be seen from Table 7 and Figure 8 that the reporting position of Southern Metropolis Daily on the "poison capsule incident" is mainly neutral and objective, accounting for 74.2%, followed by negative, accounting for 18.2%, and finally positive, accounting for 7.6%. The proportion of negative reports is greater than that of positive reports, which reflects the outspoken characteristics of Southern Metropolis Daily and plays a positive role in public opinion supervision.

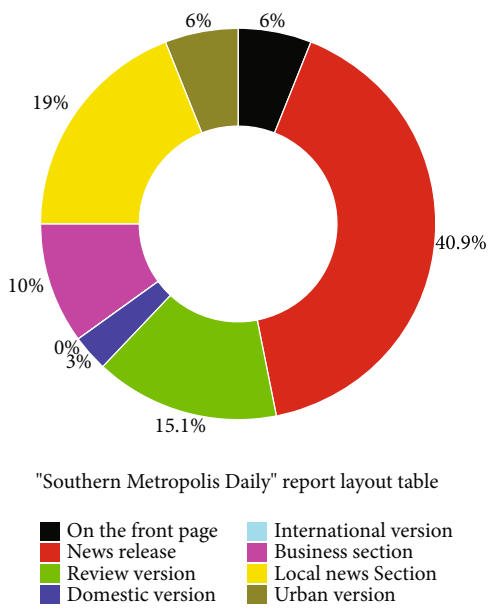


Figure 3: Strip chart of the report page of Southern Metropolis Daily.

Table 3: Distribution of report genres of Southern Metropolis Daily.

| Reporting genre | Southern Metropolis Daily | |
|---|---|---|
| | Number of reports | Proportion |
| News | 37 | 56.3% |
| Communication | 10 | 15.2% |
| Exclusive interview | 2 | 3.0% |
| Comment | 12 | 18.0% |
| Popular science abstracts | 4 | 6.0% |
| Other | 1 | 1.5% |

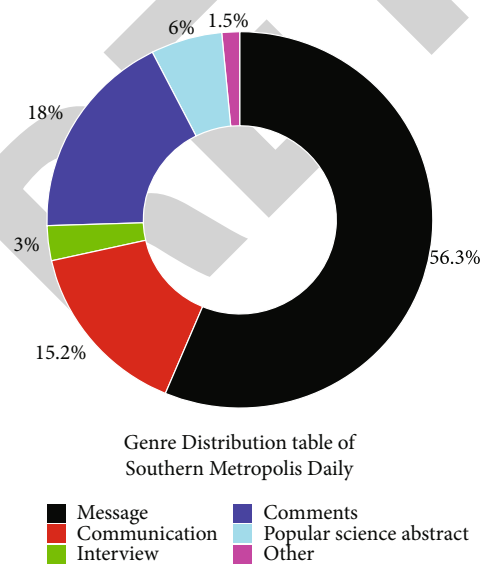


Figure 4: Strip chart of the reporting genre of Southern Metropolis Daily.

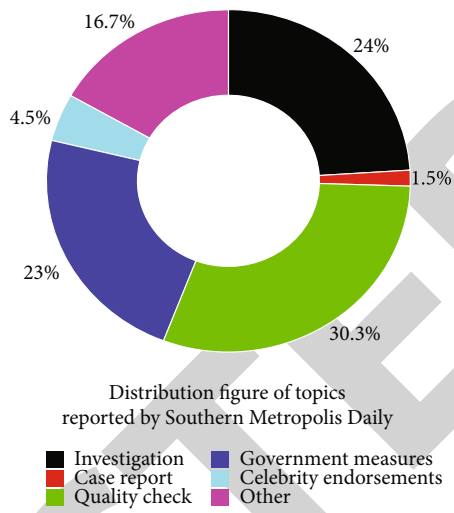


Figure 5: Distribution map of topics reported by Southern Metropolis Daily.

## 4. External Reporting Strategies of WeChat Official Account and Other Media

*4.1. The Amount of Reports Fluctuated Greatly, and the Outbreak Period Reached Its Peak.* The number of COVID-19 reports on the government official account "healthy China" ranks second among the three categories of official account, with 1804, roughly half of the "surging news" on the media official account. From the four stages of the epidemic development, the amount of reports of "healthy China" fluctuated greatly in each stage [20]. On March 9, 2020, Jianghan Fangcang Hospital, the largest Fangcang hospital in B, announced its closure, and the COVID-19 entered a continuous period. In the middle and late March, the number of new infections in many parts of the country fell to 0, and the epidemic was controlled as a whole. The number of reports of "healthy China" contracted to about half of the outbreak period, to 435. On April 8, 2020, B was "unsealed," and the epidemic development came to the recovery period. Obvious progress was made in the resumption of work and production and classes in various regions, and various industries began to return to normal operation. However, at the same time, in order to prevent the rebound of the epidemic caused by a large number of population movements, the relevant epidemic prevention measures are still not lax, such as the implementation of the serving of individual dishes and the control of the flow of people in public places of entertainment. Compared with the duration, the number of reports at this stage fluctuated slightly, rising slightly to 532. The details of reports in different periods are shown in Figure 9.

*4.2. Evening Reports Are the Main Ones, While Morning and Afternoon Reports Have Increased Significantly.* On the whole, since the gestation period, "healthy China" has remained dominated by evening reports, but the number of reports has increased significantly in the morning and afternoon. On the one hand, it is conducive to releasing

Table 4: Distribution of topics reported by Southern Metropolis Daily.

| Report theme | Southern Metropolis Daily | |
|---|---|---|
| | Number of reports | Proportion |
| Incident investigation | 16 | 24.0% |
| Case report | 1 | 1.5% |
| Quality inspection and problem capsule treatment | 20 | 30.3% |
| Government measures and disposal of relevant responsible persons | 15 | 23.0% |
| Celebrity endorsement | 3 | 4.5% |
| Other | 11 | 16.7% |

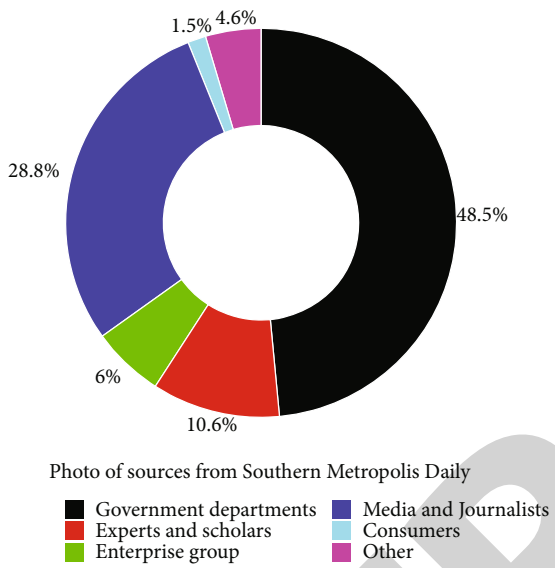


Figure 6: Columnar distribution of sources of Southern Metropolis Daily.

Table 5: Distribution of sources of Southern Metropolis Daily.

| Source | Southern Metropolis Daily | |
|---|---|---|
| | Number of reports | Proportion |
| Government departments and officials | 32 | 48.5% |
| Experts and scholars | 7 | 10.6% |
| Enterprise group and person in charge | 4 | 6.0% |
| Media and journalists | 19 | 28.8% |
| Consumer | 1 | 1.5% |
| Other | 3 | 4.6% |

relevant important information in a more timely and rapid manner, such as refuting rumors of false information and the route and whereabouts of infected people. On the other hand, due to the strict home isolation measures implemented throughout the country during the epidemic, the traditional work and rest time has changed, and the audience has relatively sufficient time to browse information in the morning and afternoon but also has greater demand for important information. The specific situation is shown in Figure 10 [21].

In terms of the distribution of push time, the push time of "healthy China" in each stage is mainly 19:00-24:00 in the evening, accounting for or close to half of the total. At the same time, through the analysis of samples, it is also found that the number of reports of "healthy China" in the morning between 8:00 and 10:00 in the brewing period is zero, while in the outbreak period, duration period, and recovery period, the number of reports in this period increased to 82, 37, and 88, accounting for 10.3%, 8.5%, and 16.5%, respectively, which is significantly higher than that in the brewing period [22]. In addition, in the afternoon between 13:00 and 17:00, the proportion of reports of "healthy China" in the outbreak period, duration period, and recovery period also increased significantly compared with the gestation period. Accordingly, the proportion of reports from 17:00 to 19:00 decreased compared with the gestation period.

*4.3. Pure Text and Graphic Forms Are Mainly Used, While Video Reports Have Increased.* In terms of content presentation, "healthy China" is mainly in the form of pure text and graphics in all stages, but there are also differences in each stage. The main performance is that in the outbreak period and duration period, the proportion of reported content in the form of video increased significantly compared with the brewing period, and the proportion of video reports in the outbreak period was the highest in the four stages, reaching 35%, and fell back to the level roughly equal to the brewing period in the recovery period, as shown in Figure 11 [23].

*4.4. Short Stories Dominated, and Medium and Long Ones Increased.* As shown in Figure 12, in terms of the length of the report, "healthy China" is mainly 0-5000 words in each stage, accounting for nearly or more than 60%. Especially in the brewing period, the proportion of reports with 0-5000 words reached 97%, while in the subsequent outbreak period, duration period, and recovery period, the proportion of reports with 0-5000 words decreased to about 60%, and the proportion of reports with more than 5000 words increased significantly, especially the amount of reports with 15000-20000 words increased rapidly from 0 in the brewing period to 106 in the outbreak period and 55 in the duration period. With the development of the COVID-19, the large-scale reports of "healthy China" have significantly increased, but the overall coverage remains small [24].

Table 6: Distribution of protagonists reported by Southern Metropolis Daily.

| Report protagonist | Southern Metropolis Daily | |
|---|---|---|
| | Number of reports | Proportion |
| Government departments and officials | 22 | 33.3% |
| Enterprise group and person in charge | 21 | 32.0% |
| Consumer | 2 | 3.0% |
| Social groups or organizations | 1 | 1.5% |
| Policies and regulations | 5 | 7.6% |
| Drug safety knowledge | 9 | 13.6% |
| Star | 2 | 3.0% |
| Other | 4 | 6.0% |

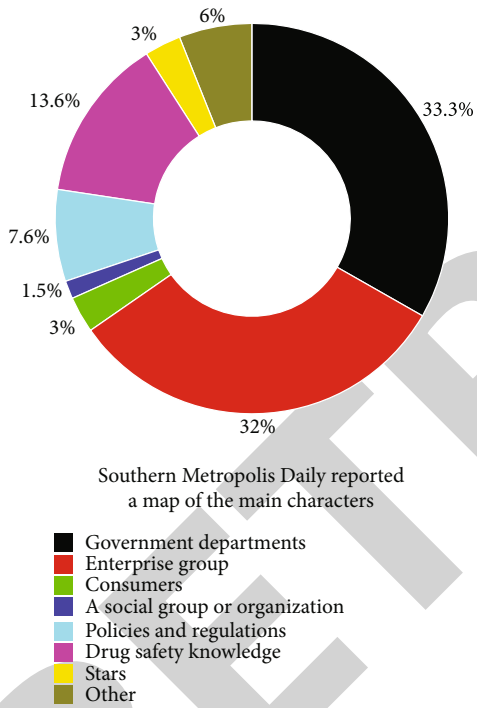


Figure 7: Distribution of protagonists reported by Southern Metropolis Daily.

Table 7: Distribution of reporting positions of Southern Metropolis Daily.

| Reporting position | Southern Metropolis Daily | |
|---|---|---|
| | Number of reports | Proportion |
| Positive | 5 | 7.6% |
| Neutral | 49 | 74.2% |
| Negative | 12 | 18.2% |

*4.5. The Original Is the Core, and the Source of Contributions Will Be Expanded in the Middle and Later Stages.* In terms of manuscript sources, the reports of "healthy China" in all stages are mainly original, and the original reports in the four stages account for more than 50%, reaching the highest in the recovery period, which is 65%. In addition, the amount of reports quoted from other mainstream media showed a gradual downward trend, with more than 40% in the gestation period and outbreak period, and fell to about 29% in the duration and recovery period. Through the analysis of the samples, it is found that the citations mainly come from the traditional mainstream authoritative media such as Xinhua news agency and people's daily and health news. In the first two stages of the severe epidemic situation, "healthy China" pays more attention to the quotation of information from the central media and party media, so as to ensure the authority and reliability of important information, answer audience doubts, and alleviate audience anxiety. In addition, the proportion of reports from social contributions and quoted from the media increased significantly during the duration, reaching 4.4% and 9.4%, respectively, and more attention was paid to the transmission of first-hand information from social groups, as shown in Table 8 [25].

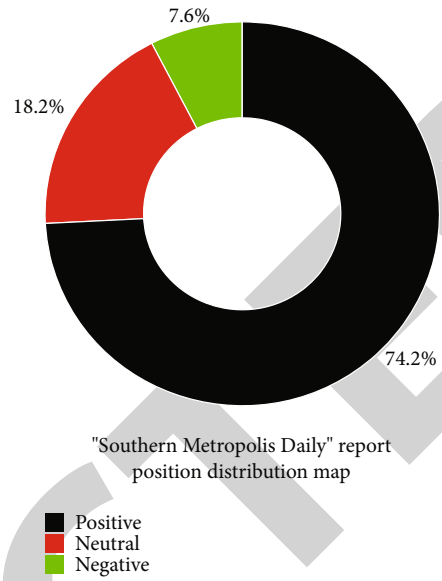


Figure 8: Distribution of reporting positions of Southern Metropolis Daily.

*4.6. Authoritative Departments Are the Primary Source of Information.* As shown in Table 9, in terms of news sources, the main sources of "healthy China" reports at all stages are from national leaders and government officials, accounting for more than 50%. Among them, 73% of the reports in the gestation period are from national leaders and government officials, which decreased in the subsequent outbreak period and duration period, 59% and 56.2%, respectively, and rebounded to 65.8% in the recovery period. The proportion of reports with experts and scholars as the main source also decreased, from 16.2% in the gestation period to 11.1% and 3% in the outbreak period and duration period. On the other hand, the proportion of reports with medical staff as the main source has increased significantly, from 10.8% in the gestation period to 19.6% in the outbreak period, 24% in the duration period, and 20.7% in the recovery period,

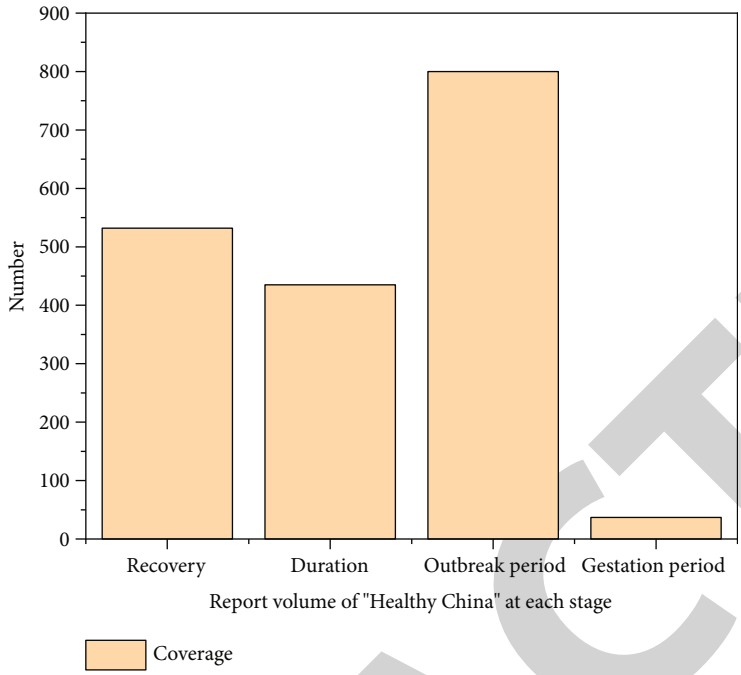


Figure 9: Report volume of "healthy China" at each stage.

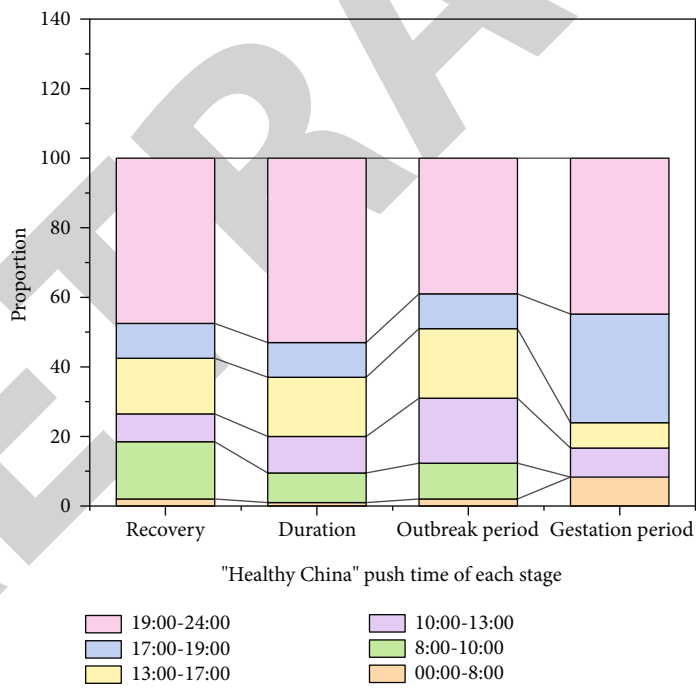


Figure 10: Push time of "healthy China" at each stage.

which are close to or more than twice the gestation period. The proportion of reports with people from all walks of life and the public as the main source has also increased from 0% in the gestation period to 4.4% and 7%. On the whole, during the epidemic, "healthy China" insisted on taking authoritative information from national leaders and government officials as the core source of its own reports and paid more attention to conveying the opinions and analysis of experts and scholars in the medical field during the gestation period when it was still unknown about novel coronavirus. As the epidemic gradually entered the outbreak period and duration, medical teams all over the country have supported all parts of Hubei, including B. Medical personnel have become the main force in the fight against the epidemic, and "healthy China" has also paid more attention to the report of information from medical personnel. At the same time, in addition to medical staff, a series of antiepidemic activities from all walks of life are also gradually spreading

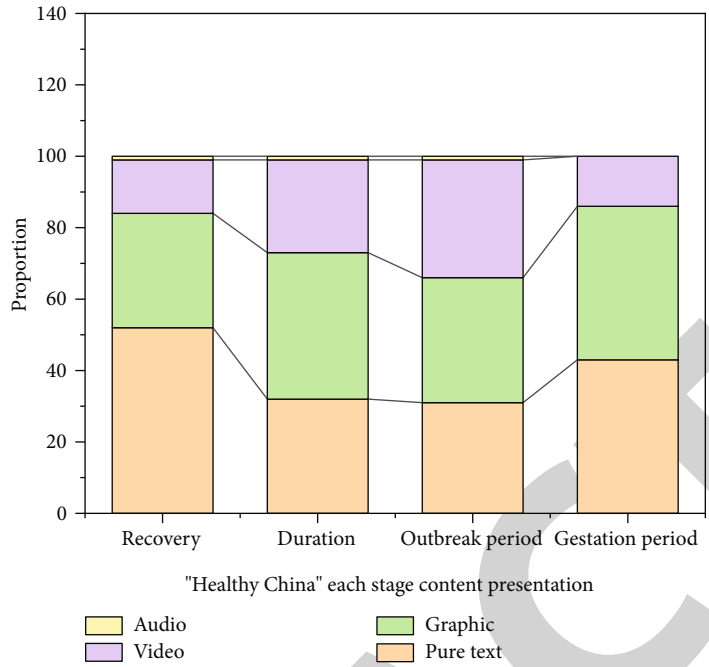


Figure 11: Content presentation of "healthy China" at each stage.

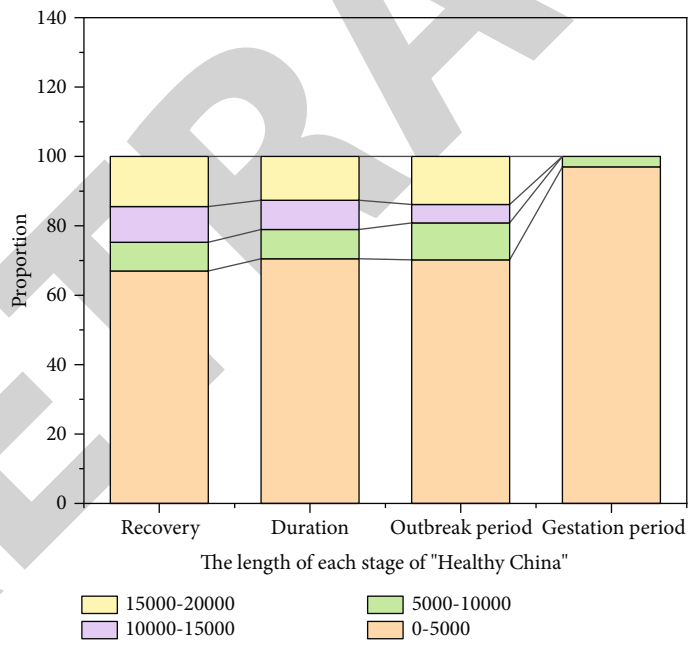


Figure 12: Text length of "healthy China" at each stage.



out during the outbreak and duration, and information from the police, grass-roots cadres, takeaway brothers, taxi drivers, and other people in all sectors of society and the public has also increased.

*4.7. The Change Trend of Relevant Reports of the Government and the Medical System Is Opposite.* The report topic is the most important category among all categories, which directly presents the core content reported by the three categories of WeChat official account. Government meetings, measures, and instructions were the main topics of coverage during the gestation period, accounting for 45.9%, and then decreased to 33.7%, 15.6%, and 17.5%, respectively. The work situation and advanced case reports of medical and epidemic prevention staff increased significantly after the gestation period, accounting for 21.3%, 29.9%, and 27.4%. A typical example occurred on February 7, when died after ineffective rescue. The reported amount of antiepidemic activities from all walks of life reached a peak during the duration, accounting for 6.9%. The

Table 8: Manuscript sources of "healthy China" at each stage.

| Manuscript source | Incubation | | Outbreak period | | Duration | | Convalescence | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Proportion | Quantity | Proportion | Quantity | Proportion | Quantity | Proportion |
| Original | 20 | 54% | 437 | 54.6% | 246 | 56.5% | 346 | 65.0% |
| Quote other mainstream media | 17 | 46% | 322 | 40.3% | 129 | 29.6% | 152 | 28.6% |
| Quoted from media | 0 | 0% | 14 | 1.7% | 19 | 4.4% | 12 | 2.3% |
| Social contribution | 0 | 0% | 26 | 3.3% | 41 | 9.4% | 21 | 4.0% |
| Foreign media | 0 | 0% | 1 | 0.1% | 0 | 0% | 1 | 0.2% |

Table 9: Sources of manuscripts at various stages of "healthy China."

| Source | Incubation | | Outbreak period | | Duration | | Convalescence | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Proportion | Quantity | Proportion | Quantity | Proportion | Quantity | Proportion |
| National leaders and government officials | 27 | 73.0% | 473 | 59.0% | 244 | 56.2% | 350 | 65.8% |
| Experts and scholars | 6 | 16.2% | 89 | 11.1% | 13 | 3.0% | 20 | 3.7% |
| Medical staff | 4 | 10.8% | 157 | 19.6% | 104 | 24.0% | 110 | 20.7% |
| Patient | 0 | 0% | 5 | 0.6% | 2 | 0.5% | 1 | 0.2% |
| Foreign governments and international organizations | 0 | 0% | 15 | 1.8% | 2 | 0.5% | 1 | 0.2% |
| People from all walks of life | 0 | 0% | 35 | 4.4% | 30 | 7.0% | 5 | 1.0% |
| Other | 0 | 0% | 27 | 3.4% | 39 | 9.0% | 45 | 8.4% |

proportion of epidemic prevention science popularization and troubleshooting reports was higher at the beginning of the epidemic, accounting for 27%, and then gradually fell, falling to 11.3% in the duration. The relevant reports on the production and living conditions of citizens during the epidemic period reached a peak in the duration, accounting for 13.1%. The resumption of work and production has been carried out in succession, and major cities across the country have gradually returned to normal production and living conditions. "Healthy China" has also paid more attention to the reports on this content. In addition, reports on the epidemic situation and prevention and control progress in various parts of the country, including Wuhan, peaked during the recovery period, accounting for 20.1%. Through the analysis of the samples, it is found that due to the overall control of the epidemic, the reports on government instructions and expert popular science content have been reduced, but at this time, all parts of the country still maintain a tight prevention and control situation, and the epidemic data notification in all regions of the country is still maintaining a certain frequency, so the proportion of such reports has increased in the recovery period. See Table 10 for details.

## 5. Analysis of Translation and Expression Strategies of Professional Terms in Publicity Reports of Public Emergencies

*5.1. Strengthen Discourse Awareness and Establish a Holistic View.* Due to the lack of textual awareness, there are a lot of cohesion problems. Most of these cohesion problems are caused by not thinking based on the text. Some studies believe that cohesion is a semantic concept, which refers to the relationship between the components in a text. Therefore, we can find that cohesive devices are not used groundlessly but serve the discourse. If the cohesive devices are used improperly, it will destroy the relationship between the textual components and make the text incoherent. Therefore, to choose appropriate cohesive devices, we must first establish discourse awareness, first understand the meaning of the whole text, and then choose cohesive devices.

*5.2. Flexible Use of Cohesive Means.* In addition to the rational use of these two strategies in publicity texts, another major feature is the use of a large number of cohesive devices. The rational use of cohesive devices can make the translation more coherent, and coherence is one of the important conditions for accurately conveying the information of the translation. The commonly used cohesive devices in publicity texts include reference, substitution, ellipsis, connection, and lexical means. Due to the formality of style, publicity texts have a high standard for the logic and coherence of language, and cohesive devices are one of the important means to achieve this standard.

There are great differences in cohesive devices between English and Chinese texts, because Chinese is a language that emphasizes "parataxis," while English is a language that emphasizes "hypotaxis." In Chinese expression, repetition is common and can be seen everywhere. However, in English, repetition should be avoided as much as possible, and some means, such as pronouns and synonyms, will be used to replace the expression that needs to be repeated. In terms of reference, there is little difference between English and Chinese. However, personal pronouns and demonstrative pronouns are used more frequently in English than in Chinese. In terms of substitution, English uses substitution more than Chinese, because Chinese is more inclined to reproduce the original word. In terms of ellipsis, because Chinese emphasizes "parataxis," Chinese expression will not focus

Table 10: Topics reported at various stages of "healthy China."

| Report theme | Incubation | | Outbreak period | | Duration | | Convalescence | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | Proportion | Quantity | Proportion | Quantity | Proportion | Quantity | Proportion |
| Government meetings, measures, and instructions | 17 | 45.9% | 270 | 33.7% | 68 | 15.6% | 93 | 17.5% |
| Working conditions and advanced cases of medical and epidemic prevention staff | 6 | 16.2% | 171 | 21.3% | 130 | 29.9% | 146 | 27.4% |
| Treatment and living conditions of affected patients and suspected infected persons | 0 | 0% | 21 | 2.6% | 6 | 1.4% | 14 | 2.6% |
| Antiepidemic activities of all sectors of society | 0 | 0% | 25 | 3.1% | 30 | 6.9% | 23 | 4.3% |
| Epidemic situation and prevention and control progress in China, including B | 4 | 10.8% | 57 | 7.1% | 55 | 12.7% | 110 | 20.1% |
| Epidemic prevention and control in the world and other countries, and exchanges and cooperation between China and other countries | 0 | 0% | 12 | 1.5% | 16 | 3.7% | 10 | 1.9% |
| Epidemic prevention science popularization, explanation of doubts | 10 | 27% | 168 | 20.9% | 49 | 11.3% | 53 | 10% |
| Activities and conferences of the World Health Organization, the United Nations, and other international organizations, and exchanges and cooperation between China and international organizations | 0 | 0% | 19 | 2.4% | 2 | 0.4% | 7 | 1.3% |
| Various adverse phenomena occurred during the epidemic | 0 | 0% | 1 | 0.1% | 6 | 1.4% | 1 | 0.2% |
| Spiritual inspiration to people | 0 | 0% | 13 | 1.6% | 12 | 2.8% | 12 | 2.3% |
| Production and living conditions of citizens during the epidemic period | 0 | 0% | 43 | 5.4% | 57 | 13.1% | 54 | 10.1% |
| Other | 0 | 0% | 0 | 0% | 4 | 0.1% | 9 | 1.7% |

on form. English emphasizes "hypotaxis" and "ellipsis is accompanied by formal or morphological markers in many cases" In short, it is not that a textual cohesive device will only be used in Chinese, not in English, and vice versa. In other words, reference, substitution, ellipsis, and connection are used in both Chinese and English, but the frequency of use is different, and the difference in frequency stems from the different emphasis of the two languages.

As Chinese is our mother tongue, it deeply affects our way of thinking. In the process of translation, we are easily drawn by the original text and easily copy the cohesive devices of the original text, such as the interpretation of the conjunction "Huan" in example 7. In Chinese, "Huan" can refer to both simultaneous events and successive events. If it is directly corresponding to "also" in English, it is easy to cause the problem of unknown event time. Therefore, in the process of translation, we should be aware of the differences in cohesive devices between English and Chinese texts. We should not directly apply the cohesive devices in the Chinese original text into the translation but deeply analyze the logical relationship between words and sentences and reselect the appropriate cohesive devices.

*5.3. Avoiding the Influence of Chinese Negative Transfer.* Because we are deeply and long influenced by our mother tongue, we will always be influenced by our mother tongue Chinese in the process of second language acquisition. As English is our second language, it is difficult for us to reach the level of native speakers at present, and every translation project is an opportunity for us to exercise and learn, so we will inevitably be affected by Chinese in the process of translation. For example, in terms of lexical cohesion, it is difficult to make good use of "cooccurrence." We often think of Chinese idiomatic collocations and then translate them into English. However, in English, such collocations are inappropriate, such as example 12. Therefore, when translating, we translators must be aware of the differences between Chinese and English languages, be able to jump out of the mother tongue circle, translate the text from the perspective of English readers, and strengthen our English thinking. Of course, to improve the use of cohesive devices, a lot of practice is essential. At the same time, we should also learn a lot of authentic English expressions and accumulate parallel texts to improve our level.

## 6. Conclusion

With the further deepening of globalization and the gradual improvement of China's international status, the demand for publicity translation is increasing. Publicity translation is aimed at introducing China to the outside world, covering politics, economy, culture, diplomacy, military, and many

other aspects. It is one of the important ways for the world to understand China. As translators, we must be careful when doing publicity translation and use cohesive devices reasonably to make the translation coherent and logical, so as to accurately express the meaning of the text.

As a publicity text, in order to improve the translation level and the ability to use cohesive devices, the author collected and studied the problems related to textual cohesion encountered in the process of preliminary translation and divided them into two categories: grammatical cohesion and lexical cohesion. Then, carry out secondary classification, divide the grammatical cohesion problems into four categories (reference, substitution, ellipsis, and connection), and divide the lexical cohesion problems into two categories (repetition and lexical collocation (cooccurrence)). In each subcategory, we find some typical cases, dig deep into the meaning of the original text, analyze the initial translation problems, break through them one by one, and summarize the laws.

Language carries the history and culture of a nation, and translation is a bridge to help us cross the language gap. Therefore, translation plays an extremely important role in cultural exchange. A good translation must be able to accurately convey the meaning of the original text. In order to accurately express the meaning of the text, the translation must be coherent, and to achieve coherence, it must be supported by appropriate cohesive means. Cohesion is not a simple stacking of discourse components, but an analysis of the meaning of each component and the relationship between their components. Then, choose appropriate cohesive devices to reflect this relationship. Due to the limited research on translation and the lack of translation experience, this paper will inevitably have some deficiencies, but I hope this paper can provide some inspiration and reference for the translation of other publicity texts in the selection of cohesive devices.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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https://doi.org/10.1155/2023/9865037

*Retraction*

# Retracted: Static and Dynamic Demonstration of the Ecological Level of Ethnic Cultural Industries Based on the Internet of Things and Environmental Responsibility

**Journal of Environmental and Public Health**

Received 25 July 2023; Accepted 25 July 2023; Published 26 July 2023



This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] W. Xie and S. Yu, "Static and Dynamic Demonstration of the Ecological Level of Ethnic Cultural Industries Based on the Internet of Things and Environmental Responsibility," *Journal of Environmental and Public Health*, vol. 2022, Article ID 5953522, 15 pages, 2022.

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https://doi.org/10.1155/2022/5953522

*Research Article*

# Static and Dynamic Demonstration of the Ecological Level of Ethnic Cultural Industries Based on the Internet of Things and Environmental Responsibility

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The cultural industry of ethnic minorities carries the wisdom of many ancients. In today's modernization, ethnic minority cultural industry products can still impress people's hearts with exquisite handicrafts, natural materials, and strong culture. The rise in demand for ethnic cultural products will bring about an increase in the demand for raw materials for handmade products, which is bound to have an impact on the environment. This paper is aimed at modeling and analyzing the ecological level of minority cultural industries based on the background of the Internet of Things (IoT) and environmental responsibility. In the experiment, this paper analyzed the ecological level of the traditional fish skin industry by taking the Hezhe people in Heilongjiang as an example. Aiming at the cultural industry of the Hezhe people, this paper selected the fish skin industry as the object of empirical analysis from the fish culture it represents. According to the ecological level of the industry, this paper selected the three first-level indicators of production energy saving level, ecological environmental protection level, and production emission reduction level and its 12 subordinate second-level indicators to model and analyze the fish skin industry of the Hezhe people. The analysis results showed that the industrial ecological level of the Hezhe fish skin industry in the past 16 years reached the standard rate of more than 75%. However, the ecological level index for the three years of 2018, 2019, and 2020 was between 0.3 and 0.5, which indicated that the ecological level in these three years was very low. This was caused by the mechanization of the handicraft industry in recent years.



## 1. Introduction

A nation's culture includes all emotions and attitudes involved in production and life, including material culture and spiritual culture formed in the interaction with the natural environment. The interaction and combination of the two constitute a complex national culture. Material culture is represented by clothing, handicrafts, dwellings, and food; spiritual culture is represented by language, customs, religion, taboo, social class, belief, etc. For cultural products, buyers mainly want to appreciate the special ethnic customs and satisfy their psychology of seeking difference, novelty, knowledge, pleasure, and exploration. Therefore, when cultural products are developed, culture should be regarded as the soul, and innovation should be carried out around it.

Cultural industry is a special form of cultural development, which links culture and economy together. Cultural exchange, dissemination, and development are realized, and economic benefits are obtained. The Hezhe people have a unique fish culture, which is a production and living culture based on a special natural and geographical environment. This reflects the cultural atmosphere of the combination of humanities and nature. Different from the cultural customs among different ethnic groups is the main

advantage of the Hezhe people in developing the cultural industry. The quaint and simple Hezhe customs are packaged into cultural products combined with modern culture, which does not lose its essence and does not highlight the trend. The excavation of cultural connotation must be paid attention to develop the cultural industry. If the industry is simply developed and the infiltration of cultural connotation is not valued, the development of the industry will be too single. The lack of the enrichment of cultural content makes the industrial development lack core competitiveness and stamina. The Hezhe fish culture is the core of developing the cultural industry. Therefore, the Hezhe people should pay attention to taking culture as the center of development while developing the cultural industry. The essence of development culture is the embodiment of competitiveness in the process of industrialization.

Ethnic minorities have a more traditional way of life and older technical skills. Their handmade products have more cultural heritage. For the cultural industry of ethnic minorities, many scholars have conducted researches. Based on sociological theory, Tarlow analyzed the inclusiveness of minority cultural industries and provided suggestions for the development of tourism from traditional industries [1]. Ding et al. used the corpus method to collect cultural industry news in Shanghai, Guangdong, Sichuan, and Shaanxi pilot free trade zones. The corpus was constructed and Python was used to analyze data from the cultural industry [2]. Rahimi et al. aimed at defining sustainability standards for traditional beekeeping in Iran, which was carried out using the three-stage classic Delphi technique [3]. Chen conducted a research on the development of cultural industry in recent years. A new direction for the development of ethnic minority traditional cultural industries was proposed [4]. Based on the collaborative innovation of the government, enterprises, universities, scientific research institutions and users, Wang et al. used the method of case study to analyze the situation of Shanghai's marine cultural industry. He also analyzed the possible deficiencies in talent training and proposed specific measures for talent training in the marine cultural industry [5]. However, their researches were more about the development and promotion of traditional industries. The purpose was to improve the economy of traditional industries. Responsibility for the ecological environment was not considered.

An environment-friendly society has always been the goal pursued by human beings. However, the economy and the environment have always been mutually destructive, which is an antagonistic relationship. There are many scholars who have done researches on the ecologicalization of industry. Based on the green economy theory, Jammoukh et al. used the gray system theory to make a dynamic forecast and analysis of the green development level of the development zone during the "Twelfth Five-Year Plan" period [6]. Yuan et al. used the gray dynamic correlation model to couple the three indicators with the economic growth rate and industrial structure optimization indicators [7]. Guan et al. established a comprehensive soil risk assessment method in industrial and mining areas. Taking a typical industrial and mining area as an example, the soil pollution risk was evaluated quantitatively and spatially [8]. Zhang et al. measured the pollution level of heavy industry and provided suggestions for its ecological construction based on the location of heavy industry [9]. Malshe and Krush focused its attention on the enterprise level. They regarded the production and sales link of the enterprise as a whole and designed the ecological evaluation indicators for the overall process of production and sales of products [10]. However, their researches were too broad. Specific cases have not been analyzed and the underlying operating principles have not been described.

The main innovations of this paper are combining the Internet of Things and the awareness of environmental ecological responsibility; the traditional cultural industries of ethnic minorities are analyzed from the perspective of environmental protection. In terms of analysis, the Hezhe fish skin industry is taken as the object of empirical analysis, which is specific to the meticulous industry. This kind of analysis is more targeted and has certain reference for the subsequent ecological development of the cultural industry. And in the analysis, the data obtained from the actual visit is used for analysis, which is very important for the verifiability and reliability of the results.

## 2. Minority Cultural Industries

*2.1. Internet of Things and the Cultural Industry of Ethnic Minorities.* Undoubtedly, the Internet of Things can bring huge economic and social benefits to the cultural industry of ethnic minorities, which is a key strategy for grasping the initiative of science and technology in the 21st century [11]. As shown in Figure 1, the application of the Internet of Things has been involved in all aspects of life.

Now, the Internet of Things is based on the Internet and extends the "tentacles" of the network to "everything." Therefore, problems such as information security, information explosion, and digital divide brought by the Internet may become more serious on the Internet of Things. The disruptive and harmful nature of the Internet of Things will be even more profound. This is completely contrary to the original intention of the Internet of Things design. Therefore, at the beginning of the full application of the Internet of Things, it is necessary to study its possible social impacts, especially negative impacts. The economic and social benefits brought by the Internet of Things need to be timely fed back, improved, and expanded [12]. The Internet of Things can connect with any item in time and space, which makes the Internet of Things reach a new dimension, as shown in Figure 2.

As a material form of information culture, it is based on the "value" brought by information technology. This is the materialized basis of the entire information culture, which provides a solid humanistic environment for the circulation of information. Information economy and information technology are the main contents of information culture as material form [13, 14]. At the level of the information economy and information technology, the Internet of Things may have the following effects on culture:

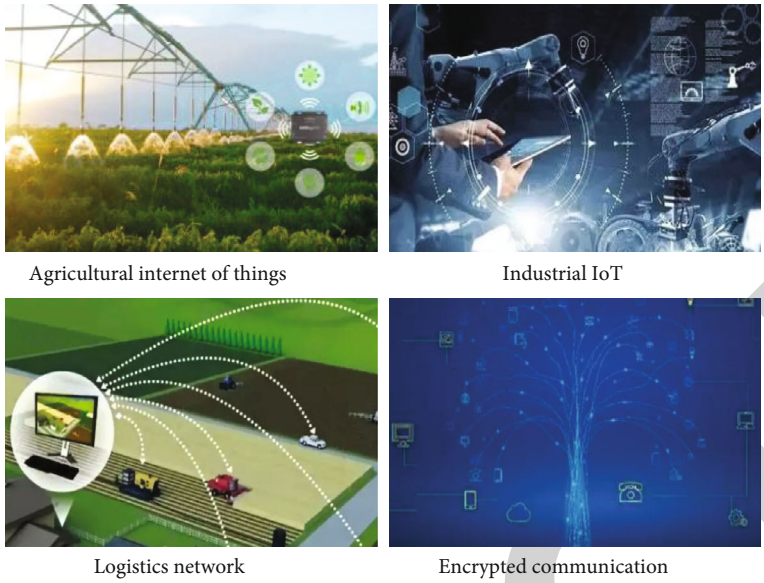



Figure 1: Application of the Internet of Things.

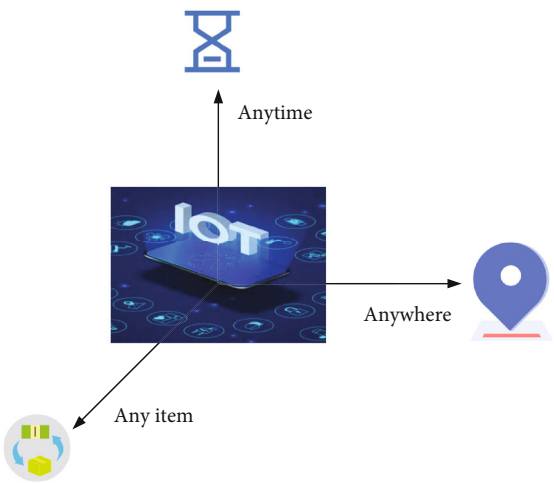



Figure 2: The new dimension of the Internet of Things.

Unemployment problem will be serious: the Internet of Things uses informatization as the means to promote the development of the information economy, which is mainly reflected in cost savings. It can not only achieve precise and meticulous control of all aspects of the economy but also reduce useless work. However, unemployment problems will follow. If the smart grid is implemented, meter readers will have nothing to do. Smart farming will drive more farmers off the land, and smart healthcare will drive more doctors off. Although the development of the Internet of Things can spawn many new industries and provide more jobs, it is very difficult to retrain those who have worked in familiar jobs for many years.

The development path of green economy is tortuous: the Internet of Things itself is a typical representative of green economy and low-carbon economy, which is also an important step in the transformation of information culture to "green culture." The Internet of Things is aimed at the green economy. By providing a series of applications such as smart buildings, smart cities, and smart environmental protection, the goals of energy conservation, emission reduction, and resource waste reduction can be achieved. In the construction of smart buildings and smart cities, how will the original infrastructure be handled? Due to the diversity of the original infrastructure, it is not only time-consuming and labor-intensive to transform on the original basis, but also it is impossible to know whether the expected effect can be achieved. If "breaking the old and building the new" is implemented, it will cause even greater waste. How to start a green economy? How can this be considered a green economy?

*2.2. Hezhe Fish Culture.* The fish culture of the Hezhe nationality refers to the cultural summation composed of the material culture created by the Hezhe nationality in production and life mainly based on the skin of fish, eating fish meat, and making fish skin handicrafts and spiritual culture with fish as totem belief under the natural conditions of the cold climate and abundant water in the early northeast. Fish culture is the tangible fish pictures, fish objects, and intangible fish customs and fish beliefs, which carry the wisdom and spirit of the Hezhe people and represent the life attitude of the simple Hezhe people who love, fear, and worship nature. This has important reference significance for coordinating the contradiction between man and land in today's society [15]. As shown in Figure 3.

Among the many Hezhe fish cultures, fish skin products are the most suitable for trading in the market as cultural products. Among them, there are many classifications of fish skin products, such as fish skin clothes, trousers, fish skin straw sandals, fish skin ornaments, and fish skin paintings. Among them, the fish skin coat is the most representative. Making fish skin into clothes is a very complicated job, which requires a series of delicate processes such as skin selection, peeling, drying, hammer pressing, stitching, cutting and stitching, and rust

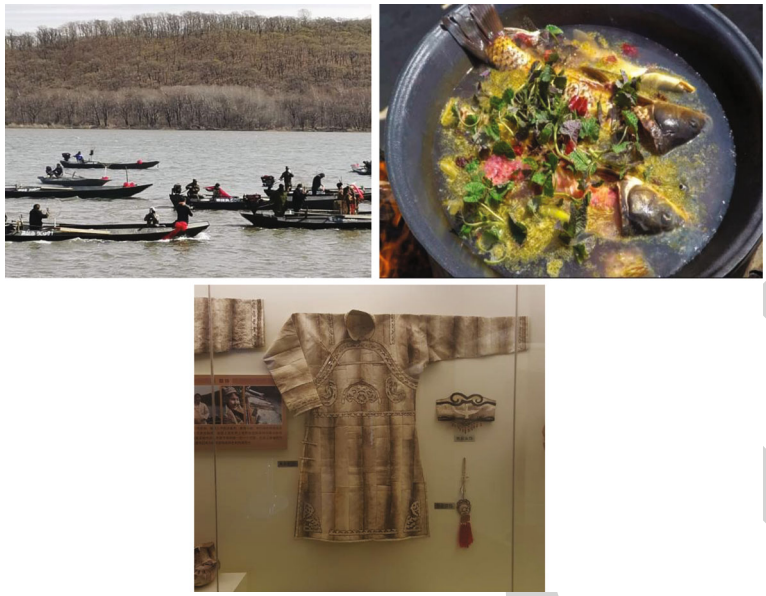


Figure 3: Hezhe fish culture.

decoration. Skin selection is to classify different types of fish skins. The soft skin of the fish is used to make clothes, and the thin and tough skin is used to make the fish skin line. Peeling is to peel off a whole piece of fish skin with scales, which is very difficult. The skin of the fish should be dried and dehydrated without losing its toughness. After peeling the fish skin, dry the skin by the fire, roll the skin tightly, put it in a wooden groove about 5 cm long and 2.5 cm wide, beat it with a sharp-free iron axe, or a special wooden axe, or put press repeatedly under the wooden rolling knife to soften the leather. You can also put cornmeal in the skin, which can remove the oil on the fish skin. Whether the fish skin clothes are soft, tough, and strong is closely related to the process of handling the skin [16]. After cutting, sewing, and decoration, the production of a fish skin garment is initially completed. The production process of fish skin clothes is complicated. At this stage, the production of fish skin products is all done by hand and machine production has not yet been popularized. Some fish skin industry products are shown in Figure 4.

*2.3. Evaluation Model of Ecological Level.* There are many methods for evaluating industrial ecologicalization. In the commonly used industrial ecologicalization evaluation models, whether the subjective weighting method or the objective weighting method is used to determine the index weight has certain limitations. On the basis that the advantages and disadvantages of various evaluation models are compared, and the application scope of each model is analyzed, this paper refers to the existing research results of other scholars and combines the improved information entropy with the principal component analysis method to evaluate the industrial ecological level. The model not only integrates subjective and objective factors, but also conducts specific analysis on each criterion layer in the index system. This enables the development status of the coking industry to be analyzed in more detail [17].

Information entropy is a basic concept of subordinate information theory, which is used to measure the amount of information. It is assumed that a system $X$ may appear in several different states $x_1, \cdots, x_n$, $p(x_i)$ represents the probability of the occurrence of $x_i (i = 1, 2, \cdots, n)$ states, then the information entropy $H(X)$ of the system is defined as

$$H(X) = -\sum_{i=1}^{n} p(x_i) \log (p(x_i)). \quad (1)$$

In the formula, $0 \le p(x_i) \le 1$ and $\sum_{i=1}^{n} p(x_i) = 1$. When $p(x_i) = 0$, $p(x_i) \log (p(x_i)) = 0$.

Information entropy is a method used to measure the ordering level of a system; the information entropy value of a system is inversely proportional to the degree of order of the system. The larger the information entropy value, the more disordered the system is. The information entropy obtains the index weight value through the operation of the data value of each index, which does not consider the influence of subjective factors on the evaluation object at all. The weight of each index is a reflection of the amount of effective information it contains. Therefore, the weights calculated by the information entropy method cannot fully reflect the importance of the indicators. The empirical factor also has a decisive effect on the indicator weight [18]. In this paper, experts' understanding of the importance of each index is added to the information entropy calculation. By constructing an expert decision reciprocal matrix, the row sum normalization method and the principle of minimum information entropy are used to improve and supplement the weight determined by traditional information entropy. Finally, the optimal solution of the comprehensive weight is obtained.

In this paper, the three first-level indicators are, respectively, established by the information entropy method to establish the evaluation model. 3 first-level index rankings are obtained. Assuming that a first-level indicator contains $m$ H-level small indicators, then a second-level indicator is

Figure 4: Fish skin industry products.

determined by a third-level indicator matrix. The specific calculation steps of each second-level indicator are as follows:

1 secondary indicator $k$ $(k = 1, 2, \cdots, p)$ contains $n$ enterprise samples and $m$ attribute indicators, which constitute the H-level indicator matrix $A_k$:

$$A_k = \begin{pmatrix} a_{11} & \cdots & a_{1m} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nm} \end{pmatrix}. \quad (2)$$

In the formula, $p$ is the number of secondary indicators, $n$ is the participating enterprises, $m$ is the number of H-level indicators included in the $k$-th secondary indicator.

Positive and negative indicators are defined. The positive index $a_{ij}^{+} \geq 0$ indicates that the larger the specific data value of the index, the better the level of industrial ecologicalization; the inverse index $a_{ij}^{-} \geq 0$ indicates that the smaller the specific data value of the index, the better the level of industrial ecologicalization. In order to ensure the consistency of each index in the evaluation of industrial ecologicalization and in the calculation of information entropy, it is necessary to standardize the positive and inverse indicators [19].

Positive attribute index normalization:

$$r_{ij} = \frac{a_{ij}^{+} - \min\left(a_{ij}^{+}\right)}{\max\left(a_{ij}^{+}\right) - \min\left(a_{ij}^{+}\right)}. \quad (3)$$

Inverse attribute index normalization:

$$r_{ij} = \frac{\max\left(a_{ij}^{-}\right) - a_{ij}^{-}}{\max\left(a_{ij}^{-}\right) - \min\left(a_{ij}^{-}\right)}. \quad (4)$$

After standardization, the decision matrix $R_k$ of the $k$-th secondary indicator is obtained.

$$R_k = \begin{pmatrix} r_{11} & \cdots & r_{1m} \\ \vdots & \ddots & \vdots \\ r_{n1} & \cdots & r_{nm} \end{pmatrix}. \quad (5)$$

The entropy $E_j$ of the attribute index $j$ is:

$$E_j = -k \sum_{i=1}^{n} r_{ij} \ln\left(r_{ij}\right). \quad (6)$$

Information bias:

$$d_j = 1 - E_j. \quad (7)$$

The weight of an index $j$ refers to the degree of influence of the index $j$ on the evaluation object. The so-called weight represents the decisive quantitative performance of the evaluation index in the overall evaluation. The size of the weight value of the indicator is proportional to the influence of the

indicator on the evaluation result. The weight of the indicator $j$ is

$$\omega_j^1 = \frac{d_j}{\sum_{j=1}^m d_j}, = \frac{1-E_j}{m-\sum_{j=1}^m E_j}. \quad (8)$$

From Formula (2) to Formula (8), the weight value obtained by the information entropy is obtained. However, it cannot fully represent the importance of indicators. The experience factor of experts in the relevant field is also very important to the decision result. Therefore, the information entropy needs to be improved. In the following part, by constructing the expert decision reciprocal matrix, the row sum normalization method and the most information entropy principle are adopted, the expert's experience factor is incorporated into the information entropy, and the optimal solution of the weight is obtained [20].

According to the reciprocal matrix given by the expert, the row sum normalization method is used to calculate the weight vector of the evaluation index

$$\omega_j^2 = \frac{\sum_{j=1}^n a_{ij}}{\sum_{k=1}^n \sum_{j=1}^n a_{kj}}. \quad (9)$$

The combined weight, $\omega_j$ is obtained by the weight $\omega_j^1$ calculated by the information entropy, and the weight $\omega_j^2$ is calculated by the expert opinion. According to the principle of minimum information entropy, the formula is

$$\min E = \sum_{i=1}^m \omega_j \ln \frac{(\omega_j)^2}{\omega_j^1 \omega_j^2}. \quad (10)$$

When min $E$ satisfies the minimum, the optimal solution can be obtained. The Lagrange multiplier method is used to construct the function to optimize the solution, and the formula can be obtained:

$$\omega_j = \frac{\sqrt{\omega_j^1 \omega_j^2}}{\sum_{i=1}^m \left(\omega_j^1 \omega_j^2\right)^{0.5}}. \quad (11)$$

It can be seen from the calculation that only when the part $\omega_j$ is equal to the geometric mean of $\omega_j^1$ and $\omega_j^2$, the min $E$ can be minimized, and the optimal solution can be obtained, and thus, the comprehensive weight of each evaluation index can be obtained.

The evaluation value of the secondary index is

$$Z_{i,k} = \sum_{j=1}^m \omega_j r_{ij}. \quad (12)$$

Table 1: Reciprocity scale column.

| Serial number | Compare | $b_{ij}$ |
|---|---|---|
| 1 | $\omega_i$ is as important as $\omega_j$ | 1 |
| 2 | $\omega_i$ is slightly more important than $\omega_j$ | 2 |
| 3 | $\omega_i$ is obviously more important than $\omega_j$ | 4 |
| 4 | $\omega_i$ is more important than $\omega_j$ | 6 |
| 5 | $\omega_i$ is extremely important than $\omega_j$ | 8 |
| 6 | $\omega_j$ is slightly more important than $\omega_i$ | 1/2 |
| 7 | $\omega_j$ is obviously more important than $\omega_i$ | 1/4 |
| 8 | $\omega_j$ is more important than $\omega_i$ | 1/6 |
| 9 | $\omega_j$ is extremely important than $\omega_i$ | 1/8 |

By repeating the steps, the secondary indicator matrix of the 3 secondary indicators is obtained:

$$Z_{n,p} = \begin{pmatrix} z_{11} & \cdots & z_{1p} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{np} \end{pmatrix}. \quad (13)$$

The principal components of the primary indicators are used to analyze the evaluation model.

The secondary index matrix $Z_{n,p}$ is subjected to principal component analysis, and the correlation coefficient matrix $R$ is calculated.

The $p$ eigenvalues of $R$ are computed:

$$\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_p \geq 0. \quad (14)$$

The corresponding eigenvector is

$$e_j = \left(l_{1j}, l_{2j}, \cdots, l_{pj}\right). \quad (15)$$

The variance contribution rate is calculated:

$$\alpha_i = \frac{\lambda_i}{\sum_{k=1}^p \lambda_k}. \quad (16)$$

The variance contribution rate is sorted in descending order, if the cumulative variance contribution rate of the first m indicators satisfies the following:

$$\alpha_{svm} = \sum_{k=1}^m \alpha_k \geq 85\%. \quad (17)$$

Then, it is considered that the $m$ principal components can comprehensively reflect $p$ indicators.

The principal components of a sample of $n$ years are computed:

$$M_{i,j} = Z_{n,p} \times \left[e_1, e_2, \cdots, e_p\right]^l. \quad (18)$$

Table 2: Judgment parameter matrix.

| | Production energy saving level | Ecological environmental protection level | Production emission reduction level |
|---|---|---|---|
| Production energy saving level | 1 | 1/2 | 1/2 |
| Ecological environmental protection level | 2 | 1 | 1 |
| Production emission reduction level | 2 | 1 | 1 |

Table 3: Indicator weights.

| Serial number | Indicator name | Weight |
|---|---|---|
| C1 | Average energy consumption per workshop | 0.022 |
| C2 | Average water consumption per workshop | 0.081 |
| C3 | Average electricity consumption per workshop | 0.045 |
| C4 | Elasticity of energy consumption in fish skin industry | 0.012 |
| C5 | Local greening rate | 0.105 |
| C6 | Workshop environmental protection | 0.231 |
| C7 | Waste disposal rate | 0.032 |
| C8 | Average wastewater discharge per workshop | 0.135 |
| C9 | Average waste emissions per workshop | 0.234 |
| C10 | Average exhaust emissions per workshop | 0.072 |
| C11 | Industrial waste discharge compliance rate | 0.019 |
| C12 | Industrial exhaust emission compliance rate | 0.012 |

The first $m$ principal components are selected, and the first-level indicators are obtained by calculation

$$F_i = \sum_{i,j}^{m} \alpha_j M_{i,j}. \tag{19}$$

$F_i$ is sorted, that is, the comprehensive evaluation ranking is obtained.

## 3. Demonstration of the Level of Industrial Ecologicalization

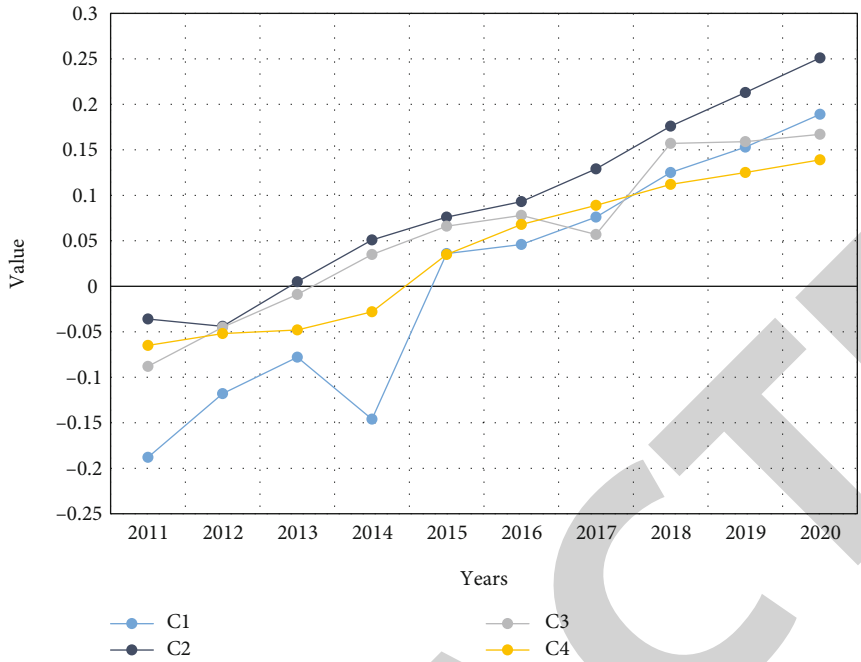
*3.1. Natural Ecology of the Hezhe People in Raohe County.* The biotechnological methods of the Hezhe people seem to be used as national symbols. Living along the river and surrounded by mountains and forests endow the Hezhe people with good conditions for fishing and hunting. Raohe County governs the area along the west bank of the Ussuri River, surrounded by mountains and rivers. The mountains in the south and west belong to the Wanda Mountains, which are mostly forested with birch, linden, oak, pine, poplar, elm, willow, and other trees. [21] Forests account for more than 79% of the county's land area, and there are many wild animals such as tigers, bears, deer, wild boars, and wolves, as well as fine-haired beasts such as nettles, foxes, weasels, and Shaw. In the north, the vast fields of the Naoli River, the Bilayin River, the Nongjiang River, and the Qili River form an area where the rivers and canals are crisscrossed in the lower reaches of the three rivers. These water towns are rich in fish such as maha, carp, crucian carp, ham, catfish, mandarin fish, and fine lin. These natural conditions are suitable for the Hezhe people hunting and fishing production. From the perspective of latitude and longitude, Raohe County is located in the frigid zone. The lowest temperature over the years is below minus 35 degrees Celsius and the highest temperature is above 30 degrees Celsius. The icing period starts from late October to mid-November on the solar calendar every year, and the ice-releasing period starts from mid-May. The farming period is about six months from late April to early October. The climate here is moderately sunny and rainy, which is suitable for agricultural production. The soil here is fertile, generally clay or clay-sand mixed with humus, which is suitable for cultivating paddy fields [22, 23].

Feeding on fish and animal meat and using fish and animal skins as raw materials for clothing is a true portrayal of the life of the Hezhe people. From the beginning of spring fishing, the women began to process fish skins. Until the fall, the skins needed for the year are picked out to make clothes and leather goods. Animal skins are also processed in spring, summer, and autumn. And these processed products are used to make clothing for winter hunting.

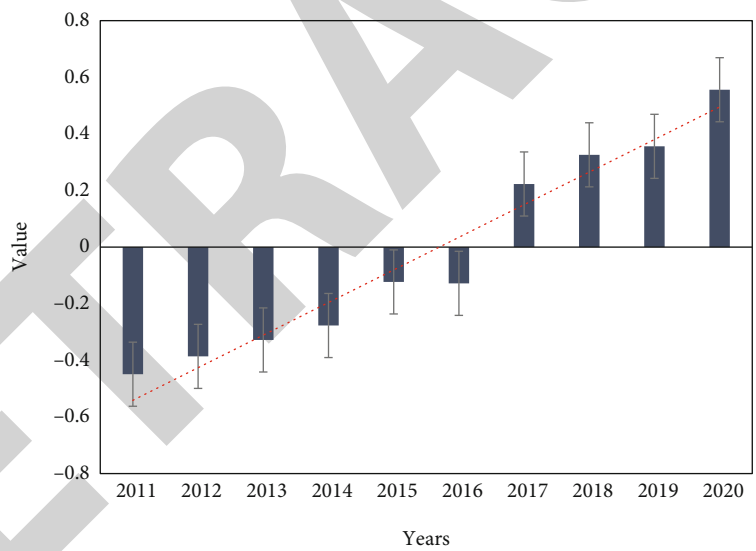
Various fish skins have different uses. For example, fathead fish and pike skin can be used as fish skin lines and pants. Fish skins such as white head fish, jellyfish, salmon, and tangled fish can be used as lepers; tartar can also be used as hand stuffy son. Carp skin and fish skin can be used as clothes and trousers. The wrapping fish skin will not become moldy after being soaked in water, so the clothes made of wrapping fish skin are worn when fishing in summer, and other clothes made of fish skin are worn in winter. Animal hides also have varying degrees of use due to their different properties. Dog skins are mainly used to make quilts, mattresses, coats, hats, etc. Deerskin can be used to make all kinds of clothes and cigarette pockets. Bear skins and boar skins can be used as boots and mattresses. [24]

*3.2. Selection of the Evaluation Index System for the Ecological Level of the Hezhe Fish Skin Industry.* To achieve ecological development, the Hezhe fish skin industry includes not only economic factors, but also environmental, ecological, humanistic, and other factors. Therefore, this paper cannot only focus on one aspect in the process of researching the problem, but must consider it comprehensively. Therefore, in the design of the indicator system, three major categories and twelve subcategories are divided [25].

When the data is standardized, data is mainly obtained from the National Bureau of Statistics and a small amount of data is obtained from enterprise surveys. Then different




(a) Secondary index after weight processing




(b) The first-level index after weight processing

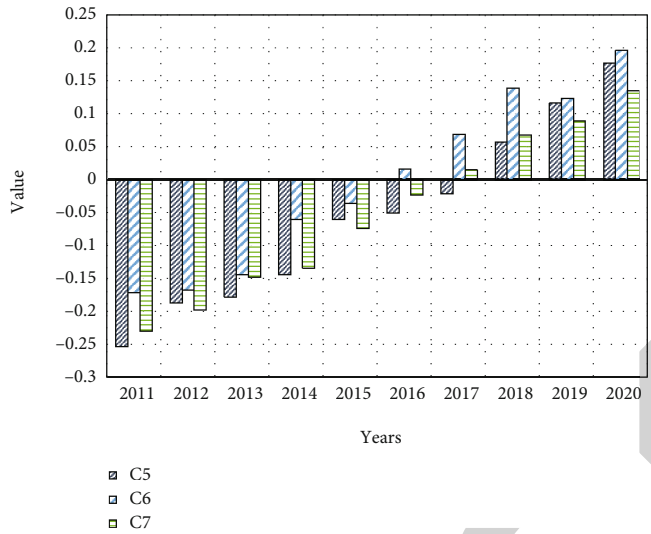
Figure 5: Index of production energy saving level.



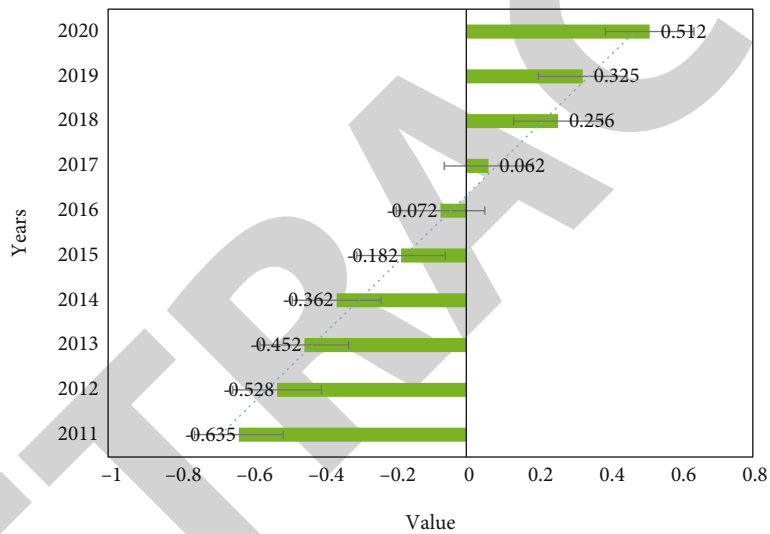
categories of data are combined for standard processing to obtain various indicator data; at the same time, according to the influence degree of each data on ecologicalization, different index weight coefficients are set, an ecological evaluation model is established and relevant ecological data indicators are calculated.

In the normalization of the index data, the methods of forwardization and dimensionlessization are used. The indicators that positively promote the ecological level of the Hezhe fish skin industry are positive indicators, and this indicator includes data related to waste treatment. And the higher the data, the higher the standard of ecological level. Inverse indicators have a negative effect on the Hezhe fish skin industry. For example, the higher the exhaust emission, the lower the ecological level. This is a inverse indicator. When determining the index system, there must be a distinction between forward and reverse, otherwise, the data cannot be calculated scientifically. The forward processing is to take the reciprocal of the reverse index, and this forward processing is conducive to the dimensionless analysis of the index. Some indicators have different data and defined dimensions, so comparisons cannot be made. Therefore, the affected amount must be eliminated [26, 27].

As shown in Table 1, the expert scores are 1, 2, 4, 6, and 8 according to the scale of 1-9, indicating the importance of the $\omega_i$ index relative to $\omega_j$ Table 1 lists the specific scale table.




(a) Secondary index after weight processing




(b) The first-level index after weight processing

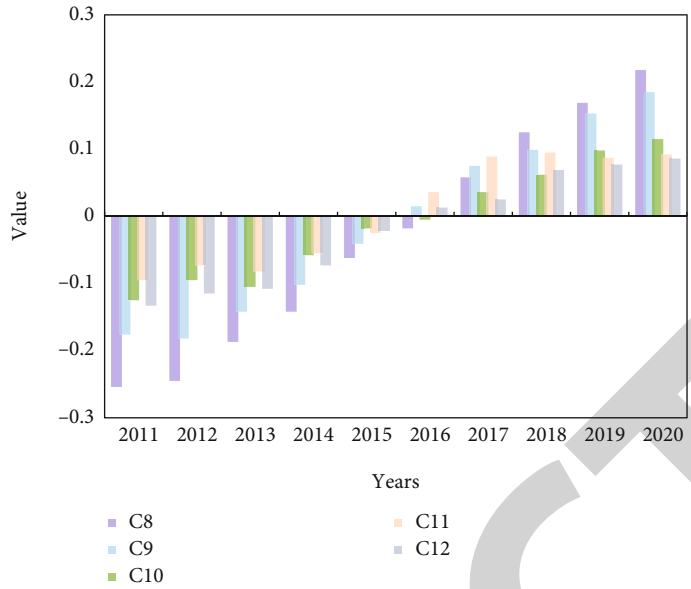
Figure 6: Ecological environmental protection level index.

After that, the calculation and judgment parameters are shown in Table 2.

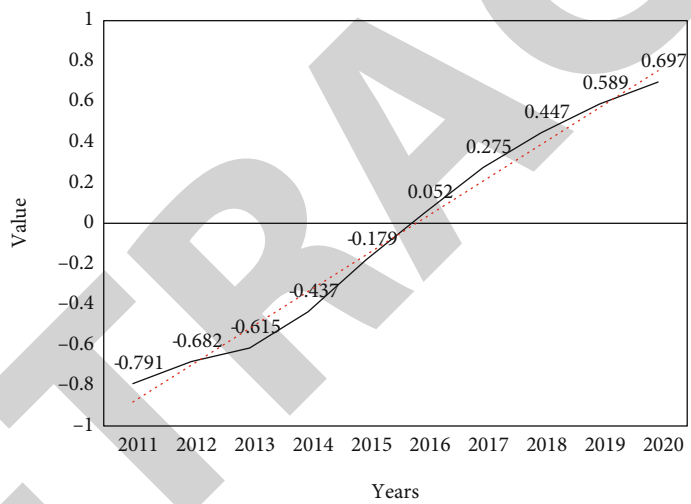
Finally, the data is input into SPSS software, and the weight of each secondary indicator is obtained as shown in Table 3.

Then combined with the actual situation, the three first-level indicators are analyzed separately.

*3.3. Production Energy Saving Level Index and Secondary Index.* As shown in Figure 5, the correlation of the production energy saving level indicators can be seen. During the current study period, the energy consumption per unit of Gross Domestic Product (GDP) showed a steady upward trend. There are two indicators: energy consumption per unit of GDP. Both the comprehensive index and the electricity consumption index per unit of GDP belong to the growth stage, which tends to rise steadily. It can be seen from the previous investigation that the electricity consumption of million industrial output value can only be said to be much higher than that of the other three, with an exponential growth. That said, during this period, the fish skin industry has made significant progress in improving the efficiency of electrical energy utilization. However, the index of water consumption per unit of GDP is one of the indicators studied. During this period, the fish skin industry had a high demand and dependence on water resources. At the same time, there is no optimal use of water resources. The significant increase in the index in 2018 shows that the energy conservation and emission reduction work adopted in recent years has achieved remarkable results. The dependence on water resources is reduced, and the utilization rate of water resources is improved. The energy consumption elasticity index has also increased significantly from the beginning of the study to the present, from -0.065 in 2011 to 0.139 in 2020. The energy-saving level index of fish skin industry production is shown in Figure 5.




(a) Secondary index after weight processing




(b) The first-level index after weight processing

Figure 7: Emission reduction level index.

From Figure 5, it can be concluded that the energy-saving level of Hezhe fish skin industry production from 2011 to 2020 is rising, but there are different levels of growth every year. Especially in recent years after 2016, there has been a more rapid growth. The reason for this situation is related to the transformation of the economic growth pattern after 2016. The initial extensive economic growth has now become dependent on scientific and technological progress and human resources. The policies of the relevant functional departments of Heilongjiang Province have strongly supported the industry, and the state has also subsidized it. The energy efficiency of enterprises has been improved, and the level of the fish skin industry has been promoted.

*3.4. Ecological and Environmental Protection Level Index and Secondary Index.* From the data in Figure 6, it can be concluded that from 2011 to 2020, the proportion of environmental protection output value continued to show an upward trend year by year. But there have also been two particularly volatile years in the process, that is, 2012 and 2019. Although there have been some fluctuations in the past two years, it does not affect the overall development trend of growth. What really matters is the right question reflected behind it. Society is constantly developing and progressing. It can be found that the smallest index among the three indices in 2011 is -0.254. It is also because in the early stage of research and development, the focus of entrepreneurs and investors is not one aspect. From 2011 to 2020, various indicators are constantly changing. Among them, the rapid growth in 2018-2019 also reflects the good foundation of ecological environmental protection, so that this rapid and steady upward trend can be obtained. By 2018, the metric is higher than the other two indices. In the course of development in the past ten years, Heilongjiang Province has

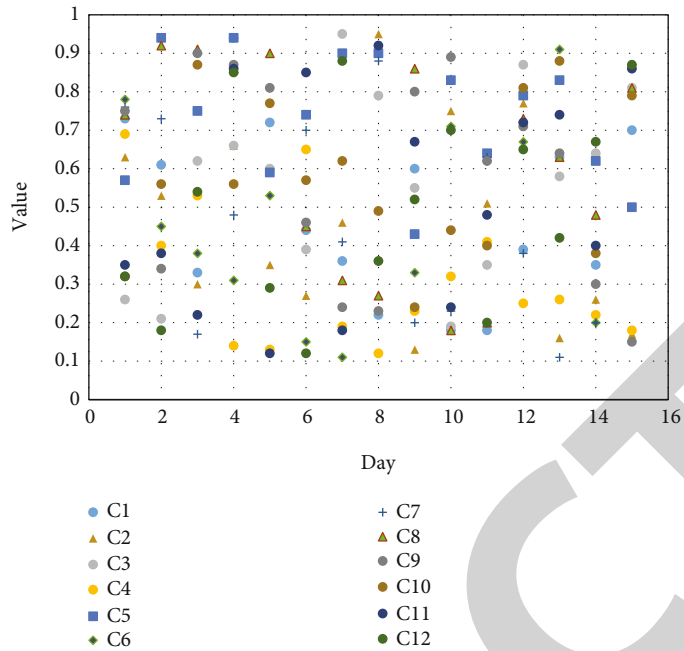



Figure 8: Dimensionless data of fish skin ecosystem for 16 consecutive days.

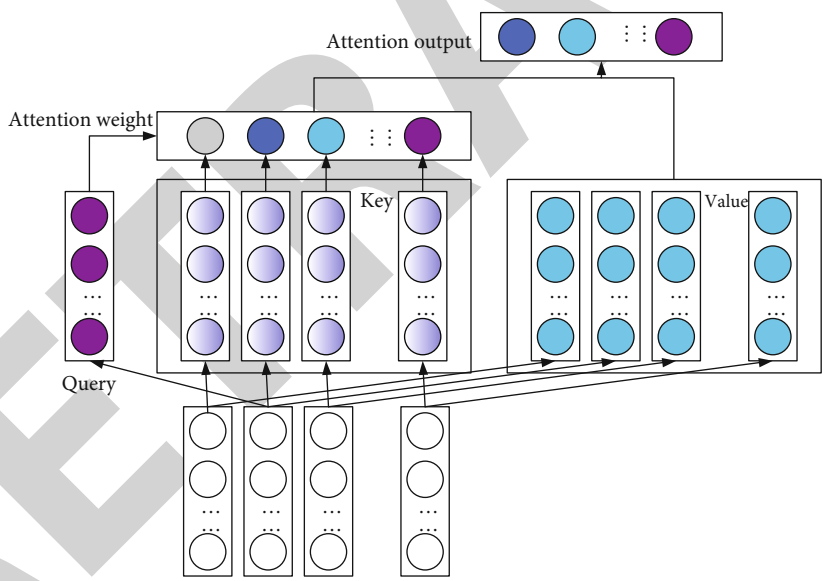


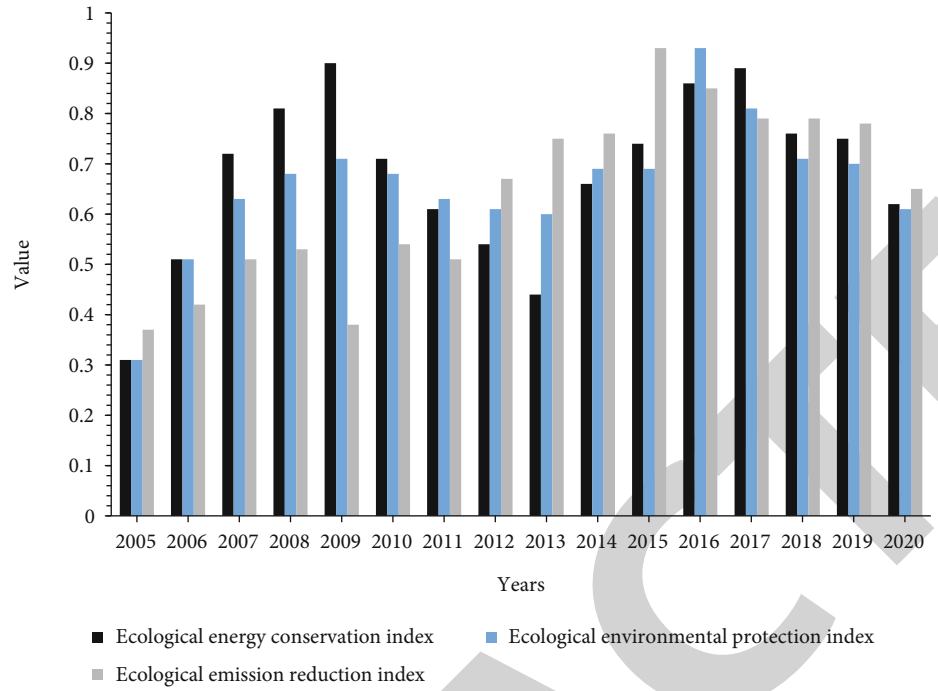

Figure 9: Attention mechanism.

Table 4: Standards for classification of safety levels.

| Security level | State | Score |
|---|---|---|
| E | Very dangerous | <0.3 |
| D | Dangerous | [0.3,0.5) |
| C | Critical value | [0.5,0.7) |
| B | Safer | [0.7,0.9] |
| A | Very safe | >0.9 |

been increasing its investment in this field. From 2011 to 2020, the trend of the waste disposal rate index can also be used to judge its efforts in this regard, rising from -0.231 in 2011 to 0.135 in 2020. The ecological and environmental protection level indicators of Hezhe fish skin industry over the years are shown in Figure 6.

By analyzing the information in Figure 6, it can be concluded that during the period from 2011 to 2020, the entire environmental protection index continued to show a steady, rising, and increasing trend, which rise from -0.635 in 2011 to 0.512 in 2020. Among them, the period from 2017 to 2018 has developed rapidly, which reflects the actual situation that the government is vigorously promoting the concept of environmental protection. However, from 2018 to 2019, the development is relatively slow and not as obvious as before. It is because after the development reaches a certain level,




(a) System review score


(b) System review rating

Figure 10: System ecological security evaluation results in the past 16 years.



the period of rapid growth has passed. Environmental protection work will be a long-term process. The faster development in 2020 is also related to less pollution emissions during the epidemic prevention and control period.

*3.5. Production Emission Reduction Level Index and Secondary Index.* From the data in Figure 7, the corresponding index changes and trends can be seen. The rapid rise in the wastewater discharge rate index from 2011 to 2020 shows that the work done by the industry has not been effective in reducing wastewater discharge. In 2020, the proportion of wastewater discharge per unit of output value will increase by 0.2158, which shows that more work and efforts need to be done in wastewater discharge. The overall exhaust emission rate is on the rise. The small decline around 2012 did not affect the overall upward trend. The growth rate of this indicator has accelerated around 2019, and attention should be paid to increasing the control of exhaust emissions. From 2011 to 2020, waste emissions showed a steady upward trend. Affected by economic development in 2012, it fell slightly and then continued to rebound. Although the overall development of wastewater compliance rate is

relatively unstable, it developed rapidly from 2014 to 2017, and reached a maximum of 0.098 in 2018. This rapid growth declined significantly in 2019. This is in an unstable state. Although it rose to 0.115 in 2020, this unstable state did not reach the highest value in 2018 but remained basically within the stable state. The exhaust gas emission compliance rate rose from -0.133 to 0.086, showing an upward trend. This shows that the government has done a lot of work on exhaust emissions. The annual emission reduction level indicators of Hezhe fish skin industry are shown in Figure 7.

By analyzing the information in Figure 7, it can be concluded that during the period from 2011 to 2020, the overall level index is an increasing trend with an overall upward trend. Through this trend, it can be shown that a number of industries have begun to carry out continuous research and rationalization of transformation and upgrading in this regard. It rose from -0.791 in 2011 to 0.697 in 2020. Then from 2011 to 2020, the emission reduction index showed a trend of stable development and a gradual increase, that is to say, the government is constantly increasing its capital investment in this area. During the period from 2014 to 2018, there has been rapid development. After 2018, although there is a trend of growth, it is less obvious than other years.

## 4. Demonstration of Hezhe Fish Skin Industry

The data are mainly derived from the actual survey of fish skin industry enterprises. Through the statistics and sorting of the relevant indicators of the daily fish skin industry for 16 years, the data information within 16 consecutive days is selected. The daily data is composed of 16-dimensional features, and the data of each dimension's features after dimensionless processing is shown in Figure 8. There are large differences in units and data sizes between indicators. In order to achieve unified processing, the data can be dimensionless processed first. The entropy weight method is used to determine the principle of their respective weights, so that the final index data dimensionless result is between 0.1-0.95.

Humans will select specific parts to focus on when processing images, which is the so-called attention mechanism. This mechanism is also used in computer and machine vision. In the face of complex scenes, a global overview is firstly browsed, and then a centralized observation is performed according to the algorithm. This mechanism can also be well applied to the determination of indicator weights. In this paper, the method of attention mechanism is applied to the data recording of the ecologicalization of the Hezhe fish skin industry. The weight value assigned to each index feature is determined according to the size of the attention weight and multiple features can be better integrated. The ecological level of evaluation based on the feature can be achieved, as shown in Figure 9.

In the research process of this paper, the evaluation of the fish skin ecosystem should have clear standards and grades. Referring to the relevant literature on ecosystem assessment in the previous theoretical part, this paper divides the grades of fish skin ecosystem security assessment. The corresponding scores are shown in Table 4.

According to the previous analysis and calculation, the ecologicalization of the fish skin industry in Heilongjiang Province is early-warned. By tracking the data, the security level is analyzed. According to the ecological level, when the comprehensive evaluation level of the year reaches level D (less safe) and level C (critical safety), an early warning should be activated to prevent further deterioration of the ecological level. The data from 2005 to 2020 are simulated, and the results are shown in Figure 10.

As shown in Figure 10, the security of the fish skin ecosystem in the past 16 years is not so optimistic. The environmental protection meaning of a large number of traditional workshops is low, and the damage to the environment is getting worse. For large enterprises, the relevant systems are not perfect and environmental issues are not paid enough attention. It can be seen that after 2015, the evaluation level of the system is getting lower and lower, which shows that the ecological problem of the Hezhe fish skin industry is facing great difficulties.

## 5. Conclusions

At present, the Hezhe fish skin industry does not have a complete system, and the development of the cultural industry requires mass production of cultural products in accordance with industrial production standards. The handmaking of Hezhe fish skin products will affect the overall development of the cultural industry. Since fish skin clothing is a finely processed product, it must be made by hand, and it is not recommended to be done by machine. But other fish skin products such as fish skin paintings and fish skin ornaments are easier to complete by machines. Whether it is the economic development of the Hezhe nationality or the protection of traditional culture, cultivating and absorbing a large number of talents is the fundamental guarantee for success. In terms of economy, governments at all levels should provide preferential conditions for some Hezhe people to return to their hometowns to start businesses. For example, the government can contact various large enterprises to provide internship opportunities for Hezhe students, allowing them to learn the advanced management experience of these enterprises. Preferential policies on capital and technology are provided to enable students to return to hometowns to start businesses. These students born and grew up here, and their understanding of the local area and the grasp of local wisdom are naturally better than those brought in from outside. The cultivated phoenix should be allowed to fly back to hometown. In the current transitional period, it is not only necessary to recruit "the businessmen of other countries" and "the capital of other countries," but also to give greater financial and policy support to those capable people who can establish themselves in the village and lead the villagers to start their own businesses. In addition, in terms of culture, the government should actively cultivate the inheritors of the Hezhe culture and the management talents for the management of the Hezhe culture. Research talents on Hezhe culture should also be absorbed. To develop the fish culture industry, the Hezhe people must take culture

as their soul. The distinctive culture of Hezhe needs to be extracted and packaged.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

## Acknowledgments

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*Retraction*

# Retracted: Sustainable Development Research of Green Smart Park in High-End Manufacturing Based on Internet of Things

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] J. Deng, "Sustainable Development Research of Green Smart Park in High-End Manufacturing Based on Internet of Things," *Journal of Environmental and Public Health*, vol. 2022, Article ID 3961647, 9 pages, 2022.

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*Research Article*

# Sustainable Development Research of Green Smart Park in High-End Manufacturing Based on Internet of Things

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During the transition from industrial production to intelligent, there are still a large number of manufacturing industries in the traditional production mode. The problems of slow information transmission, difficult integrated production management, and complicated process parameter control have led to disconnect decision-making from actual production. In addition, the current manufacturing industry is more of a traditional management method, and the upgrade and iteration speed are slow, and it is not combined with the technology of the Internet of Things. Therefore, the purpose of this article is to use the Internet of Things monitoring technology to explore the improvement of high-end manufacturing and analyze the problems and solutions in the process of consistency of ecological environment and economic effects. This article will use the research methods of specific problems and specific analysis to compare the data and draw conclusions. This article will discuss the technical mechanism of the Internet of Things monitoring and introduce the collection and data of production status data of each station equipment in the production workshop during the production process: improving the current production model, learning foreign experience at the same time, quickly carrying out load curve and data center data accumulation on the service capabilities of the park, verifying multiple operating models, and simultaneously exploring new management models. Based on comparative advantage analysis, the study draws similarities and differences in the development of high-end manufacturing industries at home and abroad, learns advanced experience, proposes improved methods and paths, combines new environmental protection paths, and finally proposes energy operation in the park. Build a green and intelligent park to provide a theoretical reference for sustainable development. The research results show that computer monitoring technology and methods have effectively improved the production environment of high-end manufacturing, combined with the development status of the existing ecological and intelligent composite production system; the infrastructure construction of industrial parks in the new era, IT support, services, manpower resources, and industries has developed rapidly.



## 1. Introduction

With the fast grow and in-depth use of new information technology like Internet of things, Internet plus, and AI, people's quality of production and life has been greatly improved, which not only promotes the economic development but also provides technical support for the transformation and upgrading of the economic structure. The current smart parks also focus more on smart logistics and IOT construction but lack quality monitoring and supervision. In order to better elevate the green and high-quality development of manufacturing industry, it is necessary to establish a complete monitoring system. In the organizational structure of the monitoring system in the green smart park, monitoring nodes are arranged according to the actual monitoring needs to ensure that the monitoring of the environment in the area and the collection of data and information can be met. It has made great contribution to the sustainable development of high-end manufacturing green smart park.

In the development process of high-end manufacturing industry, smart park has become a new trend and new requirement for the development of industrial park. With the promotion of comprehensive national strength, we are

improving our quality of life step by step. But at the same time, we cannot damage the ecological environment [1, 2]. General Secretary Xi pointed out that green water and green mountains are golden mountains and silver mountains, which proves the attitude towards the relationship between natural environment and economic development at the national level. While pursuing material interests, we should also fully consider the negative impact of manufacturing industry chain on other industries and the environment [3, 4]. In the era of wide application technology, we have realized the connection of things through sensors according to the requirements of human production and operation to realize the monitoring of human production status index [5]. Through production monitoring, the calculation and supervision of each production environment indicator in a specific region will be more convenient to update all production indicators in real time, and further efforts will be made towards the goal of green development. To study high-end manufacturing green smart park, we need to observe and analyze the industrial park, people, and environment as a whole and apply Internet of Things, big data, and cloud technology to improve the level of environmental management [6, 7]. In addition to the data collection function of environmental awareness, that is, the perception of environmental elements becomes more convenient, while accelerating the collection and transmission of information, enriching the methods of data storage and data analysis, it can also cover a wider range, and at the same time, it can build a unified common management data platform [8, 9]. Combined with other big data such as economy, production, life, and business, the comprehensive analysis can bring more perfect decision support to production management [10]. The problem of resources and environment is a common challenge for human beings. As an important carrier of urban economic development, industrial parks must adhere to the concept of green development and enhance their core competitiveness. Accelerating the green development of industry is an important measure to promote the supply side structural reform and promote the stable growth and structural adjustment of industry [11–13].

Since the 1950s, researchers in developed countries and regions have carried out a variety of targeted scientific research experiments on industrial park monitoring and environmental quality improvement [14]. Research at home and abroad shows that a large amount of human and material resources need to be invested in the early stage of monitoring network research and development. European countries are relatively conservative and adopt a monitoring point to collect only one kind of air data information, while the research of the United States in related fields is much more advanced than that of Europe [15, 16]. Many foreign scholars have concentrated on building production quality monitoring networks and national monitoring networks for trial operation of multiple industrial parks, which are used to monitor their production conditions. Then, they conduct professional assessment of air quality in these areas and seek to find their internal change trajectory [17]. Domestic scholars put forward a plan to establish an intelligent environmental monitoring system of the Internet of Things based on the research status of foreign countries. Using 51 single-chip microcomputers as an embedded processor, multiple subnodes collect environmental data through sensors and send it out by wireless module, while the total node receives and displays environmental data wirelessly, and the abnormal environmental data can send alarm SMS through GSM module [18, 19]. By using the data transmission scheme of single-chip microcomputer and GPRS wireless data transmission technology, the hardware connection and software programming of data transparent transmission between serial port and GPRS module are realized. Generally speaking, domestic experts and scholars focus more on the research of the environmental monitoring system of the Internet of Things and cloud computing and propose the establishment of the overall framework of the environmental monitoring system based on the Internet of Things and cloud computing technology [20, 21]. At the same time of gradually strengthening and improving environmental monitoring abroad, China has also completed two stages of important work in environmental protection, from scratch, from low efficiency to high efficiency, from intermittent monitoring to continuous automation, and then to establish its simple automatic monitoring environment network center system [22]. Although our country has made all the achievements in the monitoring of ecological state, there are still many problems in the monitoring of production environment compared with the developed countries, such as insufficient capital investment, backward technology, low accuracy of monitoring module, poor data accuracy, and poor system stability [23]. All of these factors will lead to the stagnation of production status monitoring and also bring some adverse effects on related research work [24, 25]. At present, some areas in our country adopt the traditional manual way to collect data and information. This cumbersome way does not have timeliness and efficiency but also does not meet the requirements of environmental monitoring in actual production, based on the current situation of modern research [26]. In addition, there is relatively little research on environmental monitoring for wireless network communication. At this time, it is of great momentous to develop and design a production environmental monitoring system for the current environmental monitoring work [27]. Chen et al. have constructed a national regional risk indicator system that includes six risk factors and 23 risk indicators. The study found that the three factors with the highest comprehensive weights include the risk of deviation from development, the risk of sustainable development, and the green risk. At the same time, the fuzzy comprehensive evaluation model proposed by the Chen et al. overcomes the shortcomings of the traditional fuzzy comprehensive evaluation model, fully considers the ambiguity and uncertainty of risk evaluation indicators in the context of big data, and also considers the ambiguity of human judgment. However, their research is only a study of one factor of the environment, without taking into account other uncontrollable factors such as policies and natural disasters [28].

Starting from the meaning and traits of the Internet of Things, this paper explores the sustainable development of high-end manufacturing green smart park, expounds the

environmental problems brought by the current economic production and construction, mainly existing problems of the industrial park, finds out the reasonable solutions and the balance basis point in line with the monitoring characteristics, and organically combines the two. In the research, the application of the Internet of Things technology to the intelligent monitoring of the park enables the high-end manufacturing industry in the intelligent industrial park to operate more greenly and efficiently. This paper will discuss the mechanism of the monitoring technology and introduce the collection and implementation of the production status data of each station equipment in the production workshop during the production process. Improve the current production mode, learn from foreign experience, quickly carry out the data accumulation of load curve and data center's service ability to the park, verify various operation modes, and simultaneously explore new management mode. Through comparative advantage analysis, this paper studies the similarities and differences in the development of high-end manufacturing industry both at home and abroad, studies advanced experience, puts forward improvement methods and paths, combines the new path of environmental protection, and finally puts forward the experience accumulated based on this mode to explore the optimal mode of energy operation and management in the park, build a green smart park, and provide theoretical reference for sustainable development.

## 2. Method

### 2.1. Core Concepts

*2.1.1. Internet of Things.* Internet of Things refers to the use of a variety of information collection terminals and information collection technology to obtain all kinds of information needed by the system and through the Internet and other carriers to upload these information data to the processing center for centralized analysis and processing, to get the corresponding results and make reasonable regulatory decisions based on them, and finally to transmit the control instructions to each terminal equipment to achieve intelligent control system. Through radio frequency identification technology and intelligent perception technology, data collection of all elements of the factory workshop, including workers, equipment, materials, and environment, is completed. According to the on-site situation, an appropriate networking mode is formulated, and the information of each station scattered in the workshop is collected and aggregated to the upper computer for processing, so as to realize the monitoring and automatic management of industrial production. In the production supervision of many production workshops, they are often faced with complex working conditions and excessive environmental interference. These environmental factors, as well as the operation status and parameter data of equipment, are the key factors affecting product quality. The use and popularization technology can achieve intelligent scheduling by setting up multiple sensor nodes to collect and supervise the data of idle and working state of the equipment and improve the utilization rate of the equipment; meanwhile, it can also collect the parameter data of the temperature and speed during the operation of the production equipment that will affect the product quality in real time, based on which the production process, and adjust and control the parameters to improve the production efficiency.

*2.1.2. Sensor.* A sensor refers to a measuring device that can convert the measured nonelectrical quantity into a corresponding quantity of electricity or an electrical parameter output that is easy to handle accurately according to a certain law. According to its basic sensing function, it can be divided into ten categories: heat sensitive element, light sensitive element, gas sensitive element, force sensitive element, magnetic sensitive element, humidity sensitive element, sound sensitive element, radiation sensitive element, color sensitive element, and taste sensitive element. In order to obtain information from the outside world, people must rely on the sense organs. However, people's sense organs alone are not enough to study the natural phenomena, laws, and production activities.

*2.1.3. Data Acquisition Technology.* Data acquisition refers to the process of automatic acquisition of nonelectricity or electricity signals from intelligent acquisition equipment, such as all kinds of sensors and other devices to be tested and other analog or digital units to be tested. Data collection is the combination and interaction of information technology and physical level. The traditional data collection method is very single. From the initial manual input, equipment supervision, and other manual operation methods to the later development of data collection using collection devices, the low efficiency of the process has been restricting the industrial production. Up to now, the production demand is growing day by day, and the amount of data in production is huge, which brings great difficulties for data collection and data specification and cleaning after it; at the same time, the protocol of industrial data is not standard, including Modbus, OPC, can, control net, PROFIBUS, ZigBee, and other types of industrial protocols, which leads to great difficulties in the interconnection of industrial protocols. The emergence of technology brings great innovation to the methods of data collection, processing, and analysis.

*2.1.4. High-End Manufacturing.* In different periods and at different levels of social and technological development, the specific manifestations of high-end manufacturing industry are different. The difference in high-end manufacturing is mainly reflected in the way and method of manufacturing, and with the high-end manufacturing, pollution will gradually decrease. Every great change in the field of science and technology has led to a leap in the quality of manufacturing industry: during the first industrial revolution, "high-end manufacturing" means mechanical manufacturing instead of manual manufacturing; during the electrification revolution, large-scale production activities appear and become increasingly mature; "high-end manufacturing" represents the production of electrification and automation; with the popularization and application of computer technology, the

production is gradually intelligent and large scale. The advantage of "informatization" is outstanding, which represents the "high-end" manufacturing mode in the new era. From the industrial point of view, the manufacturing industry that is emerging or is likely to develop into an emerging industry, with high technology content, high-added value, and strong market competitiveness of finished products, is defined as high-end manufacturing industry, which is often referred to as "new energy" and "new material" industry. For example, there are "new energy" industries, such as solar photovoltaic industry, marine wind power, and lithium-ion energy storage battery manufacturing, and "new material" industries, such as nanobiomaterials, high-performance carbon fiber composite materials, and additive printing technology.

*2.2. Research Methods.* In the process of monitoring the production status, understanding the production data, comparing with the green standard, gradient lifting tree is one of the excellent methods, which has been widely concerned and applied in industry and other fields. In this paper, the gradient boosting tree algorithm is used to perform deep learning on the monitored video to convert the monitored production status into visual data. In this paper, XGBoost is used as the research method of extreme gradient enhanced tree computing. Based on GBDT, parallel processing is used, and it has high scalability. According to the previous description, boosting, as an efficient algorithm of integrated learning, can adjust the weight of the learning machine according to its performance in the training process, realize the enhancement of weak learning machine, and improve the accuracy of classification. The process is as follows: (1) all training sets are given the same weight; (2) after $n$ iterations, each training set is classified by a classification algorithm, and the classification error rate is

$$\mathrm{err}_n = \frac{\sum \omega_i I(y_i \neq G_n x_i)}{\sum \omega_i}, \tag{1}$$

where $\omega_i I$ is the weight of the $i$th sample and $G_n$ is the $n$th classifier.

After the iteration, all the classifiers are obtained. From the above steps, it can be seen the classification error samples, whose weight will become higher, in order to optimize the next iteration effect. Finally, the sample is obtained by voting classification results. It is proved by experiments that the loss function of boosting is in exponential form, and the gradient lifting decision tree is to make the loss function drop along the gradient direction in the iteration.

So as to improve the classification accuracy, XGBoost is the optimal implementation of the algorithm. XGBoost model integrates multiple classification regression cart tree models, which are constructed according to different characteristics, and the value of the leaf node of the tree represents the importance of the characteristics. The expression of XGBoost model can be given:

$$\widehat{y}_i = \sum_{k-1}^{K} f_k(x_i) f_k \in F. \tag{2}$$

$K$ in the expression refers to the number of cart tree models, $y_i$ refers to the predicted value of a single tree, $x_i$ refers to the $i$th input sample, and $F$ refers to the total set of all cart trees with probability in training. XGBoost algorithm does not need to give all the sets of trees but uses gradient lifting method to add a new tree model each time and constantly improves the previous results.

*2.3. Characteristics of Internet of Things Monitoring*

*2.3.1. Reflecting Industrial Scale and Production Capacity.* Five indicators will be selected, including total industrial output value, number of enterprises, main business income, average number of employees, and production capacity of main products. Among them, the total industrial output value is expressed in the form of currency. The total value of the final products or labor services provided by an enterprise in a certain period of time reflects the total scale and level of production in a certain period of time. The production capacity of main products refers to the core design and manufacturing, application equipment manufacturing, software development and application, system integration, and network operation. The annual production capacity of the five links, such as information service, can be expressed in terms of output value.

*2.3.2. Reflecting Industrial Benefits and Development Quality.* Five indicators will be selected, including total profit and tax, industrial added value rate, product sales rate, total asset contribution rate, and total labor productivity. Among them, the total profit and tax is an indicator that counts the total profit and tax of the enterprise, which reflects the total profit realized by the enterprise in the quantitative indicator that undertakes the obligation to the region; the industrial added value rate refers to the proportion of industrial added value in the total industrial output value in a certain period of time, reflects the economic indicator that reduces the intermediate consumption, and is also the Internet of Things industry core indicators of development; product sales rate refers to the ratio of sales output value in the reporting period to total industrial output value in the same period, which reflects the extent to which industrial products have been sold and is an important indicator to analyze the balance of production and demand in the Internet of Things industry; total asset contribution rate reflects the relative indicators of the output of total assets of enterprises, reflects the profitability of all assets of enterprises, and evaluates industrial benefit core indicators. The total labor productivity is the comprehensive performance of the production technology level, management level, technical proficiency, and labor enthusiasm of the enterprise, and it is also an important index to assess the industrial efficiency.

*2.3.3. Reflecting Innovation Ability and Achievement Transformation.* Five indicators will be selected, including R&D expenditure, number of Internet of Things standards, number of patent applications, number of important research results, and sales revenue of new products. Among them, R&D expenditure refers to all kinds of direct and indirect expenses incurred by enterprises in the research and

Table 1: Collection and monitoring of plant equipment.

| Equipment type | Device name | Equipment number | IP address | From station number |
|---|---|---|---|---|
| Monitoring computer | Monitoring computer | | 172.17.7.3 | Master station |
| | Composite machine | JD013 | 172.17.1.2 | 1 |
| | Composite machine | JD014 | 172.17.1.3 | 2 |
| | Wet compound machine | JD037 | 172.17.1.4 | 3 |
| | Wet compound machine | JD039 | 172.17.1.6 | 4 |
| | Multifunctional compound machine | JD069 | 172.17.1.10 | 5 |
| Slitting machine | Double axis high speed slitter | JD057 | 172.17.1.17 | 6 |
| | Double axis high speed slitter | JD058 | 172.17.1.18 | 7 |
| Embossing machine | Aluminum foil embossing machine | JD048 | 172.17.1.14 | 8 |
| | Aluminum foil embossing machine | D063 | 172.17.1.27 | 9 |
| | Aluminum foil embossing machine | D074 | 172.17.1.22 | 10 |

development process of products, technologies, materials, processes, and standards; the number of important research results refers to the number of key technologies that are conquered and recognized by the state in the fields of perception, transmission, processing, application, and other technologies; the new products refer to the research results that are obtained through technological innovation. The product has a breakthrough in one aspect or obvious improvement compared with the original product, thus significantly improving the product performance or expanding the use function, which has a certain part in boosting the economic efficiency of the product and is conducive to the sustainable development of the city's industry.

*2.3.4. Reflecting Abnormal Engineering and Development Environment.* Five indicators will be selected, including the number of application projects, the number of public service platforms, the number of industrial clusters, the number of key enterprises, and the number of international cooperation. Among them, nonstandard application projects, public service platforms, industrial clusters, and backbone enterprises are all general, standard, independent and controllable application platforms, Internet of Things public service platforms, Internet of Things industrial clusters, and backbone enterprises recognized by the state; international cooperation refers to the establishment of R&D institutions in China and joint R&D and establishment abroad by overseas enterprises and scientific research institutions R&D institutions; this index helps to enhance the international competitiveness of Wuxi Internet of Things industry.

## 3. Experiment

In the experiment of this paper, firstly, the industrial equipment is screened, and the appropriate type of factory equipment is selected, and then, the Internet of Things technology is used to arrange the intelligent monitoring equipment in the factory park. Finally, the intelligent monitoring system is tested.

*3.1. Data Materials.* 24 V industrial switching power supply, PLC, temperature and humidity meter, electric energy meter, temperature control meter, pulse generator, Modbus gateway, wire, and other materials are shown in Table 1.

*3.2. Experimental Test.* Assemble the unit data acquisition module, input the PLC's own program, set the slave station address and communication parameters (baud rate 9600, 8-bit data bit, no check bit, 1-bit stop bit) for each instrument connected to 485 bus, check the circuit and power supply safety, and prepare for the subsequent test. As a comprehensive data acquisition and processing module, PLC is an important test object. Firstly, the signal acquisition function and serial communication function of PLC will be tested, and all kinds of instruments will be connected to the corresponding interfaces of PLC (analog input port, digital input port, and serial com port), and then, PLC will be connected through 485 to USB data line direct serial communication with the testing machine computer and data reading and displayed through Modbus poll debugging software. Finally, the test function interface is written through the configuration software, and the data table is read and displayed. The data acquisition and monitoring experiment of the monitoring meter have been completed successfully. The test methods of the temperature inspection instrument, the electric energy meter, and the pulse signal generator are consistent with the above process. After the server and configuration software of the machine room are built, the monitoring screen is projected to the central screen through the remote desktop, so as to realize the production in the workshop site and facilitate the timely supervision and control of the production management personnel.

*3.3. Purpose of the Experiment.* With the widespread use of the Internet, the structural transformation and development of high-end manufacturing industry also need to be improved. Industrial production began to face a series of diversified challenges; the traditional production technology and information management have been unable to meet its development needs. What changed was the birth of diversified integration of the industry, "smart factory," "smart

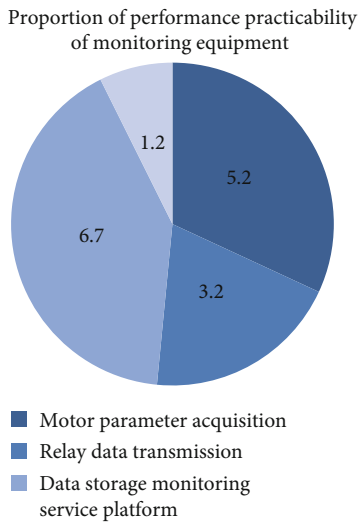


Figure 1: Proportion of performance practicability of monitoring equipment.

manufacturing," and other concepts came out. In this field, centering on intelligent manufacturing, it integrates many technologies such as industrial automation, intelligent logistics, industrial big data platform, and industrial Internet of Things, making manufacturing gradually replaces new blood. Among them, data visualization is very important. Due to the high integration of industrialization and information technology, information technology provides a variety of ways for data collection, such as bar code, two-dimensional code, RFID, industrial sensors, automatic control system, and other technologies that have been fully applied. Through the combination of RF technology and industrial sensors, the data acquisition system covering the whole production system equipment can be realized. At the same time, it is hard to manage a lot of production data only by manpower. Therefore, it is very important to realize data visualization, data centralization, and intelligent control. The intelligent system planning and design of the smart park should take the construction of green buildings and the park as the goal, to achieve functional practicality, timely technology, safety and efficiency, standardized operation, and economic rationality. The intelligent construction planning and design of the park shall be carried out in strict accordance with the building function, building equipment management, building environment management, etc., and the concept of the intelligent park. The planning and design of intelligent monitoring system engineering can know the production status and change the production mode at any time. The intelligent system planning and design of the intelligent park is based on the building and its landscape as the platform, based on the integrated application of various intelligent information, integrating architecture, system, application, management, and optimization, with the integrated intelligent ability of perception, transmission, memory, reasoning, judgment, and decision-making, and providing the park people with a safe, efficient, convenient, and sustainable development function ring environment.

## 4. Discussion

### *4.1. Performance Analysis of Monitoring*

*4.1.1. Motor Parameter Acquisition Subsystem.* Motor parameter acquisition subsystem is the basic measurement unit of the whole motor monitoring system, which is mainly composed of STM32 controller, temperature sensor, voltage, current, vibration sensor, hall speed sensor, LoRa wireless data transmission module, and TFT display interface. Complete the real-time and accurate measurement of the field motor parameters, and transmit the data to the relay data transmission subsystem through the LoRa wireless module, so as to realize the concentration of multiple motor operation parameters. As shown in Figure 1, different aspects of the performance and practicability of the monitoring equipment are affected by the actual application. As shown in Figure 1, in the performance and practicability ratio of monitoring equipment, motor parameter collection, relay data transmission, and data storage monitoring service platform are, respectively, 5.2, 3.2, and 6.7.

*4.1.2. Relay Data Transmission Subsystem.* The relay data transmission subsystem is the intermediate node of the whole motor condition monitoring system to realize the remote transmission and monitoring of motor data. It is mainly composed of STM32 controller, LoRa wireless data receiving module, and Nb IOT wireless Internet of Things module. Through LoRa wireless module, the wireless local area network function of multiple parameter acquisition subsystems on site is completed, and the data of multiple motor equipment on site is centralized. Then, through the Nb IOT module, the field motor parameters are uploaded to the open platform of the telecom IOT in order to awake the remote networking and data access operation of the field motor data.

*4.1.3. Data Storage Monitoring Service Platform.* Data storage monitoring service platform is the data storage and remote monitoring interface of the whole motor condition monitoring system. Using the API provided by the open platform of the Internet of Things, the data interaction between the IOT North host computer and the open platform of the Internet of Things is realized, the motor parameters of the front-end parameter collection and transmission unit are acquired, and the acquired parameters are stored in the corresponding data table items of MySQL database. Then, through the remote browser access Tomcat web server, the data in MySQL database is displayed in the remote access end, to achieve the monitoring of the running state of the field motor. As shown in Figure 2, one of the monitoring equipment is the operation of the multifunction peripheral.

*4.2. Analysis of Monitoring Results.* In the parameter setting of quality prediction model based on XGBoost algorithm, some parameters are set as follows, as shown in Figure 3. Each element has different depth and different characteristic performance. The maximum depth of the tree is 5; the number of iterations is 250; the weight sum of the minimum leaf

Figure 2: Monitoring equipment of compound machine.

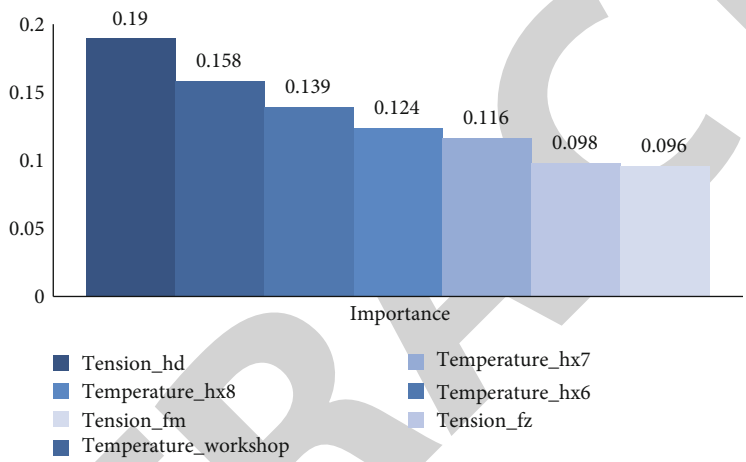


Figure 3: Ranking of feature importance.

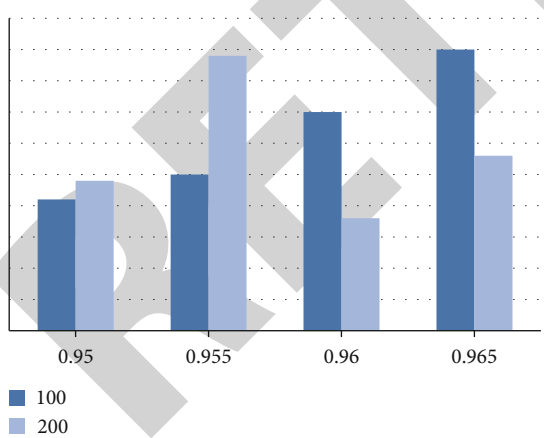


Figure 4: Relationship between XGBoost prediction accuracy and the number of trees.

nodes is 5; the random sampling proportion is 0.7; in the selection of the maximum height of the tree, because the height of the tree is too small, the model is too simple, the test performance is not good, and the fitting degree needs to be improved, but when the height of the tree is too large, the model is relatively complex and does not have good applicability, so the maximum height of the tree is set as 6. The adjustment of the number will affect the accuracy, stability, and convergence rate of the model prediction. The depth of tree and the number of trees are two relatively important control parameters. When the number of trees is fixed, the accuracy of algorithm test set will converge to a constant, and with the increase of tree depth, the stability will be greatly improved; similarly, selecting the appropriate number of trees will also enhance the stability of prediction.

The unit data acquisition module equipped with each equipment has basically completed the equipment status data acquisition required by production, completed the communication between the lower sensor and the upper computer through reasonable networking, and successfully implemented the real-time monitoring function through the configuration software. In the real-time data acquisition, there is a slight delay deviation between the actual data of the equipment and the acquisition display data, which has no impact on the product production control within the acceptable range. But it also needs to be improved later. So far, the whole data acquisition and monitoring system have been built, and the equipment number, corresponding IP address, and slave station address are recorded in the upper computer software for later query and management. Configuration software has played its due role. It not only collects

and transmits the data of the sensors of the lower equipment but also successfully completes the real-time monitoring of the configuration and provides a variety of monitoring management methods such as trend chart and report form, which provides a good foundation for the subsequent improvement and optimization. In conclusion, XGBoost algorithm has a good performance in quality prediction-oriented classification. In the production process, the prediction model can be used to complete the batch of products according to the existing process parameter settings before they are put into production; the prediction of good product rate has a more comprehensive understanding and control of production and processing, as show in Figure 4.

## 5. Conclusion

As a complex system engineering, the Internet of Things has cross integration with many technologies, such as radio frequency identification, network communication, integrated circuit, computer software and hardware, and system integration. In this technology chain, the backwardness of any link will affect the development of Internet of Things and industry.

Worldwide, Philips, French semiconductor, and Texas Instruments basically monopolize the RFID chip market; Intel, Honeywell, Foxboro, and other enterprises have absolute advantages in the sensor market; IBM, Microsoft, Sybase, Oracle, and other international giants seize the leading position in middleware, Internet of Things system integration, and overall solution market; The core technology of information module and intelligent control equipment is also basically in the hands of European and American multinational companies. As far as China's current situation is concerned, due to the limitation of domestic IC design level, there is a lack of independent intellectual property rights in key core technology areas, which restricts the further development. China has successfully cultivated a number of industry leading enterprises in this field, but in sensor manufacturing, Internet of Things system integration application, public service, and other fields, there is a lack of leading enterprises to control high-end products or core technologies, especially those chain leading enterprises that determine technical standards, master the right to formulate technical standards, and can lead the direction of technological innovation and evolution, which have not yet formed. Effective business model and industrial division system lead to the low output value of the core industry.

Technological innovation and industrial development have the relationship of mutual influence and promotion. At the same time, the development of industry also needs the combination of industrial model matching with relevant technological innovation. With the increasingly extensive application of the technology and the continuous maturity of common markets, the state needs to guide the industry of Internet of Things from support to independence, promote the connotative development of China's Internet of Things industry, achieve technological innovation and surmount in key technologies, and promote the development of new urbanization with greater advantages.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The author declares that there are no conflicts of interest.

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*Retraction*

# Retracted: Path Deconstruction of Agricultural Environmental Sustainable Development Policy in the Process of International Agricultural Trade Liberalization

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] X. Li and F. Huang, "Path Deconstruction of Agricultural Environmental Sustainable Development Policy in the Process of International Agricultural Trade Liberalization," *Journal of Environmental and Public Health*, vol. 2022, Article ID 3101244, 12 pages, 2022.

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*Research Article*

# Path Deconstruction of Agricultural Environmental Sustainable Development Policy in the Process of International Agricultural Trade Liberalization

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Agriculture is particularly essential in the equilibrium between man and nature because of its intimate contact with nature. So the cornerstone for the sustainable development of the human economy and society is the sustainable development of agriculture. When it comes to global trade, agricultural trade has always been in a very special position. The basic situation of agriculture involves food safety, environmental protection, Chinese politics, and many other issues. In order to overcome the problems of overlapping, repetitive, and too many indicators in the evaluation method of agricultural environmental sustainable development and unfavorable for practical operation, this paper proposes an ecological footprint model based on emergy. The model can effectively evaluate the ability of sustainable development of agricultural environment and solve the problem that traditional evaluation methods cannot comprehensively evaluate. This makes agricultural development sustainable and is conducive to the liberalization of international agricultural trade. The experimental results of this paper show that from 2014 to 2018, the degree of damage to the agricultural environment has increased from 21% to 45%, which has led to a decline in the quality of agricultural products, and the output and sales are not as good as before. It can be seen that only by ensuring the sustainable development of the agricultural environment can we ensure the smooth progress of the international agricultural trade liberalization and make China's economy flourish.



## 1. Introduction

Carrying out the protection of agricultural environment has an inestimable value for the development of agriculture, and it is beneficial to the continuous development of China's economy. The agricultural sector is an important production sector in China, providing people with a variety of means of life and production, and has become the basis for the development of the national economy. Agricultural production refers to the use of natural resources such as land for production activities. The soil, water, atmosphere, etc., in the natural environment are important resources for agricultural production, as well as major environmental factors. Due to the objective reasons that the Chinese people have more land and less land, in order to solve the problem of people's food and clothing, and face the pressure of people's growing material demand, people's activities are all oriented to the pursuit of grain production. Scholars began to explore whether the agroecological environment was affected. As an open system, the production mode of agriculture itself and some internal and external factors of agriculture have certain influence on the agroecological environment. After decades of practice, people will find that the environmental capacity is limited. In order to realize the sustainable development of agriculture, it is very important to ensure the sustainable development of the agricultural ecological environment.

With the close international exchanges, the improvement of China's agricultural internationalization and trade liberalization, and the changes in the market supply and

demand structure of agricultural products, China has further deepened the foreign trade policy of agricultural products while implementing the strategic adjustment of agricultural products. The EU is China's first trading partner and has also gradually become China's major agricultural trade partner. China is a developing nation with quick economic expansion. China's economy has been more internationalized and significant in the global economy since the adoption of the reform and opening up program. Trade volume and impact on the global economy have risen steadily over time. Agricultural commerce has also increased in importance relative to other sectors of the Chinese economy. This paper's originality is its use of the emergy ecological footprint model to assess agricultural environment sustainability, identify issues with agricultural environment sustainability, and take proactive measures to address such issues. This makes it possible for agriculture to grow sustainably, guaranteeing the position of agricultural goods in the liberalization of global trade.

## 2. Related Work

Sustainable agroenvironmental development means that it is technically appropriate, economically feasible, and widely accepted by society, without deteriorating the environment and maintaining the development of land, water, and plant resources. The possible effects of agriculture trade liberalization on various nations were examined by Nuetah and Xin. To calculate the probable effect of agricultural trade liberalization on global agricultural market prices, they employed simulation models for agricultural trade and policy [1]. According to Sunge and Ngepah's research, China is now a net importer of agricultural products despite the growing liberalization of agricultural commerce. While neglecting the connection between efficiency, empirical research have concentrated on the relationship between trade liberalization and productivity development. They provided evidence that agricultural trade statistically increases technological efficiency through technology transfer [2]. Baer-Nawrocka et al. found that every reform of the Common Agricultural Policy (CAP) has some impact, not only on agricultural products but on society as a whole. They proposed a new methodology to determine the potential impact of EU agricultural policy reforms, which is combined with game theory [3]. Mensah et al. found that China has about 22% of the world's population and less than 10% of the arable land and faces many challenges in the agricultural sector. They discussed the main challenges facing China's agricultural sector and its future prospects. Urbanization, industrialization, environmental pollution, and trade liberalization are identified as the main problems facing China's agricultural sector [4]. According to Karunakaran and Sadiq, liberalization and modernization represent a serious danger to agriculture, which is the primary source of income for farmers. Organic farming is environmentally benign, supports sustainable development, maintains soil fertility, and gives farmers long-term crop income. By giving better pricing and enhancing the lives of their communities, free trade emerged as a movement to help disadvantaged organic farmers [5]. The importance of agriculture to China's economy has been discussed by academics. China is a sizable agricultural nation, and agriculture and economic development are inextricably linked. Additionally, the liberalization of commerce has a significant impact on agriculture, so it is very necessary to develop sustainable agriculture in order for China to maintain a pivotal position in the world. But the scholars did not mention how to make the agricultural environment sustainable.

In recent years, the free trade of international agricultural products is developing faster and faster, which also brings some problems to the agricultural environment. According to Yang and Hu, the evaluation of regional ecological construction is based on capital stock and capital flow use, which helps to encourage the coordinated growth of the economy and natural capital utilization and raise the effectiveness of that utilization. They applied the partial least squares method to determine the driving forces behind changes in the region's ecological footprint through the examination of per capita ecological footprint and per capita ecological carrying capacity [6]. Liu et al. believed that global warming is a very serious environmental problem. People have the responsibility to build a low-carbon agricultural environment, and they proposed a comprehensive model of ecological footprint. This indicates that the agroenvironment is classified as highly sustainable to promote agroenvironmental sustainability [7]. Ma et al. thought that the inconsistency between China's economy's rapid growth and its agricultural environment, which is not favorable to the sustainable development of agriculture, has become more pronounced. A common metric of sustainable growth is the ecological footprint. They made the emergy ecological footprint model his method of choice in an effort to address the sustainable development of the agricultural environment [8]. Using a recently created ecological footprint model, Aydin et al. investigated the nonlinear impacts of economic expansion on the ecological footprint as an indicator of environmental deterioration. According to empirical findings, environmental pressure on agriculture will rise as the economy develops [9]. Scholars have found that in the development of agriculture, the agricultural environment is facing important challenges. With the development of economy, the agricultural environment has also been destroyed. If people want sustainable development of agriculture, people should solve the problem of sustainable development of agricultural environment. Scholars use the ecological footprint model to evaluate the sustainable development of the agricultural environment and improve the unfavorable indicators. But scholars have no concrete measures to address this problem.

## 3. Based on the Ecological Footprint Model and Sustainable Development of Agricultural Environment

*3.1. Relationship between Agricultural Environment and Sustainable Agricultural Development.* The development of agriculture has further promoted the improvement of the

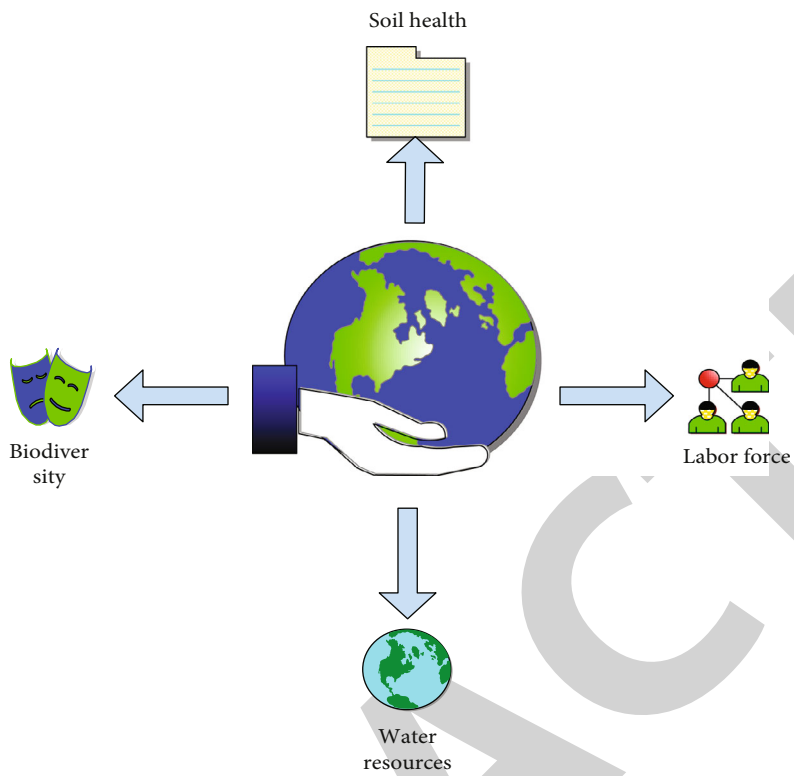


Figure 1: Agricultural sustainability.

world industry, the world economy, and the living standards of the world people. Agricultural productivity has increased rapidly due to the substantial increase in energy input, but it has also suffered from a series of serious ecological and environmental impacts [10]. This operation results in compaction of the soil and reduction of soil organic matter. On the one hand, the industry helps to realize agricultural mechanization and modernization; on the other hand, it causes pollution of water, atmosphere, and soil, which brings immeasurable losses to the agricultural ecological environment [11]. The sustainable development of agriculture is shown in Figure 1.

As shown in Figure 1, the sustainable development of agriculture requires a good ecological environment, which is not only a social and economic reproduction process but also a natural reproduction process of the production, development, and reproduction of animals and plants themselves. Sustainable agriculture is an agriculture that manages, protects and sustainably utilizes natural resources, adjusts farming systems and techniques, and continuously meets the needs of contemporary human beings for the quantity and quality of agricultural products without harming the interests of future generations. The agroecological environment and animals and plants are interdependent and affect each other and maintain a certain dynamic balance [12].

Agricultural natural reproduction has the characteristics of long cycle and dependence on seasonal, regional, and natural environment factors. Due to changes in environmental factors, it is easy to affect the quality of products. Therefore, agriculture is a weak industry, and its production cycle requires not only the support of external policies and equipment investment but also a good natural ecological environment for crops to grow. Agriculture is the economic lifeline of a country, and protecting the agricultural ecological environment is conducive to maintaining the sustainable development of agriculture and is conducive to farmers' food and clothing security. The agricultural environment is shown in Figure 2.

As shown in Figure 2, the sustainable development of agricultural environment is an extension of a globally recognized sustainable development strategy in the field of rural economic development. At present, the whole world is advocating the concept of sustainable development under the banner of sustainable development. The sustainable development of agriculture will also become the eternal theme of the world. Sustainable agricultural development is an agriculture that can maintain and rationally utilize land, water, and animal and plant resources without causing environmental degradation, while being technically feasible, economically viable, and widely accepted by society.

*3.2. Evaluation Method of Agricultural Sustainability Index (ASDI).* Numerous research have demonstrated the existence of the phenomena of diminishing returns in the input of agroecosystems and the S-shaped relationship between the ecosystem's input and output. This means that the marginal productivity of the system is positively connected with input up to a certain level and starts to fall after that point [13]. Marginal productivity refers to the increase in output or revenue by adding the last unit of the factor of production, other things being equal. The environment supporting agriculture has the highest ecological carrying capacity. An

Figure 2: Agricultural environment.

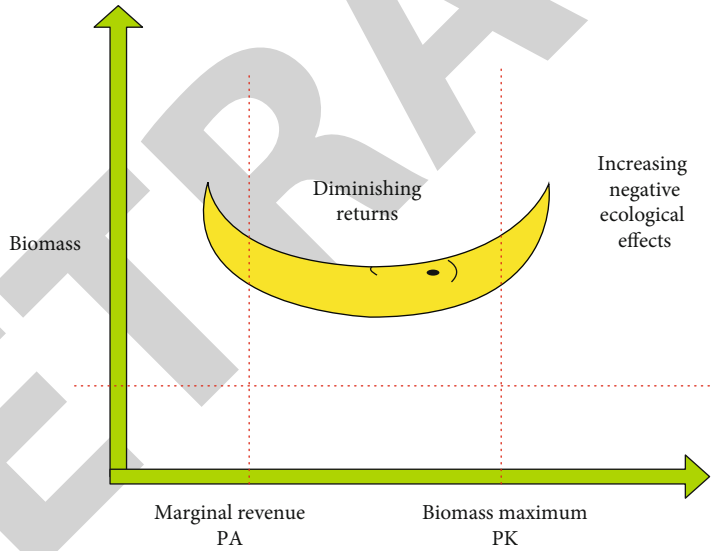


Figure 3: Agricultural Sustainability Index figure.



excessive amount of input will result in a decrease in output, an inability to raise output, and environmental contamination. This study clarifies the input efficiency of agricultural production and assesses the state of sustainable development through the analysis of agricultural energy input and output.

The level of the farming ecosystem's energy input and output in an S-curve scenario can be used to assess the ecosystem's sustainability. Energy input and emissions are at an accelerated stage of declining marginal benefits when the input surpasses the carrying capacity of the largest ecosystem in the area. As a result, the Kuznets curve and the agricultural sustainable development index are similar [14]. The Kuznets curve is a hypothetical curve that depicts the relationship between economic inequality and per capita income in the process of economic development (assumed to be time-dependent). Figure 3 displays the figure for the agricultural sustainable development index.

As shown in Figure 3: The S-curve is used in this study to determine the inflection point P of production and investment profits and to split the range of marginal revenue growth and decline. And use the parabolic first derivative as the critical point of energy investment, that is, to reach the maximum support force of the regional PK, to determine the investment required to increase the interval of negative ecological impact [15]. Internet energy investment is to help residents invest and trade in energy through the high-speed convergence of Internet information.

The specific methods include finding the corresponding means of production:

$$b = \frac{K}{1 + e^{(ax+b)}}. \tag{1}$$

The inflection point value P will appear if the limit productivity is equal to the average productivity, which is the case when EEI = 1, and the associated PA may be determined using the following formula:

$$\begin{aligned} AEP &= \frac{\left(b - b^0\right)}{a}, \\ MEP &= \frac{db}{da} = -k \times \frac{a \times e^{(ax+b)}}{\left(1 + e^{(ax+b)}\right)^2}, \\ EEI &= \frac{MEP}{AEP}. \end{aligned} \tag{2}$$

The sustainable development of agriculture is different from the sustainable development of other fields such as industry, and its index system should include its specific index. The Agricultural Sustainability Index (ASDI) is divided into three intervals, and the range of values is set between -1 and 1, such as follows:

$$ADSI = \begin{cases} \dfrac{A}{PA}, (0, 1] \\ \dfrac{E - A}{E - PA}, (1, 0] \\ \dfrac{E - A}{A}, (0, -1]. \end{cases} \tag{3}$$

*3.3. Ecological Footprint Model.* Ecological footprint analysis is a biological method to measure the degree of sustainable development. Ecological footprint is the biologically productive territorial space that can continuously provide resources or consume waste. In the resource environment system, whether it is human survival and development, or the accommodation of resource exploitation and waste, it needs to occupy a certain environmental space. And this kind of space with resource production function and waste storage function is ecological productive land [16], as shown in Figure 4.

As shown in Figure 4, the productive land that can provide agricultural products, livestock products, timber, fishery products, and urban residential areas and roads is called the ecological footprint of biological resources. It is composed of the total ecological demand of cultivated land, grassland, woodland, water area, and construction land [17, 18].

The model of the ecological footprint analysis method is as follows:

$$EF = Nef = N \sum_{i=1}^{n} \left( \frac{rici}{pi} \right). \tag{4}$$

In the formula, $i$ represents the category of consumer goods, and EF represents the sum of the ecological footprint. In the calculation of ecological environment capacity, due to the difference of resource stock and ecological productivity in each region, the adjustment must be multiplied by the corresponding balance coefficient. The proposal of ecological carrying capacity is a great progress for the study of carrying capacity theory. Compared with single-factor carrying capacity, ecological carrying capacity pays more attention to the integration, sustainability, and coordination of ecosystems. The calculation formula of ecological carrying capacity is as follows:

$$EC = NeC = N \sum_{i=1}^{6} (aj \times rj \times yj). \tag{5}$$

$yj$ is the yield factor of different types of ecologically productive land.

The ecological footprint model is easy to understand, the calculation method is simple, and the calculation results are quantified, so that people can intuitively perceive the degree of impact on the environment [19]. At the same time, the ease of comparison with the limited supply of Earth's space makes the measure of sustainable development truly regionally comparable.

Although the ecological footprint model has many advantages, it still has many shortcomings. It is mainly manifested in that the research method is only based on ecology and does not fully reflect the actual resource occupation of the ecological environment by human beings [20].

*3.4. Ecological Footprint Model Based on Emergy Deconstruction.* The proposal of the concept of sustainable development has aroused great repercussions from the international community, prompting scholars to conduct in-depth research on its evaluation system and analysis methods. Using a certain index system to scientifically evaluate the status and effect of regional sustainable development and provide reasonable theoretical guidance and policy recommendations for sustainable development in different regions has become a hot topic of current research.

Emergy analysis method is mainly used in the evaluation of ecological benefits, used in the study of ecosystems and human social and economic systems, and quantitatively analyzes the real value of resources, environment, and economic activities and the relationship between them. And it improves the approaches used in research on the evaluation of sustainable development.

The status of sustainable development can be reflected by the results obtained by comparing the ecological footprint and ecological carrying capacity. The calculation formulas are as follows:

$$\begin{aligned} ER &= EC - EF, \\ ED &= \frac{EC}{EF}. \end{aligned} \tag{6}$$

In the formula, $ER$ represents ecological surplus, and $EC$ represents ecological deficit. The formula for calculating the

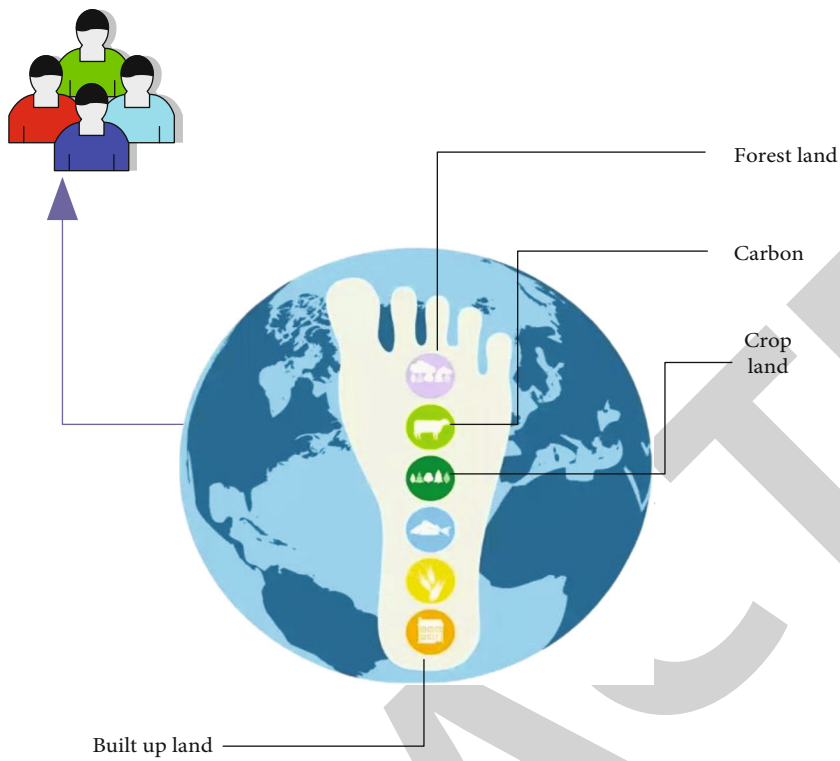


Figure 4: Ecological footprint analysis.

Table 1: Import value of agricultural products (growth rate) from 2014 to 2018.

| Year | Cereals | Vegetable | Fruit | Livestock products |
|---|---|---|---|---|
| 2014 | 9.6% | 11.9% | 13.7% | 16.2% |
| 2015 | 11.8% | 17.4% | 17.6% | 18.5% |
| 2016 | 13.6% | 15.9% | 19.8% | 19.4% |
| 2017 | 18.9% | 22.7% | 26.5% | 22.5% |
| 2018 | 21.7% | 25.6% | 31.8% | 23.3% |

Table 2: 2014-2018 agricultural product export value (growth rate).

| Year | Cereals | Vegetable | Fruit | Livestock products |
|---|---|---|---|---|
| 2014 | 5.7% | 8.7% | 11.9% | 15.5% |
| 2015 | 10.6% | 18.8% | 18.6% | 17.8% |
| 2016 | 17.9% | 19.4% | 21.3% | 23.2% |
| 2017 | 25.4% | 25.3% | 26.8% | 29.0% |
| 2018 | 33.2% | 35.5% | 33.0% | 30.8% |

per capita ecological footprint is

$$E_f = \sum_{i=1}^{n} a_i = \sum_{i=1}^{n} \frac{c_i}{p_2}. \tag{7}$$

Among them, $E_f$ is the per capita ecological footprint, and $a_i$ is the per capita ecological footprint of the $i$th resource.

For renewable resources, the sustainable utilization of resources is mainly achieved by reasonably regulating the utilization rate of resources. The sustainable utilization of renewable resources is mainly restricted by the law of natural growth. When calculating the ecological environment carrying capacity, only the use of renewable resources can make the ecological environment carrying capacity truly sustainable, as shown in the following:

$$E_c = \frac{e}{p_1}. \tag{8}$$

Among them, $E_c$ is the per capita ecological carrying capacity, $e$ is the per capita solar energy value of renewable resources, and $p_1$ is the global average emergy density.

Add a person's ecological footprint to each consumer item and compare it with each person's ecological capacity. Using this, we measure the ecological profit and loss of the region:

$$E_p = E_c - E_f. \tag{9}$$

If $E_p > 0$, it means that there is an ecological surplus, and the regional ecosystem is in a sustainable state.

Ecological profit and loss refers to the difference between ecological carrying capacity and ecological footprint, and this index indicates the ecological status of a certain area. The calculation of ecological profit and loss can directly reflect the carrying status of the development of the research area, but the degree of utilization of natural resources in the

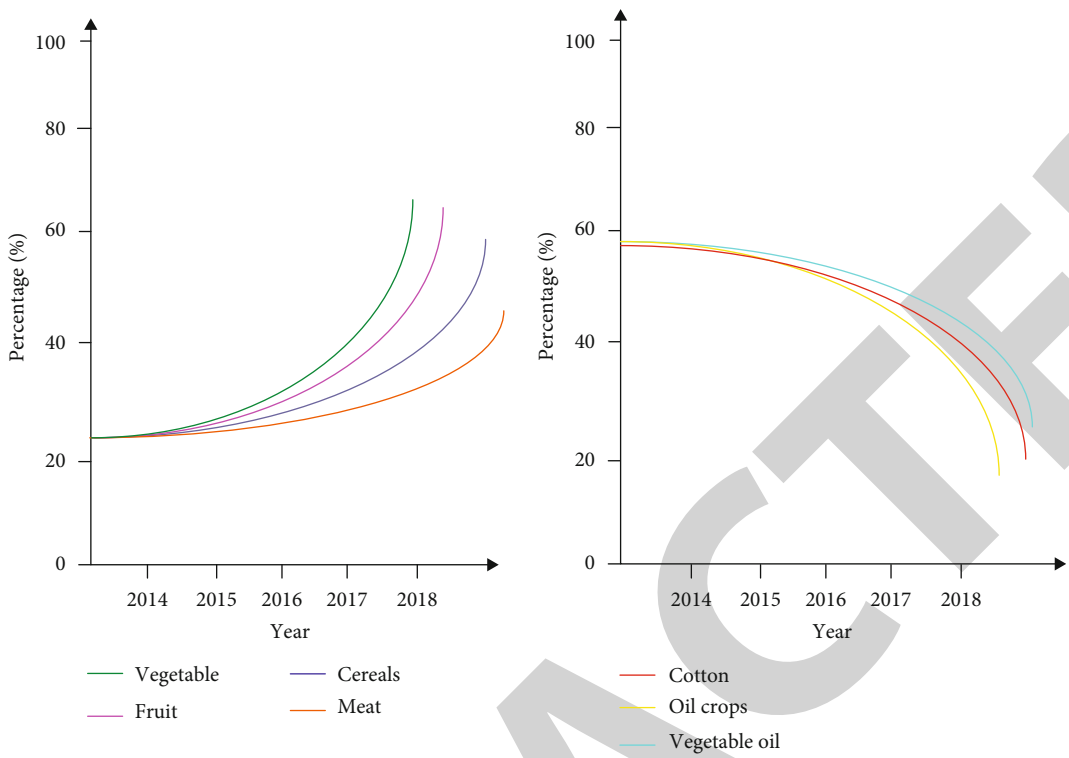


Figure 5: Income of major agricultural products and employment of farmers from 2014 to 2018.

area needs to be measured by the sustainable development index. Its calculation method is as follows:

$$SEI = \frac{E_c}{(E_c + E_f)}. \tag{10}$$

The ecological footprint diversity index is used to represent the ecological footprint balance of different consumer goods in the survey area. The calculation formula is

$$H = -\sum (P_i \times InP_i). \tag{11}$$

Among them, $P_i$ and $InP_i$ represent the proportion and distribution of the ecological footprint of the $i$th consumption item in the total.

This paper mainly considers three kinds of renewable energy sources: solar radiation energy, rain chemical energy, and surface soil energy. Its calculation formula is

$$EC = \frac{E}{N \times D} \times B. \tag{12}$$

In the formula, $EC$ is the ecological environment capacity of per capita cultivated land, and $E$ is the energy value of renewable resources on the surface of cultivated land in the survey area. The yield coefficients of various crops are summed using the weighted method to obtain the corrected field yield coefficients. The weights are different weights taken in the adjustment calculation due to the difference in the precision of the measured values. The higher the precision, the greater the weight. "Weighted" means "multiplied by the weight", that is, "multiplied by the coefficient," as shown in the following:

$$B = \sum \left( \frac{a_i}{G_i} \times p_i \right). \tag{13}$$

$a_i$ is the city (or county) average arable land yield of the $i$ th crop.

## 4. Investigation and Deconstruction Based on Sustainable Development of Agricultural Environment

*4.1. Investigation on the Development Trend of International Agricultural Trade Liberalization.* After the implementation of the reform and opening policy, with the change of China's trade policy, the role and status of agricultural trade have also undergone fundamental changes. For a long time, China's agricultural trade has basically been in a surplus state. But by the late 1990s, the situation began to reverse, with surpluses and deficits alternating. The main purpose of agricultural trade is no longer to earn foreign exchange, but to gradually evolve to satisfy people's different consumption preferences to improve their quality of life, and at the same time, it is also conducive to the further improvement of farmers' income.

China's entry into the World Trade Organization is a new milestone for China's agricultural trade. With the changes in the market supply and demand of agricultural products, agricultural products gradually turn from shortage to surplus, which forces people to seek a channel to solve the

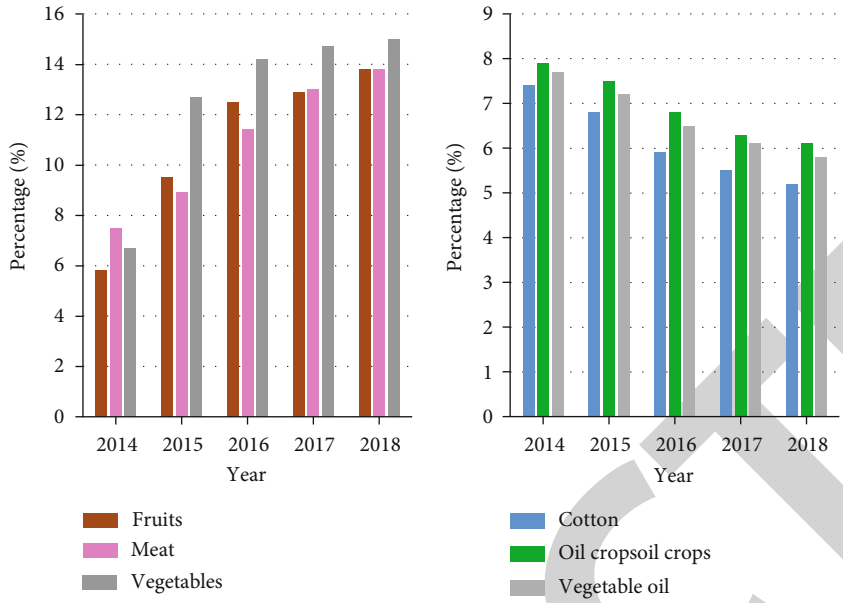


Figure 6: Farmer employment from 2014 to 2018.

Table 3: Annual chemical fertilizer usage in the country and province A from 2014 to 2018.

| Year | National fertilizer use (10,000 tons) | Fertilizer usage in province A (10,000 tons) | National average fertilizer usage (kg/ha) | Average fertilizer usage in province A (kg/ha) |
|---|---|---|---|---|
| 2014 | 10879.4 | 3647.2 | 1643.4 | 4352.5 |
| 2015 | 12785.7 | 3748.9 | 1785.6 | 5636.3 |
| 2016 | 14638.5 | 3980.6 | 2175.8 | 6590.4 |
| 2017 | 16890.6 | 4325.3 | 2687.5 | 7825.1 |
| 2018 | 19536.2 | 4880.9 | 3636.2 | 8903.6 |
| 2019 | 23245.5 | 5256.4 | 4245.9 | 8094.5 |

surplus of agricultural products. Generally speaking, besides agricultural producers adjusting their own production structure and stimulating Chinese consumption to boost demand, seeking more trading partners to increase overseas exports is also an important way to solve the surplus of agricultural products. The import value of agricultural products is shown in Table 1.

As shown in Table 1, the growth rates of imports of cereals, vegetables, fruits, and livestock products in 2014 were 9.6%, 11.9%, 13.7%, and 16.2%, respectively. It can be seen that in 2014, China's agricultural products began to be initially imported. The growth rates of imports of cereals, vegetables, fruits, and livestock products in 2015 were 11.8%, 17.4%, 17.6%, and 18.5%, respectively. By 2018, the growth rates of imports of cereals, vegetables, fruits, and livestock products were 21.7%, 25.6%, 31.8%, and 23.3%, respectively. Compared with 2014, the growth rate has become much faster, which also shows that China's agricultural free trade has been developed.

The export value of agricultural products from 2014 to 2018 is shown in Table 2.

As shown in Table 2, in 2014, the growth rates of export value of cereals, vegetables, fruits, and livestock products were 5.7%, 8.7%, 11.9%, and 15.5%, respectively. It can be seen that in 2014, the development of China's agricultural product exports lagged behind the development of imports. By 2016, the export value of China's agricultural products began to catch up with the growth rate of the import value. By 2018, the growth rates of imports of cereals, vegetables, fruits, and livestock products were 33.2%, 35.5%, 33.0%, and 30.8%, respectively. Compared with the growth rate of imports, the growth rate increased by 11.5%, 9.9%, 1.2%, and 7.5%, respectively. At this time, it shows that China's agricultural products have been welcomed by the international community.

From the perspective of changes in agricultural output, due to the reduction of trade barriers, the role of comparative advantage in the adjustment of agricultural production structure is more obvious. Among all agricultural products, the increase rate and absolute amount of grain and fruit and vegetable production are the highest. Fruit and vegetable agricultural products have always been China's dominant agricultural products. And China's grain, especially rice, will increase its export demand due to the reduction of trade barriers, which will lead to the enhancement of its competitive advantage. This will promote the production of rice in China, which in turn will increase the total grain output, as shown in Figure 5.

As shown in Figure 5, the total income of farmers is increasing, but it is mainly concentrated in the fields of grains, fruits, vegetables, and meat. These agricultural products are also agricultural products with rapid export and output value growth. On the contrary, the income of cotton, oil crops, and vegetable oil workers has declined. This is because these agricultural products belong to the industries whose

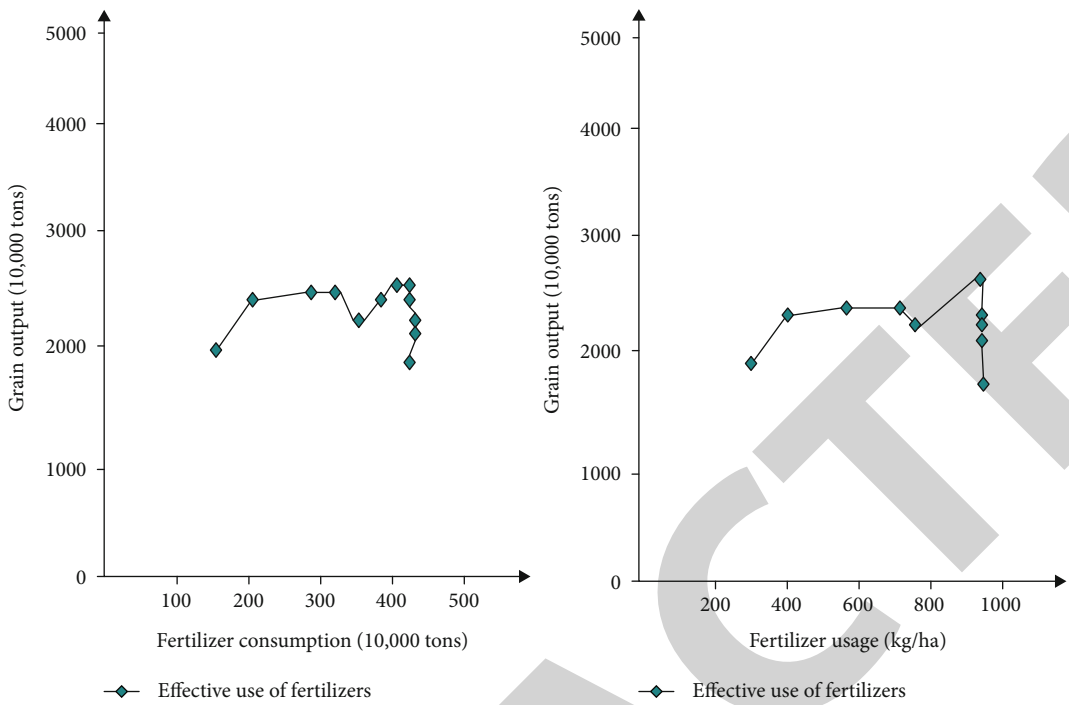


Figure 7: Effective utilization of fertilizers.

production is affected by the agricultural products of other countries, but because the impact is not large, the degree of income decline is not obvious. The employment situation of farmers from 2014 to 2018 is shown in Figure 6.

As shown in Figure 6, changes in farmers' income also bring corresponding changes in farmers' employment. The employment level of agricultural products with increased farmers' income also increased, and the employment level of farmers in the two sectors of fruits, vegetables, and meat increased the most. Due to China's sustained economic growth and a considerable scale of agricultural trade, the EU is optimistic about the international trade of agricultural products between the two sides. On the other hand, according to linked research, changes in the consumption pattern of agricultural products by EU citizens have occurred as a result of people's increased focus on their health, primarily seen in the rise in consumption of pork and poultry meat as well as the rising demand for agricultural goods like rice and edible fungus.

*4.2. Investigation on Sustainable Development of Agricultural Environment in Province A.* The agricultural production in province A mainly uses natural resources such as soil, water, etc., as well as a large amount of agricultural chemicals for production. The pursuit of pure grain yield is a simple linear development of "resources-production-products+waste." This mode of production does not take into account the agroecological environment and does not pay enough attention to the environment.

The ecological environment of agriculture is the material basis of agricultural production, and it is also a major issue related to the development of contemporary agriculture, which is of strategic importance in the entire economic construction. As 70% of China's population lives in rural areas, it is very important to ensure and improve the quality of life of rural people. Its condition also determines the output, quality, and production potential of agricultural products and directly and indirectly affects the physical and mental health of human beings, which will inevitably affect the sustainable development of agriculture. Agriculture is an open system. Due to the pollution of agriculture itself, the pollution of industry, and the pollution of domestic waste, the agricultural ecological environment has been under triple pressure, and agricultural production has been affected. The national and provincial annual chemical fertilizer usage from 2014 to 2018 is shown in Table 3.

As shown in Table 3, in recent years, the increase in the application intensity of chemical fertilizers has begun to slow down, and the application rate of chemical fertilizers has reached a high level.

In addition to the excessive use of chemical fertilizers, the use of chemical fertilizers has had a certain impact on the agricultural ecological environment due to the unreasonable fertilization structure and the reasons for scientific fertilization. The effective utilization rate of chemical fertilizer is shown in Figure 7.

The harm and pollution trend of China's agroecological environment has not been substantially managed, as indicated in Figure 7, and certain places are continuously degrading. As a result, people must focus on preserving the sustainable growth of the agroecological environment that influences the quality of agricultural goods in order to compete with the market for high-quality agricultural products in China and overseas.

The change of China's agricultural free trade policy not only has an impact on the trade, production, and income of agricultural products industry sector itself but also has a

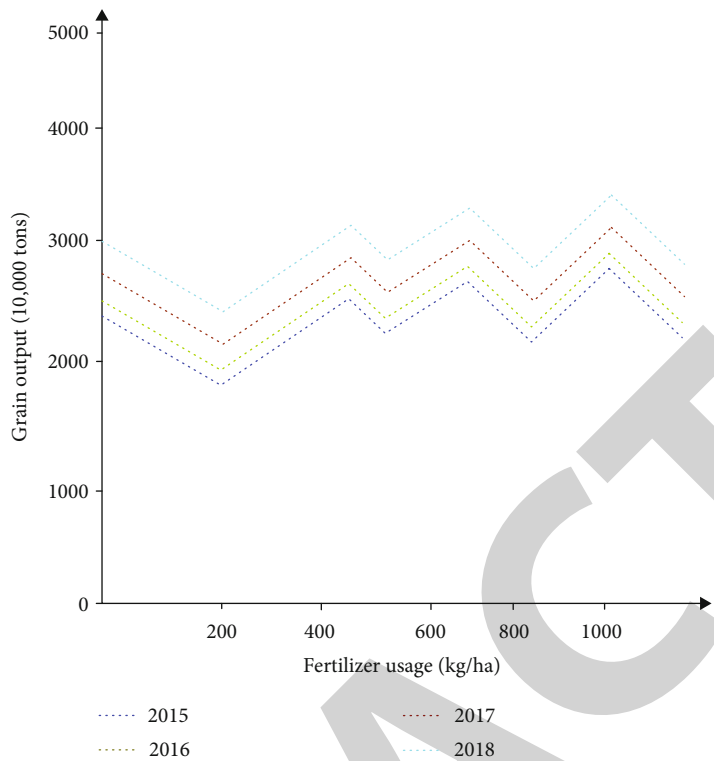


Figure 8: Agricultural environmental damage rate in province A.

significant impact on the environment. The agricultural environmental damage rate of province A in recent years is shown in Figure 8.

As shown in Figure 8, the impact of human activities on the environment has received increasing attention in countries around the world. Agriculture is an ecological and economic organism in which natural ecology and socioeconomics are interdependent, combined, changed, and interacted. Therefore, since the 1990s, the Chinese government has attached great importance to environmental protection and sustainable agricultural development and regarded it as an important goal of agricultural support policies.

*4.3. Advocating the Concept of Sustainable Development of Agricultural Ecological Environment.* From the strategic height of macrocontrol, develop relevant technical systems, policies, and legal support to comprehensively improve the rural ecological environment and promote agricultural development. In order to establish the view that environment is resource, environment is benefit, and environment is productivity, people realize that agriculture is not only the source of agricultural products but also the source of environmental services and the importance of agroecological environment. Farmers are the main body of agricultural production. Protecting the agricultural ecological environment and preventing agricultural pollution require the active participation of farmers. In order to make most farmers aware of the long-term benefits of the agricultural environment, it is necessary to strengthen publicity activities in the vast rural areas to improve people's environmental awareness and awareness of sustainable development.

*4.3.1. Change Production Methods and Develop Circular Economy.* The current agricultural development model is a linear economic model, pursuing pure grain production, high-intensity development of the earth's materials and energy. This mode of agricultural development not only is not the best economic interests but also cannot achieve sustainable development from the perspective of environmental and ecological interests. Recently, the newly advocated development model is the closed-loop model of "resources-production-products + waste utilization-products," which regards the reuse of agricultural wastes as the input of other agricultural industries. This model can achieve the win-win goals of the highest resource utilization rate, the lowest emission, and a virtuous circle of economy and ecology and basically realize the economic model of the transformation of China's agricultural model from a linear economic model to a circular economy.

*4.3.2. Adhere to the Dualism of Economic Development and Environmental Protection.* It is essential to rationally use natural resources, reduce or avoid environmental pollution and ecological hazards, strengthen the prevention and management of environmental pollution, and enhance environmental quality in order to fully utilize the environment and natural resources during the process of economic development, then promote the sustainable growth of the social economy while realizing the sustainable development of the agricultural environment. Protecting the environment is a basic method to enable people and the environment to coordinate and develop sustainably, and its essence lies in ensuring the better development of productive forces.

Agricultural environmental protection needs to cooperate with other countries and regions in the world, absorb the most advanced technology and the best production and living experience, and promote the common interests of environmental protection and economic development.

## 5. Conclusion

China is a big agricultural country, and the development of agriculture is beneficial to China's economic development. With the increasing international status of China, agricultural products are also popular in the liberalization of international trade, but the economic development also faces challenges. The agricultural environment has been seriously damaged, which has affected the development of agricultural products, which has led to the slow process of international agricultural trade liberalization. Therefore, a significant influence on the growth of agricultural trade liberalization is the study of the sustainable development of the agricultural environment and ensuring that it can achieve sustainable development. This research conducts a thorough assessment of the sustainable development of the agricultural environment using the emergy ecological footprint model and puts forward corresponding measures. After investigation and analysis in the experimental part, it is found that China's agricultural products have developed in international trade in recent years, indicating that the status of agricultural products in the world is also getting higher and higher. The experiment compares and analyzes the ecological footprint model and the emergy ecological footprint model and finds that the evaluation of the emergy ecological footprint model is more comprehensive and accurate. Finally, it is concluded that the development of international free trade of agricultural products will be more and more smooth only if the agricultural environment has been developed sustainably. The evaluation method proposed in this paper is within the scope of people's knowledge, and there may be better evaluation methods, which need to be studied in future work. It will also constantly correct its shortcomings.

## Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to sensitivity and data use agreement.

## Conflicts of Interest

These are no potential competing interests in our paper. And all authors have seen the manuscript and approved to submit to your journal. We confirm that the content of the manuscript has not been published or submitted for publication elsewhere.

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*Retraction*

# Retracted: Legal Guarantee of Smart City Pilot and Green and Low-Carbon Development

**Journal of Environmental and Public Health**

Received 5 December 2023; Accepted 5 December 2023; Published 6 December 2023



This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] N. Yan, "Legal Guarantee of Smart City Pilot and Green and Low-Carbon Development," *Journal of Environmental and Public Health*, vol. 2022, Article ID 4280441, 11 pages, 2022.

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*Research Article*

# Legal Guarantee of Smart City Pilot and Green and Low-Carbon Development

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Green and smart cities are based on clean energy and rely on information technology. They are the guarantee for the realization of efficient and intelligent urban development and green ecological transformation, the basis for sustainable social and economic development, and the inevitable trend of urban development. Therefore, the evaluation of the development level of green and smart cities is of great significance to the development of Chinese cities. This paper has aimed to study the issue of smart city pilots and legal guarantees for green and low-carbon development and introduced the concept of smart city line management, as well as the related theory of entropy weight method, cloud model, and support vector machine algorithm. Based on the sustainable development index system, this paper has combined the low-carbon concept to construct the low-carbon city evaluation index system and carried out an empirical analysis. The sustainable development index system, the research results of low-carbon city, and the current situation and characteristics of low-carbon city construction are studied and analyzed. On this premise, a low-carbon city assessment framework in view of reasonable improvement is built, including low-carbon economy, low-carbon society, low-carbon climate, and low-carbon component. The experimental results of this paper show that the low-carbon environment subsystem has the best coordinated development among the four subsystems, and the current state is the best. By 2021, the coordination degree value has reached 0.6656, which is in a relatively coordinated state.



## 1. Introduction

With the development of new technologies such as the huge amount of information, the Internet of Things, and distributed computing, the concept of metropolitan development has been continuously improved, and this is only the tip of the iceberg. The innovative concept of further development has been incorporated into the field of metropolitan development. A new impetus for urban development was provided. With the development of cities, smart cities gradually replace digital cities and become the highest stage of urban development. Since IBM introduced the term "smart planet" in 2008, more than 50 countries including the United States, Sweden, Japan, Singapore, and South Korea have begun to build smart city pilot projects. In fact, as of May 2016, more than 550 cities in 95% and 85% of the cities above the county level in China are building smart cities. This paper has traced the development process of smart cities, combined with the new planning and construction of sustainable urban development in the "13th Five-Year Plan." From the investigation of green and brilliant urban communities, the assessment file arrangement of China's green and shrewd urban communities is laid out, the advancement level of China's green and savvy urban communities is all the more precisely assessed, and the local distinctions of China's green and brilliant urban areas and the explanations behind the distinctions broke down. It is convenient to draw relevant advanced experience from it, so as to accurately locate different regions of China. It can find solutions to problems and improve strategies for builders to grasp the direction of urban development. It will provide new impetus for the sustainable development of cities and provide certain support for improving the level of China's green and smart construction. The innovation of this paper is that exploring the connotation and goals of green smart city can enrich the relevant theories and research methods of green smart city and expand the research horizon.

## 2. Related Work

With the improvement of society, individuals give increasingly more consideration to low-carbon ecological security. To decrease creation cost and acknowledge green creation process, Guo et al. proposed a new method for preparing activated carbon by ammoniation activation method to improve its physicochemical properties and adsorption properties [1]. Qu et al. synthesized a porous silicon-carbon composite extracted from paper mill sludge and used for rapid iodine capture [2]. Chu et al. investigated two cases to upgrade the water center into a "green gas station" for a low-carbon city. Green gas stations include biomethane, green hydrogen supply systems, and power supply systems [3]. Holm and Vennervirta concentrated on how professional schooling and preparing and advanced education could add to a green and low-carbon economy in Finland [4]. In any case, the deficiencies of these examinations are that the model development is not logical and sufficiently sensible. The information actually should be taken to the next level.

With the advancement and innovation of science and technology, the support vector machine algorithm has penetrated into all aspects of personal life. This is just the beginning, and more and more researchers are working on it. The combination of the microfluidic sensor proposed by Jinhong and the support vector machine algorithm provides a promising platform for the construction of sensor networks in smart hospitals [5]. Aiming at the operation status of medium and low-pressure gas regulators in SCADA systems, Hao proposed a new safety precaution method for gas regulators based on support vector machine (SVM) [6]. Shyamala et al. proposed a SVM-based damage detection strategy, which is performed step-by-step by first locating and then determining the severity of the damage [7]. Zhu talked about the ongoing models of energy oversight frameworks at home and abroad, worked on the strategy in blend with the deficiencies of information mining, and afterward applied the help vector machine (SVM) calculation to the web-based business energy oversight model [8]. The drawback of these examinations, in any case, is that the contemplations are not adequately extensive to adjust to additional perplexing circumstances, and accuracy should be moved along.

## 3. Relevant Methods for Smart City Pilots and Legal Guarantees for Green and Low-Carbon Development

### *3.1. Smart City*

*3.1.1. Theoretical Framework of Smart City.* The concept of smart city is built on the basis of digital city, which digitizes information in different fields and geographical locations such as economy, culture, and transportation. The smart city has added a perception layer composed of technical terminal equipment such as radio frequency identification and infrared induction. Data collection is carried out, and the processing work after the collected data is formed through the huge Internet of Things data connection and sharing. Finally, through the analysis of data information, various applications based on data platforms are optimized. Among them, the Internet of Things, cloud computing, and big data technologies are widely used in all aspects of smart city construction, making urban development more intelligent (Figure 1) [9, 10].

*3.1.2. Construction of the Evaluation Index System*

*(1) Theoretical Connection of Secondary Indicators.* The core composition of a city is people, and it is also the result of the agglomeration effect of people, and smart cities also aim to improve the efficiency between people in urban space. The regular life of people in cities divides individual people into three major organizational groups. First, government organizations are responsible for rational planning and management of basic urban public services. The second is enterprise organization, which forms the basic commercial activities of the city. Finally, there are thousands of family groups in the city, and it is also the most basic activity group in the city. The core of a smart city is how to use the Internet of Things, cloud computing, big data, and other network components to improve the efficiency of the relationship between the government, enterprises, and individuals [11]. Therefore, from the perspectives of the government, enterprises, and individuals, three indicators representing smart cities can be summarized, namely, smart city online government, smart city industrial economy, and smart city humanistic environment. On this basis, the strengthening of the connection between the three requires a basic network. Therefore, it needs to add the indicator of smart city infrastructure, and finally whether it is a government organization or a business organization. From the perspective of an individual person, one needs to live, to travel, to see a doctor, to travel, and so on. Therefore, a smart city life service indicator is added at the end.

As shown in Figure 2, under the mesh envelope of smart city infrastructure and life services, the efficiency of the connection between the government, enterprises, and people is improved, making the city more intelligent.

*(2) Evaluation Index System.* The scientific, practical, operable, and guiding principles are the core of the evaluation index system. The existing literature on the smart city indicator system is complex and diverse, but considering the completeness and availability of statistical data in various cities in Hebei Province, indicators such as the level of democracy and environmental awareness are not used as evaluation indicators in this paper. This paper extracts the statistical indicators related to the construction of smart cities by sorting out the existing indicators and searching according to the China Urban Statistical Yearbook and Internet data [12, 13]. The selection of indicators covers the most basic smart city basic indicators such as transportation, medical care, tourism, education, technology, entertainment, and life. The most basic indicators are obtained in two categories: one is obtained from the Urban Statistical Yearbook, and the other is obtained from

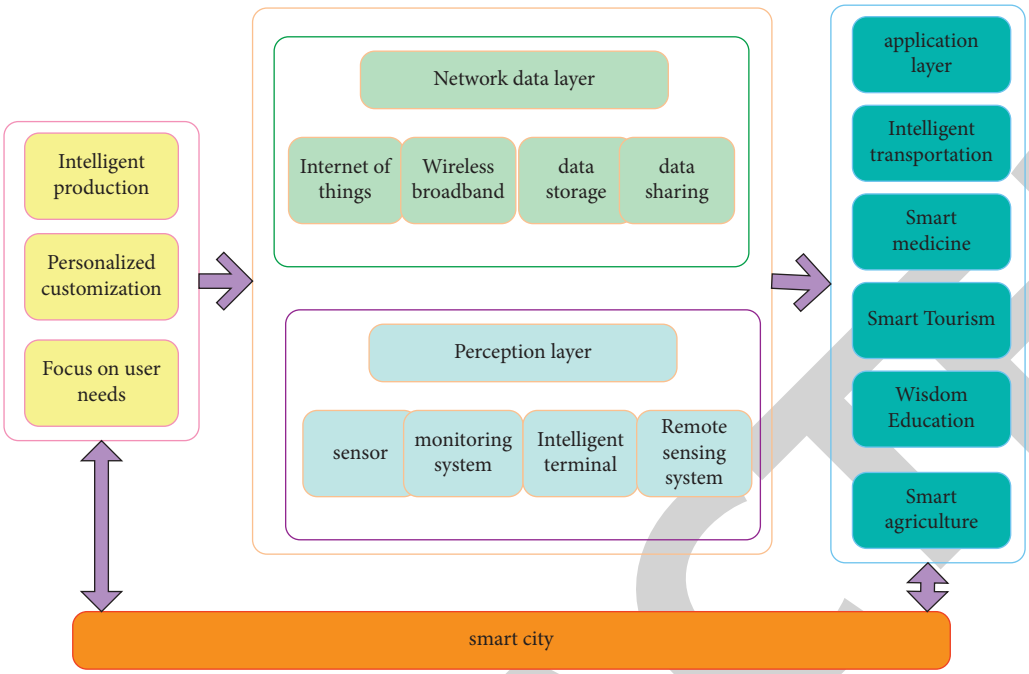


Figure 1: The theoretical framework of smart cities.

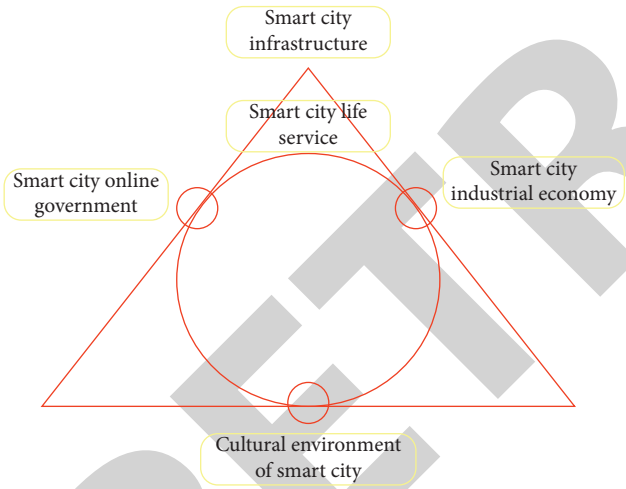


Figure 2: Smart city secondary finger connections.

Internet search data. And the basic data are classified and merged with weights, and the index system is sorted out, as shown in Table 1.

There are a total of 12 three-level indicators, which are obtained through basic data. Smart city infrastructure is measured by mobile phones, internet broadband, and the distribution of the three major operators. The smart city industrial economy is represented by industry, network economy, and innovation. Smart city online government is represented by online and online information release. Smart city life services are represented by network applications such as transportation, medical care, and tourism, and online processing of life services. Finally, the humanistic environment of the smart city is represented by the education situation of people and the urban environment where people live [14].

*3.1.3. The Main Body of Green Smart City.* The main body of green smart city includes almost all social organizations and individuals; specifically, it can be divided into the government, enterprises, and citizens.

*(1) Government.* The government plays the role of "brain" in the city, and its importance determines that the core task of building a green smart city is to build a smart government. The government can organize regulation through policy guidance, strategic planning, and regulatory constraints. Therefore, it will play a guiding role in the development of China's green and smart cities [15]. The top-level design of a green smart city can be planned. From the perspective of a leader, the overall structure of the smart city can be comprehensively designed, and all aspects of the overall structure can be planned. Reasonable top-level design and overall planning blueprint are conducive to resource sharing between cities, industries, and departments [16]. It is helpful to clarify the development direction of the city. It is beneficial to improve resource utilization by supporting the development of science and technology. In the "Internet +" era, the Chinese government's administrative system has entered a period of deepening transformation and reform. Under the new normal, smart government has gradually replaced e-government and has become an advanced stage of e-government development. Smart government is centered on big data analysis and supported by modern information technology. Information resources are screened, optimized, and reorganized. The smart government cloud platform is built to implement data exchange and resource sharing, thereby saving government costs. Transparency and fairness in government affairs are increased. The work efficiency and decision-making ability of government management services are improved [17].

Table 1: Smart city evaluation index system.

| Primary index | Secondary indicators | Tertiary indicators |
|---|---|---|
| Smart city | Smart city infrastructure | Mobile phone index |
| | | Internet broadband index |
| | | Operator distribution index |
| | Smart city industrial economy | Smart industry development index |
| | | Network economy development index |
| | | Innovation development index |
| | Smart city online government | Online government index |
| | | Information release index |
| | Smart city life service | Intelligent application index |
| | | Smart convenience index |
| | Cultural environment of smart city | Education index |
| | | Environmental index |

*(2) Enterprise*. In urban construction, the role of enterprise development is far greater than that of the government. The government is the guide, and the enterprise is the leading [18]. Enterprises are the main body of the market economy. In the market, there are not only public service products provided by the government, but also products that conform to the rules of market competition. The main role of enterprises in the construction of green and smart cities is to implement the development of related industries and promote the application of related industries and products in various fields.

*(3) Residents*. The ultimate goal of building a green and smart city is to serve people and enable urban residents to live a better life. The government needs to encourage more enterprises and residents to actively participate in it. Occupants are both makers and buyers in the development of green and shrewd urban communities. Occupants accept various jobs and partake in the whole course of metropolitan development. The public authority can work on occupants' attention to natural security and the capacity to take part in the development of green and brilliant urban communities through exposure, advancement, schooling, and preparing connected with green and savvy urban areas. Residents are encouraged to participate in construction, and the values of harmonious coexistence and common development between man and nature and the concept of green consumption are advocated; residents' participation is fully utilized, natural resources and information resources are optimally allocated, and the construction of green and smart cities is supervised and promoted.

### 3.2. Theories Related to the Entropy Weight Method

*3.2.1. Overview of the Entropy Weight Method.* Entropy was initially only an idea of thermodynamics in material science and, later, brought into data hypothesis, called "information entropy," which has been widely used in various engineering or economic fields [19, 20]. The entropy weight method is an objective method for determining weights, which has the characteristics of wide applicability, high accuracy, and strong objectivity. The basic idea of the entropy weight method is to determine the weight of each indicator according to the degree of variation of each variable and then modify it to obtain a relatively objective weight [21, 22]. The entropy weight method has a strong mathematical theoretical basis and can objectively and accurately determine the index weight, avoiding the influence of subjective factors of other subjective weighting methods.

*3.2.2. Determining the Weight by the Inheritance Law.* Let the initial data matrix of object set A be

$$A = \left(a_{ij}\right)_{n\times m}. \tag{1}$$

It includes $n$ objects to be evaluated and $m$ evaluation indicators.

Then, the detailed steps to obtain the evaluation index weight by using the direct right method are as follows.

*Step 1.* Standardize the initial indicator data: set the normalized value of each indicator data, and then, there are

$$B_{ij} = \frac{A_{ij} - \min\left(A_i\right)}{\max\left(A_i\right) - \min\left(A_i\right)}. \tag{2}$$

*Step 2.* Calculate the data relative worth of each record: the data relative worth of the jth gathering of file information is

$$Q_j = -\ln\ (n)^{-1} \sum_{k_{ij}}^{n} \ln\ k_{ij},$$
$$k_{ij} = \frac{B_{ij}}{\sum_{i=1}^{n} B_{ij}}. \tag{3}$$

If

$$k_{ij} = 0, \tag{4}$$

then define

$$\lim_{k_{ij} \longrightarrow 0} k_{ij} \ln\ k_{ij} = 0. \tag{5}$$

*Step 3.* Calculate the indicator weight vector:

$$\omega = \{\omega_1, \omega_2, \ldots, \omega_n\},$$
$$\omega_j = \frac{1 - Q_j}{\sum_{j=1}^{m}\left(1 - Q_j\right)}, \tag{6}$$
$$0 \le \omega_j \le 1,$$
$$\sum_{j=1}^{m} \omega_j = 1.$$

*3.3. Theories Related to Cloud Models.* This paper evaluates the development level of green and smart cities, and there will inevitably be certain uncertainties. Therefore, in order to make a reasonable and effective evaluation, the inevitability of the existence of uncertain factors should be noticed. To address the unavoidable uncertainty, other evaluation methods are compared. This paper finally chooses to use the direct right method-cloud model to evaluate the development level of China's green and smart cities.

*3.3.1. The Concept of the Cloud Model.* Natural language is the crystallization of human wisdom and the carrier of knowledge, but natural language contains too much uncertainty. To study the expressions and methods of uncertainty in language, it is necessary to establish a qualitative and quantitative mutual conversion model, as the basis for the transformation of natural language and data language.

Let $M$ be a quantitative universe, and let $C$ be a qualitative concept on the quantitative universe M, and the quantitative value a is a random realization of C, that is, $a \in M$, and the random number $\mu(a)$ is the degree of certainty that a realizes on C, $\mu(a) \in [0, 1]$, and has Stable Tendency:

$$\begin{aligned} \mu(a)\colon M &\longrightarrow [0, 1], \\ &\forall a \in M, \\ a &\longrightarrow \mu(a). \end{aligned} \tag{7}$$

Then, the distribution of a on the universe of discourse M is called a cloud, and the random number reflects the degree of certainty of the quantitative value a to the qualitative concept C.

*3.3.2. Digital Features of Cloud Models.* The overall characterization of the cloud model concept can be used to represent the mathematical properties of linguistic values by using the cloud's numerical features—expectation ($E_a$), entropy ($E_n$), and hyperentropy (He) [23, 24]. Expectation $E_a$: the point where cloud droplets are reflected in domain M that best represents qualitative concepts. Entropy $E_n$: the probability and ambiguity of qualitative concepts are represented, which can reflect not only the discrete degree of cloud droplets, but also the value range of cloud droplets. Hyperentropy He: the entropy of entropy, representing the uncertainty measure of entropy. Taking (0, 1, 0.1) as the three digital features of the cloud model and 5000 cloud droplets as an example, the one-dimensional normal cloud model is shown in Figure 3.

*3.4. Support Vector Machines*

*3.4.1. The Concept of Support Vector Machine.* Support Vector Machine (SVM) identifies the evaluation object by constructing the optimal decision hyperplane, so as to transform the optimization problem into the relevant classification and regression analysis problems to obtain the optimal results [25]. It is based on the VC dimension theory (Vapnik–Chervonenkis Dimension) in statistical theory and the principle of minimum structural risk.

The specific idea of SVM to solve the problem is reflected in two aspects: one is to classify the linearly separable evaluation objects. The second is to develop the ideal order hyperplane by applying the guideline of limiting primary gamble in the low-layered example space, to get the ideal outcome (Figure 4).

*3.4.2. Regression Prediction Algorithm of Support Vector Machine.* From the perspective of support vector machine regression prediction used in this paper, considering that the main algorithms used in support vector regression prediction are the algorithms of insensitive function and kernel function, the specific algorithms are summarized as follows:

*(1) SVM Regression Prediction Algorithm.* Let sample set

$$X = \left\{(b_l, a_l) | b_l \in R, a_l \in R^{\mathrm{d}}\right\}. \tag{8}$$

The regression function is expressed linearly as

$$g(a) = \omega^T \phi(a) + y. \tag{9}$$

In order to minimize the structural risk of the regression function $g(a)$, that is, to achieve min $1/2\omega^T\omega$, it is necessary to seek $\omega$ and $b$. The optimal regression function can be determined by the minimum value of the function, and the nonnegative slack variable $\xi_i$ and the penalty factor C are introduced to obtain

$$\min\left(\frac{1}{2}\omega^T\omega + C\sum_{i=1}^{l}\left(\xi_i + \xi_i^*\right)\right), \tag{10}$$

where $\omega$ represents the dimension, C is a constant that has been determined, and slack variables control the upper and lower bounds of the output constraints.

$$\begin{cases} b - \omega^T\phi(a_i) - y \le \varepsilon + \xi_i, \\ \omega^T\phi(a_i) + y - b \le \varepsilon + \xi_i^*, \\ \xi_i, \xi_i^* \ge 0. \end{cases} \tag{11}$$

Introduce the Lagrange multiplier:

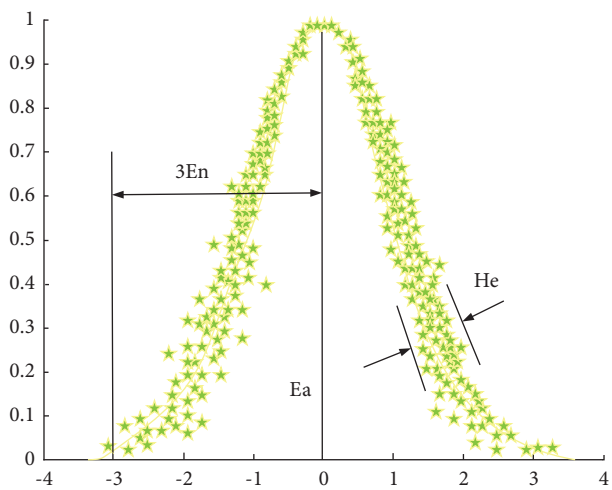


Figure 3: One-dimensional normal cloud map formed by 5000 cloud droplets with (0, 1, 0.1) as eigenvalues.

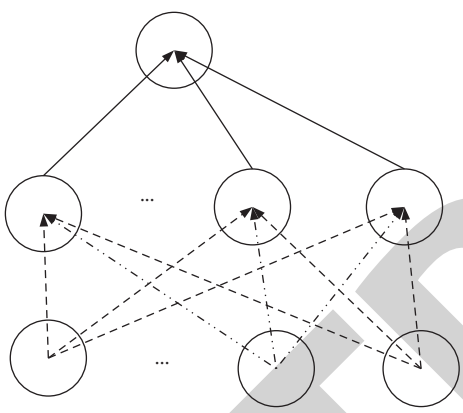

Figure 4: Schematic diagram of the structure of the support vector machine.

$$L = \frac{1}{2}\omega^T\omega + C\sum_{i=1}^{l}(\xi_i + \xi_i^*) - \sum_{i=1}^{l}\left(\varepsilon + \xi_i - b + \left(\omega^T\phi(a_i)\right) + y\right),$$
$$- \sum_{i=1}^{l}\alpha_i\left(\varepsilon + \xi_i + b - \left(\omega^T\phi(a_i)\right) - y\right) - \sum_{i=1}^{l}(\eta_i\xi_i + \eta_i^*\xi_i^*). \tag{12}$$

In the formula, $\alpha_i$ is the Lagrangian product factor. If the non-zero factor in the multiplication factor $\alpha_i$ is represented by $\alpha_i^0$, then $\alpha_i^0$ is the support vector obtained through training by using support vector machine (SVM) [26].

*(2) Kernel Function*. Kernel functions play an important role in SVM operations, not only to solve the nonlinear latitude problem, but also to replace the direct inner product operation in the high-dimensional feature space. There is no need to specify the function of a certain high-dimensional space, and the high-dimensional operation is simplified [4, 27].

For building choice guidelines, three normal sorts of SVMs are given as follows:

(1) Polynomial machine with part capability:

$$D(h, h_i) = (h \bullet h_i + 1)^r, \tag{13}$$

where $r$ is the request for the polynomial piece.

(2) Radial premise capability machine with piece capability:

$$D(h, h_i) = \exp\left(\frac{-1}{\delta^2(h - h_i)^2}\right), \tag{14}$$

where $\delta$ is the bandwidth of the radial basis function kernel.

(3) Two-layer brain network machine with piece capability:

$$D(h, h_i) = F[(h \bullet h_i)], = \frac{1}{1 + \exp(v(h \bullet h_i) - b)}, \tag{15}$$

$v$ and $b$ are the parameters of the F-shaped function $F[(h \bullet h_i)]$ satisfying the inequality $b \geq v$.

The basic idea of SVM is shown in Figure 5.

## 4. Experiments on Legal Guarantees for Smart City Pilots and Green and Low-Carbon Development

After the low-carbon city development document framework is formulated, it should be utilized and the practicability and feasibility of the filing framework should be tested. Considering that Shanghai is one of the principal pilot low-carbon urban communities in China, and the information measurements are moderately finished and simple to get, Shanghai is picked for instance. The utilization of this file framework and the reception of sensible assessment techniques do a particular assessment that concentrates on the development of low-carbon city in Shanghai. It gets the improvement of the city, in this manner, giving a reference to future turn of events.

As China's monetary, exchange, show, and delivery focus, Shanghai focuses closer on feasible improvement, while the economy is growing quickly. As one of the main pilots of a low-carbon city, Shanghai has gone all out in the development of a low-carbon city and has accomplished productive outcomes; however, there are as yet numerous issues and colossal difficulties.

Doing the act of metropolitan low-carbon life in Shanghai, the principal items in the task plan include the following: first and foremost, to research the energy utilization of structures and further develop the energy proficiency of huge structures. The World Wide Fund for Nature collaborated with the Shanghai Institute of Building Research and the Shanghai Construction and Transportation Commission to carry out the work and selected large

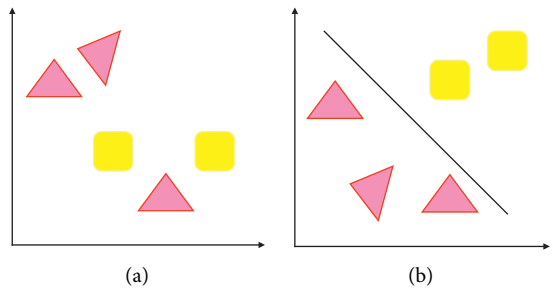


Figure 5: Basic idea of support vector machine.

commercial buildings such as shopping malls, office buildings, and hotels as pilot projects. The energy consumption of these buildings is investigated, calculated, and made public. The second is to start the training of building industry managers. The energy-saving operation capability of the building will be improved by training relevant management personnel. The third is the policy research on ecological building development and the selection and implementation of demonstration projects.

*4.1. Evaluation Index Data Collection.* As indicated by the built low-carbon city assessment file framework, the assessment of low-carbon city development and advancement incorporates four subsystems: low-carbon economy (A1), low-carbon society (A2), low-carbon climate (A3), and low-carbon system (A4). There are specific evaluation indicators under different subsystems. There are 13 specific indicators. It chiefly remembers the extent of tertiary industry for GDP (A11), energy utilization per unit of GDP (A12), energy utilization per unit of modern added esteem (A13), per capita energy utilization (A21), utilization of public vehicle vehicles per 10,000 individuals (A22), urban per capita lodging living region (A23), modern wastewater release consistence rate (A31), metropolitan sewage treatment rate (A32), per capita green region (A33), air quality magnificent rate (A34), fossil fuel byproducts (A35), R&D as a level of monetary consumption (A41), and Internet client infiltration rate (A42). The concept of "low-carbon economy" was formally proposed in 2003, and it has been widely concerned and developed in various countries. In addition, according to the availability of data, the selection and collection of evaluation index data began in 2017. The Shanghai Statistical Yearbook over the years was searched, and the specific data of Shanghai evaluation indicators from 2017 to 2021 were collected as shown in Table 2.

Sorting is carried out by performing fuzzy operations on the judgment matrix of the above subsystems and specific indicators under the subsystems. The final weights of indicators at all levels are shown in Table 3.

*4.2. Coordination Degree Model.* To calculate the coordination degree, the efficacy value of each evaluation index in the system must be calculated first. According to the formula of the efficacy function, the upper and lower limit values of the indicators at the critical point of system stability need to be determined. Since the concept of "low-carbon economy" was formally proposed in 2003, the concept of low-carbon was paid attention to and applied in practice after that. In addition, considering that low-carbon-related indicators began to be counted in 2004. Therefore, the data in 2004 is used as the lower limit. The selection of the upper limit value is generally a future development goal. Therefore, the upper limit is the development goal to 2015 proposed in Shanghai's "Twelfth Five-Year Plan." For those that are not clearly specified in the "Twelfth Five-Year Plan," the trend extrapolation method is used to forecast, and the forecast value is taken as the upper limit. The upper and lower limits of the specific indicators in each subsystem are shown in Table 4.

The collected current value of each evaluation index in Shanghai and the above-determined upper and lower limit values are brought into the function formula, and also, every subsystem in the assessment file arrangement of Shanghai's low-carbon city development from 2017 to 2021 is gotten. The viability upsides of the assessment markers are displayed in Figure 6.

*4.3. Evaluation Results.* The low-carbon city construction in Shanghai from 2017 to 2021 was evaluated using the coordination degree model based on triangular fuzzy hierarchy. The development status of the system and the overall coordination degree of the main components between the systems can be seen from the final coordination degree value:

(1) Overall, the overall coordination degree of Shanghai has been developing towards a high degree of coordination. The specific change trend is shown in Figure 7. As can be seen from the figure, in 2017, the total coordination degree was 0.1509, which was in a very uncoordinated state. After that, the total coordination degree generally showed an upward trend, especially by 2020, and the total coordination degree was 0.5015. For the first time, the basic coordination state is reached. This is closely related to the fact that Shanghai was listed as a low-carbon city pilot in 2019 and began to pay more attention to the development of low-carbon cities. By 2021, the overall coordination degree of Shanghai's low-

Table 2: Historical data of evaluation indicators.

| Index | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|
| A11 (%) | 52.2 | 54.5 | 55.99 | 59.37 | 57.4 |
| A12 (tons of standard coal/10000 yuan) | 0.861 | 0.804 | 0.774 | 0.728 | 0.713 |
| A13 (ten thousand yuan per ton of standard coal) | 1.188 | 1.126 | 1.07 | 1.028 | 0.953 |
| A21 (tons of standard coal/10000 yuan) | 4.520 | 4.685 | 4.768 | 4.692 | 4.848 |
| A22 (vehicle/10000 persons) | 12.64 | 12.30 | 10.62 | 11.09 | 12.45 |
| A23 ($m^3$) | 16 | 16.5 | 16.9 | 17.2 | 17.6 |
| A31 (%) | 0.697 | 0.674 | 0.783 | 0.745 | 0.763 |
| A32 ($m^3$) | 11.6 | 12.01 | 12.51 | 12.9 | 13 |
| A33 (%) | 37.2 | 37.6 | 38 | 38.2 | 38.1 |
| A34 (%) | 88.4 | 89.9 | 89.5 | 91.6 | 92.2 |
| A35 (ten thousand tons/hundred million yuan) | 2.092 | 1.93 | 1.809 | 1.719 | 1.622 |
| A41 (%) | 5.21 | 4.9 | 4.6 | 7.2 | 6.1 |
| A42 (%) | 52.8 | 58.1 | 61.4 | 65.1 | 68.1 |

Table 3: Weights in the low-carbon city evaluation index system.

| Subsystem layer | Weight | Index layer | Weight |
|---|---|---|---|
| Low carbon economy (A1) | 0.261 | Proportion of tertiary industry I in GDP (A11) | 0.233 |
| | | Energy consumption per 10000 yuan GDP (A12) | 0.296 |
| | | Energy consumption per unit industrial added value (A13) | 0.470 |
| | | Per capita energy consumption (A21) | 0.446 |
| Low carbon society (A2) | 0.182 | Use of public transport vehicles per 10000 people (A22) | 0.350 |
| | | Urban per capita housing area (A23) | 0.207 |
| | | Standard rate of industrial wastewater discharge (A31) | 0.240 |
| | | Urban sewage treatment rate (A32) | 0.171 |
| Low carbon environment (A3) | 0.420 | Per capita green area (A33) | 0.063 |
| | | Air quality excellence rate (A34) | 0.145 |
| | | Carbon emissions (A35) | 0.382 |
| Low carbon mechanism (A4) | 0.133 | Ratio of R & D to fiscal expenditure (A41) | 0.585 |
| | | Internet penetration rate of Sichuan households (A42) | 0.415 |

Table 4: Upper and lower limits of specific indicators.

| Index | | Upper limit value | Lower limit value |
|---|---|---|---|
| Low carbon economy (A1) | A11 (%) | 65.00 | 50.74 |
| | A12 (lots of standard coal/10000 yuan) | 0.598 | 0.916 |
| | A13 (lots of standard coal/10000 yuan) | 0.781 | 1.260 |
| | A21 (lots of standard coal/10000 yuan) | 5.838 | 4.041 |
| Low carbon society (A2) | A22 (vehicle/10000 persons) | 15 | 13.04 |
| | A23 (m') | 18 | 14.799 |
| | A31 (%) | 85 | 0.494 |
| | A32 (m3) | 13.5 | 10.12 |
| Low carbon environment (A3) | A33 (%) | 38.5 | 36.000 |
| | A34 (%) | 95.000 | 85.1 |
| | A35 (ten thousand tons/hundred million yuan) | 1.344 | 2.286 |
| Low carbon mechanism (A4) | A41 (%) | 10.000 | 2.800 |
| | A42 (%) | 70.000 | 37.000 |

carbon city development will be 0.5675, which has achieved greater development compared with 2020 and is approaching a more coordinated state. This shows that the overall development of Shanghai's low-carbon city construction is relatively rapid.

(2) From the subsystem level, the four subsystems of Shanghai's low-carbon economy, low-carbon society, low-carbon environment, and low-carbon mechanism show a continuous development trend from an overall perspective. The specific trends are shown in Figure 8.

It can be seen from Figure 8 that the coordination degree of the low-carbon economy has risen rapidly, showing a linear upward trend. In just 5 years from 2017 to 2021, the coordination degree value has risen from 0.0379 to 0.5983, which is close to a relatively

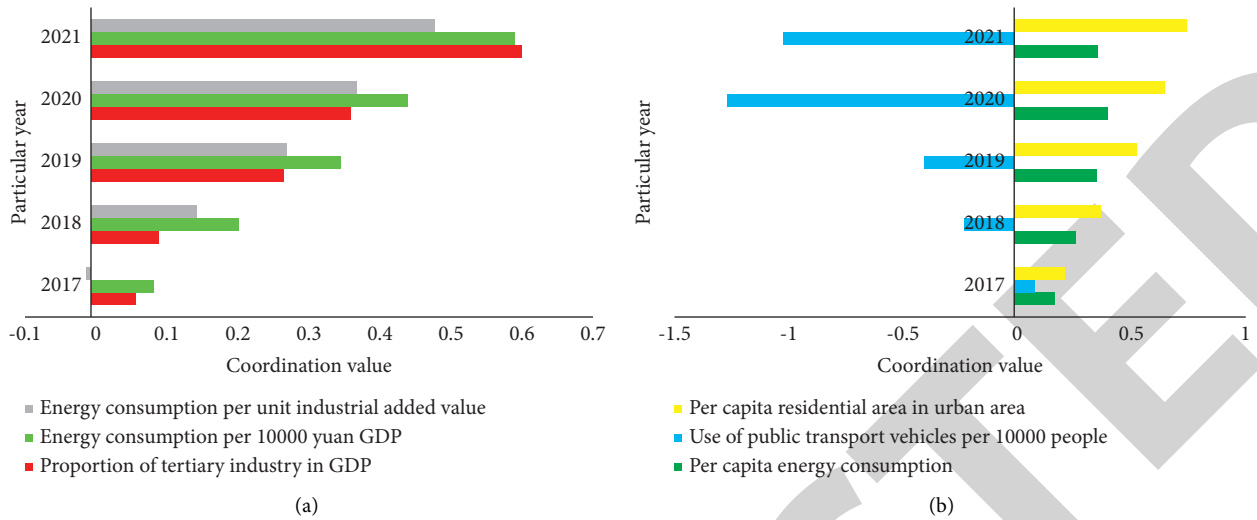


Figure 6: 2017–2021 low-carbon economy subsystem indicator efficacy values.

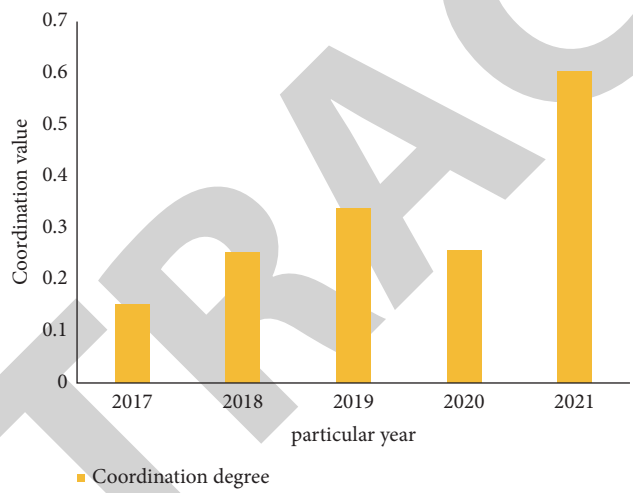


Figure 7: The overall coordination trend of low-carbon city development in Shanghai from 2017 to 2021.

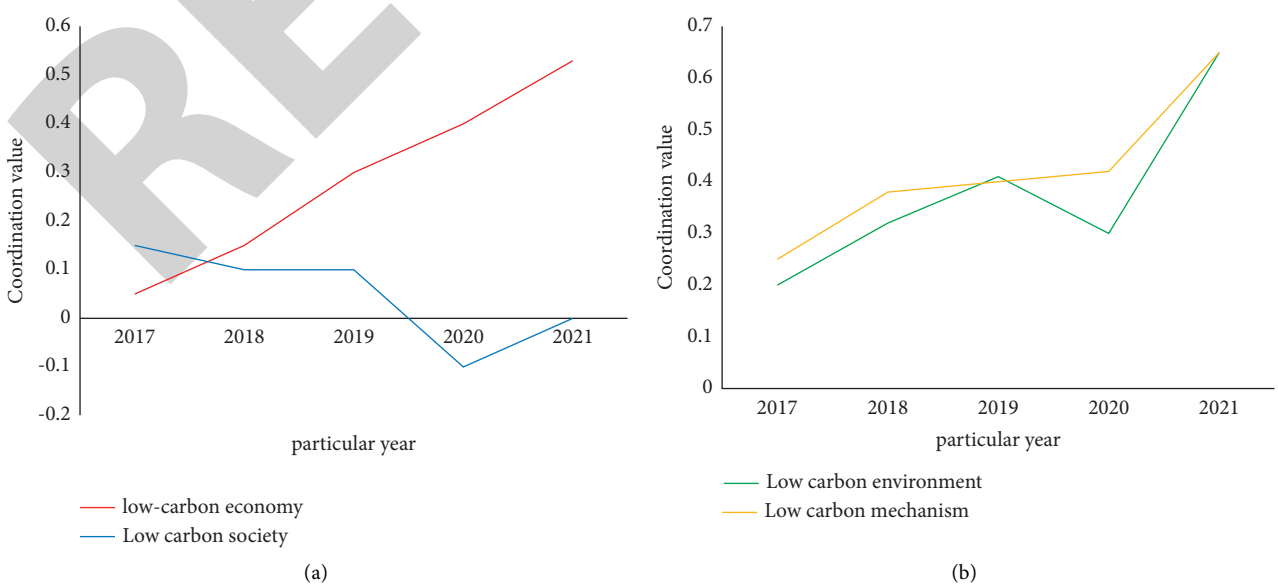


Figure 8: The trend of coordination degree of various subsystems of low-carbon city evaluation in Shanghai from 2017 to 2021.

coordinated state. This shows that Shanghai is paying more and more attention to low carbon while achieving rapid economic growth. The coordination degree of the low-carbon society is poor, and it will still be in a state of disharmony by 2021, and the coordination degree value will be negative in 2019 and 2020. This is because the specific indicator value of public vehicles owned by every 10,000 people in this subsystem has dropped sharply in the past two years, resulting in unreasonable coordination value. The low-carbon environment subsystem has the best coordinated development among the four subsystems, and the current state is the best. By 2021, the coordination degree value has reached 0.6656, which is in a relatively coordinated state, indicating that Shanghai is in a state of environmental protection, especially reducing carbon emissions. Extraordinary headway has been made in ecological assurance. The coordination degree worth of the low-carbon component has developed consistently, coming to 0.6074 by 2021, and a moderately planned state has likewise been accomplished, mirroring that Shanghai connects incredible significance to the improvement of low-carbon economy and low-carbon urban communities and has given more prominent help and exposure. In general, in these four subsystems, the low-carbon climate and low-carbon components are in a somewhat organized state and are well nurtured, while the low-carbon economy and low-carbon society are still in the basic planning state and should be further developed.

(3) Based on the particular assessment pointers under every subsystem, under the low-carbon economy, the energy utilization per 10,000 yuan of GDP and the energy utilization per unit of modern added esteem have arrived at a somewhat planned state. The proportion of the tertiary industry in GDP is still in an uncoordinated state: in a low-carbon society, the per capita living area in urban areas has reached a highly coordinated state, while the coordination between per capita energy consumption and public vehicles per 10,000 people is low. In a low-carbon environment, except that the discharge compliance rate of industrial wastewater is still in an uncoordinated state, other indicators are relatively coordinated. Under the low-carbon mechanism, the penetration rate of Internet users has achieved a high degree of coordination, while the ratio of R&D to fiscal expenditure is not in a coordinated state. It shows that the government should continue to increase investment in the construction of low-carbon cities.

## 5. Conclusions

Green development is a change from the past development model, and it is based on the tolerance of the environment and the limited use of resources, taking ecological protection as a critical reference in China's development. In addition, the continuous breakthrough of China's economy often leads to damage to the ecological balance and waste of resources. In order to minimize its negative impact, green development is an inevitable choice. This article discusses the issue of circular economy legal safeguard mechanism at this level, mainly using interdisciplinary and empirical research methods to conduct in-depth research on China's relevant legislation, law enforcement, judiciary, and law-abiding safeguard mechanisms. Then, from the three aspects of government promotion mechanism, market adjustment mechanism, and public participation mechanism, a circular economy legal guarantee mechanism for China's green development is constructed, so as to find a green and ecological development path with Chinese characteristics.

With the progressive exhaustion of worldwide energy and the persistent extending of the idea of feasible turn of events, people started to look for new improvement strategies, and the idea of low-carbon economy and low-carbon city appeared. Low-carbon economy and low-carbon city complement each other. The development of a low-carbon city requires a low-carbon economy as the foundation, and the development of a low-carbon economy requires a low-carbon city as a backing. China has gradually settled in Shanghai, Baoding, and other low-carbon pilot cities to explore the improvement model of low-carbon urban communities. The development of a low-carbon city is a course of persistent investigation, and a sensible assessment of the improvement status of a low-carbon city has turned into a vital connection in this cycle. It can give dynamic premise to the further improvement of low-carbon urban communities and advance the advancement of low-carbon urban communities in a superior bearing. Accordingly, the examination on the assessment of low-carbon city development is of incredible importance. Based on concentrating on the practical advancement record framework and low-carbon meaning, this paper has developed the low-carbon city assessment file framework and presented the three-sided fluffy number insightful pecking order process and the coordination degree model to build the fluffy coordination degree model for the development of low-carbon urban areas. Finally, Shanghai is regarded as a model of low-carbon city development and a pilot project for low-carbon city evaluation.

## Data Availability

This article does not cover data research. No data were used to support this study.

## Conflicts of Interest

The author declares that there are no conflicts of interest.

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*Retraction*

# Retracted: Comparative Analysis of Machine Learning Methods for Breast Cancer Classification in Genetic Sequences

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] B. Kurian and V.L Jyothi, "Comparative Analysis of Machine Learning Methods for Breast Cancer Classification in Genetic Sequences," *Journal of Environmental and Public Health*, vol. 2022, Article ID 7199290, 6 pages, 2022.

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*Research Article*

# Comparative Analysis of Machine Learning Methods for Breast Cancer Classification in Genetic Sequences

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Breast cancer is the leading cancer in women, which accounts for millions of deaths worldwide. Early and accurate detection, prognosis, cure, and prevention of breast cancer is a major challenge to society. Hence, a precise and reliable system is vital for the classification of cancerous sequences. Machine learning classifiers contribute much to the process of early prediction and diagnosis of cancer. In this paper, a comparative study of four machine learning classifiers such as random forest, decision tree, AdaBoost, and gradient boosting is implemented for the classification of a benign and malignant tumor. To derive the most efficient machine learning model, NCBI datasets are utilized. Performance evaluation is conducted, and all four classifiers are compared based on the results. The aim of the work is to derive the most efficient machine-learning model for the diagnosis of breast cancer. It was observed that gradient boosting outperformed all other models and achieved a classification accuracy of 95.82%.



## 1. Introduction

*Cancer* stands second as the cause of death worldwide. 10 million people die of cancer, the most threatening disease, every year. Some of the causes of cancer include internal factors such as genetic mutations, hormone changes, less immunity, and external factors namely eating practices and environmental changes as well as population rate. For the prediction of any disease, next-generation sequencing plays a vital role for few decades.

Machine learning and artificial intelligence have a promising future in every technological development, especially in the healthcare industry. Early detection of cancer and due strategies for preventing the disease can save many lives. For the purpose of breast cancer prognosis, the latest machine learning methods ease the prediction, prevention, and cure. Next generation sequencing using machine learning methods resumes by extraction of genetic sequences, both benign and malignant from any resource, such as the National Centre for Biotechnology Information (NCBI) or Wisconsin. Features are extracted from these DNA sequences for classification purposes. Analysis of features is done with the box method to find the outliers, histogram for data distribution, and scatter matrix for revealing the feature relationship. The distinction between benign and malignant sequences is done. Training and testing datasets are derived in the ratio 80 : 20. Classification is done by various traditional as well as boosting classifiers. Classification accuracy is calculated for various machine learning models, and the performance is evaluated using the F1 score. An optimal method is selected based on the accuracy of classification, and hence, the distinction between benign and malignant becomes much easier.

*1.1. Related Work.* A plethora of research has been carried out on cancer prognosis using various machine learning methods. It is very challenging to diagnose cancer at an early stage and thus do the needed treatment since it is a dangerous disease. Combining artificial intelligence and NGS has research scope in the diagnosis and cure of BC. Many

researchers have implemented several ML methods for making prediction easier.

[1] compared several machine learning algorithms in detecting disease as well as finding metastasis. The methods were evaluated for performance with specificity, accuracy total, and ratio of likelihood. In order to differentiate between malignant and benign tumors, genetic programming techniques were applied by using [2], and the best features as well as parameters of the classifiers were selected. Decision tree and gradient boosting were applied together for the distinction between negative breast cancer and positive breast cancer, and predictive performance was conducted [3]. Gradient boosting has achieved better accuracy than the decision tree technique. Transparent breast cancer management is developed for identifying major risk components in the occurrence of BC with the decision tree as well as the neural network [4].

This random forest model is also utilized in cancer prediction with measures such as the F metric and the curve of ROC [5]. An ensemble method for breast cancer detection which was an efficient technique was conducted with two machine learning algorithms, the random forest algorithm and the gradient boosting algorithm [6]. While classifying with 12 features, the random forest algorithm achieved a classification accuracy of 74.73% and XGBoost achieved 73.63%. Nine supervised machine learning techniques including boosting algorithms were applied for breast cancer prediction by extracting 10 features from the genetic sequences of *Homo sapiens*, BRCA1, and BRCA2 [7]. The decision tree algorithm outperformed other models with 94.03% accuracy.

A genetic algorithm was combined with an online gradient boosting algorithm for the detection of breast cancer which was an efficient method because of its incremental way [8]. A hierarchical clustering-based random forest algorithm was used for calculating the similarity between all decision trees [9]. In order to build the hierarchical clustering random forest, the representative trees were chosen from divided clusters. Classifiers are made by a protocol using the AdaBoost algorithm, and frequently occurring breast tumor patterns were considered for disease prognosis [10]. A breast cancer classification model that combined random forest and AdaBoost algorithms to differentiate between benign and malignant data was developed [11].

*1.2. System Description.* Breast cancer prognosis is conducted with the help of four classifiers namely the decision tree technique, random forest as well as boosting algorithms such as AdaBoost and gradient boosting. The overall cancer prediction consists of three data retrieval, classifying data, and optimal classifier selection. Data/genetic sequences are extracted from the NCBI database in the form of FASTA files. The next step in disease prediction is classification, which consists of feature extracting, construction of machine learning models, performance evaluation as well as comparative analysis of classifiers. The final step is the best classifier selection process that is based on the accuracy of classification. The architecture diagram is depicted in Figure 1.

*1.3. Data Extraction.* Various normal human genetic sequences as well as cancerous sequences such as BRCA1 and BRCA2 datasets were derived as data instances in the form of FASTA files from NCBI. Though the sequences vary in their length, the average of the nucleobases was considered, and hence, the dataset reliability is conserved. A genetic sequence comprises various occurrences of nucleobases such as adenine, guanine, cytosine as well as thymine. The sequences derived vary in their length from 648 to 12386. Random sequences were selected for classification because the human genome comprises of millions of nucleobases. The resilience and stability of the DNA sequences make the work more promising than RNA sequences. DNA information is better protected and can be easily repaired compared to RNA sequences. The sequences stored in a variable are fed as input to the immediate classification phase.

*1.4. Data Classification.* Data classification makes use of the class or labels for forecasting an unlabelled dataset. The classification in the breast cancer prediction work consists of the extraction of features, construction of classifiers for the purpose of classification, and selection of classifiers that are optimized.

*1.5. Features Extraction.* The classification of benign as well as malignant breast cancer is performed with various features extracted related to breast cancer. The features derived for the purpose include the occurrence of G-quadruplex, count of ORF, GC content, class value, and mutation rate. The features were selected based on their relevance to cancer acquisition. The class value is used as the classification target that comprises values 0, 1, and 2. The occurrence of G-quadruplex and ORF contributed more to the prediction of breast cancer because it increases the probability of malignancy. The features strength was calculated using the histogram, scatter matrix as well as box plot graph. The box plot graph represents the data outliers. Outliers were identified for data using the box plot graph. Table 1 shows all 5 features along with their corresponding classes.

The extraction of features is conducted by the following algorithms.

(1) G-Quadruplex Occurrence

$$\text{avg}_{G4} = \frac{C}{\text{lngth}(Sj)}. \quad (1)$$

(i) Let the count of 'GGGG' be C.

(ii) Calculate the average count of G4.

C - Total count of 'GGGG' in the sequence.

$\text{Avg}_{G4}$ - Average count of 'GGGG'.

lngth(Sj) - $j^{th}$ sequence length.

(2) Open Reading Frame (ORF) Measure

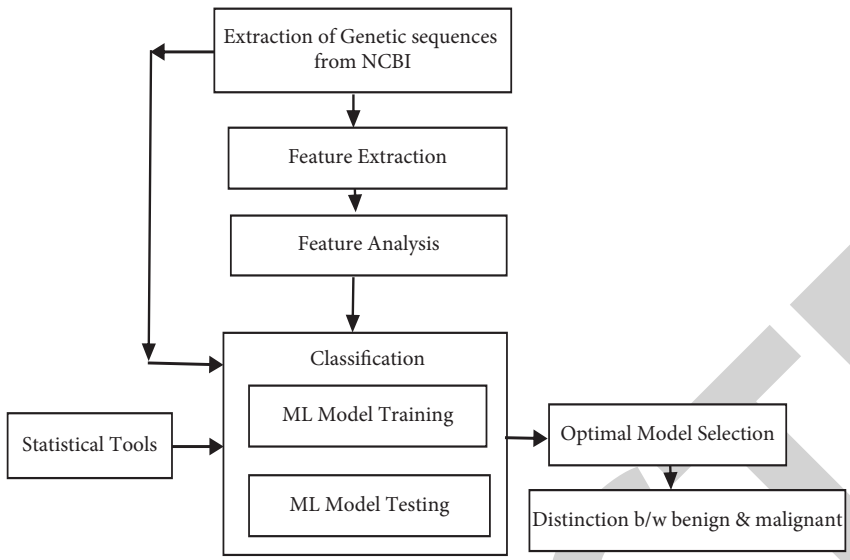


Figure 1: Overall architecture diagram.

(i) $S_{Length} \leftarrow$ length of SeqDNA

(ii) initial_codon = ATG; final_codon = TAG, TAA, TGA

(iii) for $i$ varies from 1 to $S_{Length}$ Till $EoS_{S_i} \neq$ True

(a) Convert Si to string

(b) $cdn_{S_i} \leftarrow$ Divide the sequence into 3 continuous nucleobases

(c) $initial\_val_{S_i} \leftarrow$ start codon points from $cdn_{S_i}$

(d) $final\_val_{S_i} \leftarrow$ stop codon points from $cdn_{S_i}$

(e) $m \leftarrow$ len $(initial\_val_{S_i})$ ; $n \leftarrow$ len $(final\_val_{S_i})$

(f) $j \leftarrow 1$; $k \leftarrow 1$; $ORF_{S_i} \leftarrow 0$

(g) If $(j<=m)$ and $(k<=n)$

If $(initial\_val_{S_{i_j}} < final\_val_{S_{i_k}})$

$ORF_{S_i} \leftarrow ORF_{S_i} + 1$

Else if $(initial\_val_{S_{i_j}} < final\_val_{S_{i_k}})$

(i) Move $k$ until $(initial\_val_{S_{i_j}} < final\_val_{S_{i_k}})$

(ii) If $(initial\_val_{S_{i_j}} < final\_val_{S_{i_{k-1}}})$

Move $j$ until $(initial\_val_{S_{i_j}} < final\_val_{S_{i_k}})$

(i) $ORF_{S_i} \leftarrow ORF_{S_i} + 1$

$S_{Length}$ - Total length of sequences extracted.

$Seq_{DNA}$ - DNA sequences extracted.

Initial_codon and final_codon - Start and stop codons to check for the ORF existence.

$EoS_{S_i}$ - End pointer of the sequence Si.

$initial\_val_{S_i}$ and $final\_val_{S_i}$ - start and stop codon positions of the sequence Si.

$m$, $n$ - No of start codons and stop codons.

$J$, $k$ - Index variables representing start codon and stop codon.

$ORFS_i$ - Number of ORF existence in the whole sequence Si.

(3) GC- Content

$$Avg_{GC} = \frac{(Count_G + Count_C)/2}{\text{len}(S_i)}. \quad (2)$$

Avg of GC occurrence is calculated as above

$Count_G$ - Total count of Guanine.

$Count_C$ - Total count of Cytosine.

$Len(S_i)$ - $i^{th}$ sequence length.

(4) Class Value

If Normal *Homo sapiens* Then$TargS_i = 0$

else if BRCA1 then $TargS_i = 1$

else $TargS_i = 2$

where $Seq_i$ - $i^{th}$ sequence.

(5) Mutation Rate

$$p1 = \frac{\text{Match}(Seq_i)}{Al\_\text{len}(Seq_i)} * 100. \quad (3)$$

(i) *Homo Sapien* reference DNA, $R$ of nucleobase range 52861230 is extracted from NCBI.

(ii) Employ paired alignment technique "GlobalAlignment ()" to find the align sequence length of$S_i$, no: of matches, no: of mismatches, no: of insertion and number of deletion w.r.t to the reference genome.

(iii) For $Seq_i$

(iv) Measure p1:

(i) Measure p2:

$$p2 = \frac{\text{Ins}(Seq_i) + \text{Del}(Seq_i)}{Al\_\text{len}(Seq_i)} * 100. \quad (4)$$

(i) Calculate Mutation Rate

Table 1: Feature sample data.

| Class value | G-quadruplex | ORF | GC content | Mutation rate |
|---|---|---|---|---|
| 0.0 | 6.81543 | 14.0 | 0.012 | 7.61523 |
| 0.0 | 7.47697 | 29 | 0.0010014 | 6.98697 |
| 0.0 | 8.58236 | 23 | 0.0102327 | 7.28334 |
| 1.0 | 8.58717 | 30 | 0.0108499 | 8.58717 |
| 1.0 | 6.77323 | 43 | 0.0132389 | 7.74343 |
| 1.0 | 7.71764 | 27 | 0.0088549 | 7.22864 |
| 1.0 | 6.8438 | 27 | 0.00801603 | 7.9538 |
| 2.0 | 7.47079 | 15 | 0.00702106 | 6.67077 |
| 2.0 | 7.8 | 9 | 0.00600858 | 6.74622 |
| 2.0 | 6.87361 | 8 | 0.0121595 | 6.87361 |

$$MR_{\mathrm{Seq}_i} = 100 - p1 + p2. \quad (5)$$

$\mathrm{MRseq_i}$ - Rate of mutation in the $\mathrm{i^{th}}$ sequence.

P1 and p2 - matches as well as mismatches percentage.

Match ($\mathrm{Seq_i}$) - Sequence matches total.

Al_len ($\mathrm{Seq_i}$) - Sequence length of alignment.

Ins ($\mathrm{Seq_i}$) - Insertions total.

Del ($\mathrm{Seq_i}$) - Deletions total.

*1.6. Construction of the Machine Learning Model.* Classification of breast cancer is performed by construction after the selection of features. Four classifiers such as the decision tree technique, random forest, AdaBoost algorithm as well as gradient boosting algorithm were used for differentiation between benign as well as malignant sequences, and their comparative classification performance was evaluated. For every class of sequences, 4 different sets of instances are derived ranging from 50 to 200 in groups of 50 genetic instances. Features such as G-quadruplex, count of ORF, GC content, and mutation rate are applied to all the four classifiers. These models derive the model class named from the class label. Training and testing genetic sequences are divided with an 80 : 20 ratio. Testing is carried out in the absence of the target value.

*1.7. Selection of the Optimal Classifier Model.* The selection of an optimal model is done based on the performance metrics. Statistical methods such as classification metrics and error matrices are used for this purpose. With the help of the confusion matrix, parameters for performance measurement are calculated. The performance of classification is evaluated by calculating the F1 score, precision, recall, and support values. The accuracy of breast cancer classification can be enhanced by including more features such as copy number variations.

Among the four classifiers, the best model is chosen for efficient sequence classification. For this purpose, statistical measures such as classification measurement and error representation matrix are generated. With the help of the confusion matrix, performance measurement parameters are calculated. Based on the performance parameters, an optimal classification model is generated.

Table 2: Sequence extraction details.

| | | Time of extraction (milliseconds) | | |
|---|---|---|---|---|
| Category of sequences | Dataset size | Normal Sequence | BRCA1 | BRCA2 |
| 50 | 142 | 7.114621 | 7.163212 | 8.578941 |
| 100 | 309 | 8.325282 | 8.209327 | 8.220029 |
| 150 | 451 | 8.841028 | 7.082911 | 0.049044 |
| 200 | 657 | 8.119077 | 7.162478 | 0.038251 |

## 2. Results and Discussion

Three types of benign and malignant instances were extracted under categories, class 0, 1, and 2, respectively. In each class, the size of sequences ranges from 50 to 200 in groups of 50. The length of the genetic sequences greatly influences the execution time. The extraction time of all three categories of NGS sequences is given in Table 2.

Five machine learning models such as the decision tree technique, random forest, the AdaBoost algorithm as well as the gradient boosting model were made with training and testing data sequences. Training and testing datasets are following the ratio of 80 : 20 for the breast cancer classification process. For all 3 classes of genetic sequences, the performance of classification is represented by Table 3.

The number of classes used for cancer classification is represented by a $3 * 3$ confusion matrix. Three classes, C1, C2, and C3 constitute the $1^{st}$, $2^{nd}$, and $3^{rd}$ row/column, respectively. Testing data detected correctly in the corresponding class is denoted as the diagonal values in the matrix and is characterized as $C_i$, where $i = 1,2,3$. The row summation in the confusion matrix represents the sum of testing instances in every class. The $1^{st}$, $2^{nd}$, and $3^{rd}$ rows' total denote the entire instances for the test in the classes C1, C2 as well as C3, respectively.

The accuracy rate of breast cancer classification is measured as a percentage of classes correctly found and the total data tested. The accuracy of classification for all classifiers is shown in Table 4.

For the dataset sizes of 50, 150, and 200, the classification accuracy report depicts that the gradient boosting classifier has achieved a maximum accuracy of 67.50, 95.82, 90.72, and 95.39, respectively. The comparative classification accuracy of the traditional models such as the random forest learning algorithm and decision tree technique as well as boosting algorithms such as AdaBoost and gradient boosting is shown in Figure 2.

The classification performance is measured with parameters of performance measurement. Table 5 represent the performance parameters of gradient boosting.

The above table shows that the F1 score of the gradient boosting model is .95, the same as the accuracy value of the corresponding model calculated using the confusion matrix. Hence, the gradient boosting model has performed better than all the other three models. The inference clearly shows

Table 3: Representation of the confusion matrix.

| ML model | Dataset size | | | |
|---|---|---|---|---|
| | 50 | 100 | 150 | 200 |
| DT | [3 4 3]<br>[4 6 5]<br>[2 2 7] | [12 2 3]<br>[0 14 3]<br>[1 3 12] | [22 1 2]<br>[1 28 2]<br>[0 6 19] | [34 0 2]<br>[0 32 2]<br>[0 5 47] |
| RF | [0 7 2]<br>[1 10 0]<br>[1 8 0] | [18 0 1]<br>[0 18 4]<br>[0 1 17] | [23 0 0]<br>[0 32 4]<br>[1 10 15] | [34 0 0]<br>[0 32 4]<br>[0 6 41] |
| AB | [ 2 4 3]<br>[5 4 5]<br>[3 2 5] | [11 3 0]<br>[4 18 0]<br>[2 9 12] | [20 3 0]<br>[0 30 2]<br>[2 11 10] | [35 0 0]<br>[0 37 0]<br>[1 28 23] |
| GB | [1 8 1]<br>[2 5 3]<br>[1 2 5] | [14 1 1]<br>[0 22 1]<br>[1 2 15] | [21 1 0]<br>[0 32 5]<br>[0 14 12] | [35 1 0]<br>[2 33 2]<br>[3 5 45] |

Table 4: The classification accuracy rate of classifiers.

| | Dataset size | | | |
|---|---|---|---|---|
| ML model | 50 | 100 | 150 | 200 |
| DT | 67.43 | 87.48 | 85.62 | 94.85 |
| RF | 44.38 | 95.18 | 87.58 | 91.58 |
| AB | 64.38 | 87.56 | 89.91 | 94.96 |
| GB | 67.50 | 95.82 | 90.72 | 95.39 |

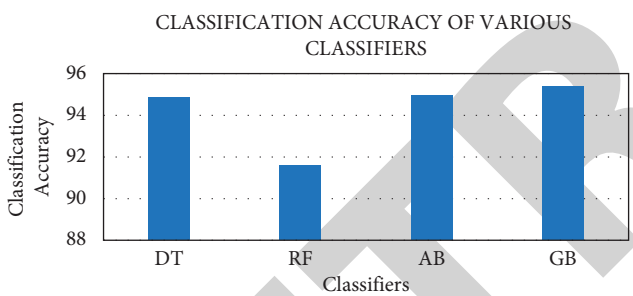


Figure 2: Comparison of classification accuracy of classifiers.

Table 5: Performance Evaluation metrics of the gradient boosting model.

| Label of class | Precision value | Recall value | F1 score value | Support value |
|---|---|---|---|---|
| 0 | 0.95 | .97 | 0.99 | 38 |
| 1 | 0.94 | .95 | 0.94 | 41 |
| 2 | 0.95 | .91 | 0.93 | 55 |
| Average/Total | 0.95 | .94 | 0.95 | 134 |

that the boosting model could perform better than traditional classifiers.

## 3. Conclusion

Since the real causes of breast cancer are still unclear and vary from person to person, the prediction and diagnosis of breast cancer are complex. In our research, various genetic sequences, namely, benign human sequences and BRCA1 as well as BRCA2 as three classes are extracted from the NCBI data repository, and classification between benign and malignant data was performed. From all three classes, the datasets were categorized as groups of 50 DNA sequences ranging from 50 to 200, totalling 2640 sequences. Four classifiers namely the decision tree technique, random forest, and the AdaBoost model as well as the gradient boosting model were constructed with five features relevant to cancer and compared based on classification accuracy. Gradient boosting outperformed all three models and was selected as the optimal model with a classification accuracy of 95% for the distinction of datasets. For the prediction of COVID-19, the work could be extended where extraction of RNA sequence features could be used for classification purposes.

## Data Availability

All the required data used to support the findings of the study are available within the article.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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*Retraction*

# Retracted: Water Environment Governance of Urban and Rural Spaces Integrating Natural Ecological Landscape Design Method

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] J. Li, "Water Environment Governance of Urban and Rural Spaces Integrating Natural Ecological Landscape Design Method," *Journal of Environmental and Public Health*, vol. 2022, Article ID 3623141, 10 pages, 2022.

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*Research Article*

# Water Environment Governance of Urban and Rural Spaces Integrating Natural Ecological Landscape Design Method

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The water environment is one of the basic elements that constitute the environment. It is an important place for the survival and development of human society, and it is also the most seriously disturbed and damaged area by humans. The pollution and destruction of water environment has become one of the major environmental problems in the world today. The essence of urban water space landscape design under the concept of integrating people's ecological design is the ecological landscape design of urban water spaces, while the development of ecological landscape design in the field of urban water space landscape design is still in its infancy, and the interpretation of its concept is also different. The ecological design of the landscape reflects a new dream of human beings, a new aesthetics and value: the true cooperative and fraternal relationship between man and nature. At present, the ecological design of urban water space landscape has not put forward a more accurate concept, clear principles and standards, and a complete and systematic theoretical basis, which requires further research, discussion, and continuous practice by this generation of designers to improve it. To this end, this paper proposed a research method on the integration of water environment governance in urban and rural spaces with natural ecological landscape design. This paper mainly talked about the status quo of water environment and its network sensor algorithm research and analyzed its coverage area one by one. Then, the water quality extraction is introduced in detail. And finally, the data analysis of the Beijing river waters, the analyzer rainfall, water quality, and so on are carried out in the experimental part. It could be seen from the experimental results that there were currently 22 reclaimed water plants in six urban areas of Beijing, with a daily water treatment capacity of 4.08 million cubic meters and a sewage treatment rate of 98%. As of 2016, 440 million cubic meters of reclaimed water has been reused. With the commissioning of the new reclaimed water system, the proportion of reclaimed water in the river and lake environment will continue to increase.



## 1. Introduction

With the acceleration of urbanization, the natural ecological environment has been greatly damaged, the consumption of natural resources is increasing, and the quality of human life is getting worse and worse. In the report of the 19th National Congress of the Communist Party of China, it directly pointed out the general idea of environmental governance that "lucid waters and lush mountains are invaluable assets" and the five development concepts of "innovation, coordination, greenness, openness, and sharing." The ecological environment construction has reached an unprecedented level. The rapid development in the past was based on a lot of consumption and sacrifice of resources. It is not too late to make amends. Therefore, this paper should take protective measures as soon as possible to control the direction of urban development and carry out urban development in a sustainable development model.

Water is an indispensable element in the living environment of all living things, including human beings. It is directly related to the survival and health of human beings and is also the basis of social progress and economic development. Once the water environment is damaged, it will have a very serious impact not only on the local area but also on the entire country and even the world. Therefore, the protection of water environment should be strengthened. In order to ensure the sustainable development of China's water resources utilization, it is necessary not only to pay

attention to the treatment of polluted waters but also to protect water resources from the source. Improving the water environment monitoring and management mechanism is a key issue in water resources protection and water pollution prevention and control.

This paper focuses on the current situation of the water environment, studies its network sensor algorithm, analyzes the areas covered by it one by one, describes the water quality in detail, and analyzes the data of the river water in Beijing. Finally, data analysis was carried out for the rainfall and water quality of the system. The innovation of this article is that the data used in the article are the most real, and the average algorithm is carried out for each year and era. The concept of water environment involved in this article includes not only the original water volume, flow direction, and water quality of rivers and lakes in the natural state but also the development, utilization, management, and protection in the artificial states. This also makes the experimental results more accurate.

## 2. Related Work

Ecological landscape science is a new branch of ecology that studies the spatial structure, interaction, coordination function, and dynamic changes of the whole (i.e., landscape) composed of many different ecosystems in a relatively large area. According to the ecological vulnerability theory, an evaluation index system based on "environment-environmental sensitivity-adaptability" is proposed. Ecological vulnerability is the sensitive response and self-recovery ability of an ecosystem at a specific temporal and spatial scale relative to external disturbances, and it is an inherent attribute of an ecosystem. The application of Zang et al. in the ecosystem improved the service value estimation model based on empirical parameters [1]. Although many ecological landscape indicators have been applied to date, it was challenging to develop an indicator that was easy to assess and inexpensive while reflecting the complexity of ecosystems. Sowinska-Swierkosz aimed to develop such an indicator: the Indicator of Ecological Landscape Quality (IELQ), which ranges from 0 to 2. This was based on the use of alternative measures for assessing ecological quality (EQ) and GIS methods [2]. According to the ecological landscape theory, using MapInfo software, the ecological environment map of Huaping town was drawn. In this map, Thn describes all components of the natural environment, pollution, degradation, disaster, and destruction of the environment [3]. Cedar was a widely studied woody invasive plant, but it was rarely seen in modern socio-ecological landscapes due to the impact of cedar windbreaks advocated in agricultural programs that may cause woody invasion, the reasons for the spread of cedar from windbreaks, and the location of the invasion. Donovan et al. used remote sensing imagery to identify the presence and patterns of wood erosion in Nebraska dune windbreaks [4]. They all conducted research on natural ecological landscape design but did not use water environment sensor network technology, so this paper conducted an in-depth research on water environment sensor network technology.

Water resources protection and water pollution control should start from two aspects: on the one hand, formulate environmental quality standards for water bodies to ensure the quality of water bodies and the purpose of water use; and proper handling. It is necessary to formulate the Water Environment Standard (WES) according to the current Chinese Water Quality Standard (WQC): (a) the agricultural sector, with a concise description of irrigation-related management and needs of agricultural plantations; (b) the manufacturing-industrial sector, including chemical-industrial-textile industrial processes; and (c) the household-public sector, including water requirements for home and garden use. To this end, Wang et al. briefly summarized several typical mechanisms for the application of WES in several countries with a long history of developing WES and identified three limitations of developing WES in China [5]. Facing the rapid economic development, China faces the challenge of protecting the water environment. This fact highlights the urgency of adopting the water environmental carrying capacity (WECC) as a sustainable development measure for human society. Zhou et al. proposed an ensemble model based on system dynamics (SD) and cellular automata (CA) models. The analysis of space-time water environment carrying capacity in the process of urban evolution has been tried and realized in Changzhou, China [6]. For target search and tracking in unknown underwater environments, Cao et al. proposed an ensemble algorithm of Multiautonomous Underwater Vehicle Collaboration Team (Multi-AUV) [7]. They all analyzed the current situation of the water environment and its rectification countermeasures very well, but they did not specifically analyze the natural garden landscape, so it was not comprehensive.

## 3. Water Environment Algorithm

*3.1. Current Status of Water Environment.* The water environment refers to the environment in the spaces where the formation, distribution, and transformation of water occur in nature. It refers to the totality of various natural factors and related social factors surrounding the human spaces and the water body that can directly or indirectly affect human life and development. The water environment is the most basic ecosystem on earth, and it is also the foundation of human survival. The components of the water environment include rivers, lakes, reservoirs, oceans, treated industrial effluent, and drinking water. Water resources are one of China's most important natural resources, as well as China's strategic resources, and an important part of China's comprehensive national strength. The scarcity of water resources and the serious pollution of the water environment are the two major problems facing the water environment in the world today [8, 9]. Due to the pollution of the water body, the water body is eutrophicated, and the algae multiply, resulting in an unpleasant smell and harmful algal toxins. It has brought great harm to the daily drinking water and seriously affected the health level of the population.

China is the most water-scarce country in the world. Although it has a large amount of water resources, its per capita water resources are only 2,350 cubic meters, accounting for only 26% of the world's total. Many water bodies in

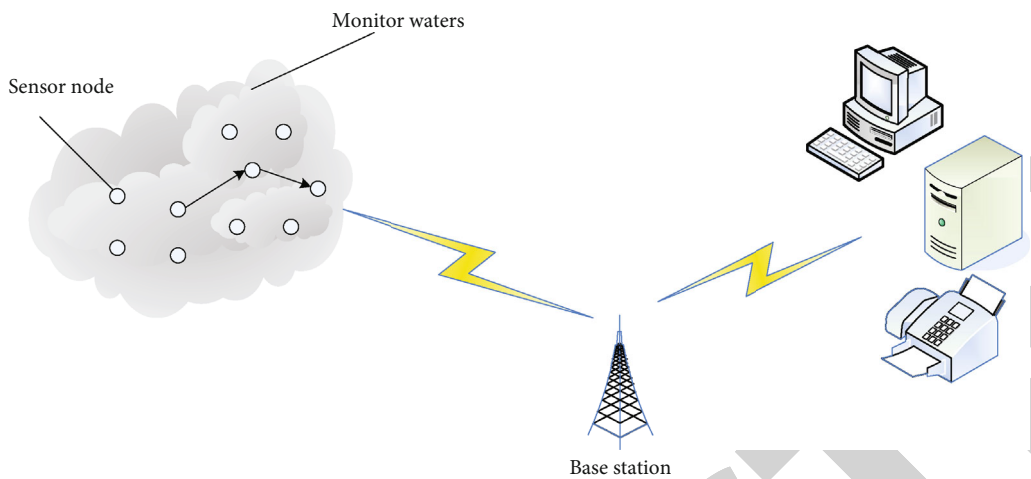



Figure 1: Schematic diagram of underwater wireless sensor network structure.

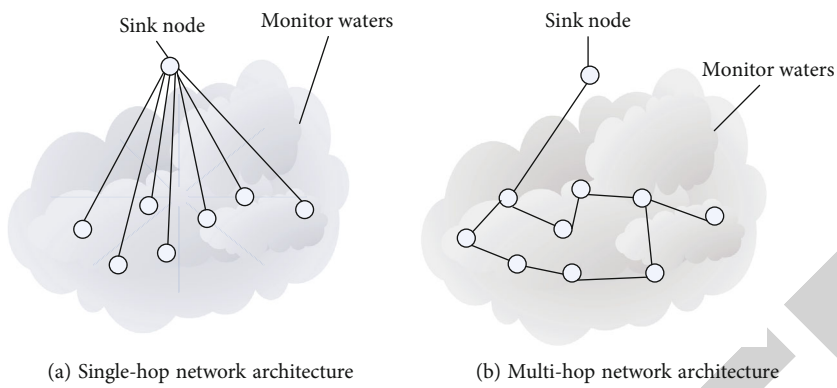
China are already polluted, making the efficient use of water resources very difficult. Among the more than 600 cities in the country, more than 400 cities are facing water shortages, and more than 100 cities are facing water shortages. With the rapid development of China's economy, the demand for water is increasing, and the shortage of water resources has become the main obstacle to China's economic development and people's lives [10]. China's urbanization process is accelerating, and rural land has been requisitioned by local governments, bringing demand for nonagricultural water for urban construction. China's water shortage problem is becoming increasingly serious, and urban construction and industrial water use are increasing day by day.

*3.2. Structure of Water Environment Sensor Network.* Ecological vulnerability, ecosystem complexity, water quality, and environment. The water environment sensor network is usually a large number of sensor nodes, which are suitable for the water environment and are randomly scattered in the monitoring waters by means of transportation such as aircraft or ships. Then the node position is adjusted through different coverage control algorithms or manually deploy the node to the precalculated position, and finally an overlay network with a certain topology structure is formed, as shown in Figure 1. The research on node deployment strategy of wireless sensor network is an important research topic of sensor networks. Reasonable and effective deployment of nodes in the network can reduce the cost of the network, maintain the connectivity of nodes, improve the coverage of the network, and enhance the network operability and improve network performance. By deploying the wireless sensor network oriented to the water environment, people can perceive, collect, and analyze the target information of the monitored waters more conveniently and quickly [11, 12].

The sensor node is a miniature embedded device, which requires low price and low power consumption. These limitations will inevitably lead to the relatively weak processor capability and small memory capacity it carries. Each sensor node can send data to the sink node through a long-range communication, as shown in Figure 2(a), or it can send data to the sink node through multihop short-range communication, as shown in Figure 2(b). In a traditional wireless local area network (WLAN), each client accesses the network through a wireless link connected to an AP. If users want to communicate with each other, they must first access a fixed access point (AP). This network structure is called a single-hop network. Through single-hop long-distance communication, it needs to consume a lot of energy, and because the communication distance is long, its power increases with the increase of the distance, and its energy consumption is mainly used for communication. Since the energy of sensor nodes is limited, to reduce the energy consumption of the network and improve the life of the network, the data transmission distance should be shortened as much as possible. Therefore, multihop short-range communication is widespread [13]. The data is divided into data blocks of a certain length, and the identification information called header is assigned to form "information packets." The exchange method of data transmission in units of information packets is called packet switching. Using intermediate nodes for multiple transmissions, data can be transmitted to the sink node, thereby greatly reducing the energy consumption of the network. The structures of multihop short-range wireless sensing systems can be divided into two categories: planar and clustered, as shown in Figure 2.

*3.3. Reduction of Water Quality Data by Principal Component.* This paper randomly selects 6 data sets from 1200 water quality factor data and performs principal component analysis according to the above steps. For each principal component, the variance of the main factor was calculated separately. And based on the variance, the eigenvalue contribution rate was calculated as shown in Table 1.

As can be seen from Table 2, DO has an eigenvalue of 1.62 and a contribution rate of 31.87%; the eigenvalue and contribution rate of CODMn are 1.55 and 29.56%, respectively; those of NH3-N are 1.13 and 22.23%; those of pH are 0.52 and 10.37%; and those of TP are 0.37 and 6.00%.




(a) Single-hop network architecture (b) Multi-hop network architecture

Figure 2: Wireless sensor network structure diagram.

Table 1: Experimental sample date for principal components.

| River name | Section name | pH | DO | CODMn | NH3-N | TP |
|---|---|---|---|---|---|---|
| Yangtze | Zhu Tuo | 7.7 | 9.3 | 2.1 | 0.16 | 0.08 |
| Yangtze | Fan Tuo | 8 | 9.6 | 1.8 | 0.15 | 0.07 |
| Yangtze | Pier | 8 | 9.9 | 1.6 | 0.33 | 0.08 |
| Qujiang | Monk mountain | 7.2 | 9.6 | 1.7 | 0.21 | 0.1 |
| Yangtze | Yuxi | 7.4 | 9.7 | 1.3 | 0.17 | 0.08 |
| Peijiang | Wanmu | 8.1 | 9.4 | 1.7 | 0.14 | 0.06 |

Table 2: Principal component results.

| Variable | Eigenvalues | Eigenvalue contribution rate | Cumulative eigenvalue contribution rate |
|---|---|---|---|
| DO | 1.62 | 31.87% | 31.35% |
| CODMn | 1.55 | 29.56% | 62.46% |
| NH3-N | 1.13 | 22.23% | 83.73% |
| pH | 0.52 | 10.37% | / |
| TP | 0.37 | 6.00% | / |

## 4. Water Environment Management of Rivers and Lakes in Beijing

*4.1. Water Scarcity.* Yongding River diversion canal and Jingmi diversion canal are important ways for ecological water use of rivers and lakes in Chinese cities and towns. The natural water sources of Guanting Reservoir and Miyun Reservoir are their important water sources. As shown in Figure 3, Beijing has been suffering from drought since 1999. The annual rainfall reaches 475 mm, accounting for 80% of the average over the years. The water resources of Guanting Reservoir and Miyun Reservoir are becoming increasingly scarce. Since 2007, the Guanting Reservoir has ceased to supply water to urban rivers and lakes, only for emergency industrial water supply in the western Beijing area. The water supply of the Jingmi canal for urban rivers and lakes decreased from 110 million cubic meters in 1999 to 30 million cubic meters in 2012 and reached 3.86 million cubic meters in 2005. Beginning in 2006, urban rivers and lakes have used reclaimed water to ensure water use for urban river and lake landscapes and to develop new water sources. In 2007, rivers and lakes in some areas solved the problem of water shortage by introducing groundwater, but the water supply capacity was limited. At present, the ecological water use of urban rivers and lakes in China has formed water resources mainly derived from the utilization of surface water, reclaimed water, groundwater, and rainwater. Although the types of water sources have increased, ecological water use has shown a gradual decline. According to the water diversion data of urban rivers and lakes in recent years, less than 50 million cubic meters of natural water are used as ecological water in urban rivers and lakes in China. In 2012, it was the lowest, which was less than 30 million cubic meters (Table 3). At the same time, the use of reclaimed water as an effective landscape water source can reach 10 million cubic meters to 20 million cubic meters a year. As China's water resources decline year by year, this can only meet the normal evaporation and seepage of urban rivers and lakes, making them unable to circulate. However, it cannot be supplemented for a long time [14, 15]. Today, five years later, this situation has been resolved, so this study is a research analysis of the past situation, which has called for people to protect the environment.

According to the data from the Beijing Municipal Commission of Water Resources (Figure 4), from 2001 to 2011, the nationwide surface water volume was 440 million cubic meters, just over one-fifth of the 2.11 billion cubic meters per year; the average annual runoff of the Guanting Reservoir was 97 million cubic meters, a decrease of 89.7% over the same period last year; the annual precipitation of Miyun Reservoir reached 320 million cubic meters, a decrease of 67.9% over the same period last year. The two reservoirs, Guanting and Miyun, have reduced their storage capacity. If the water shortage problem is not addressed, the replenishment capacity of surface water and groundwater will be seriously insufficient and will not be significantly improved in the short term [16, 17].

With the expansion of Beijing's urban scale and the increase of the total population, the total urban water consumption is also increasing (Figure 5). At present, there are 22 reclaimed water plants in the six districts of the city. The reclaimed water production capacity reaches 4.08 million $m^3$/d. The sewage treatment rate has increased to 98%. As of 2016, the reclaimed water used for the city's river

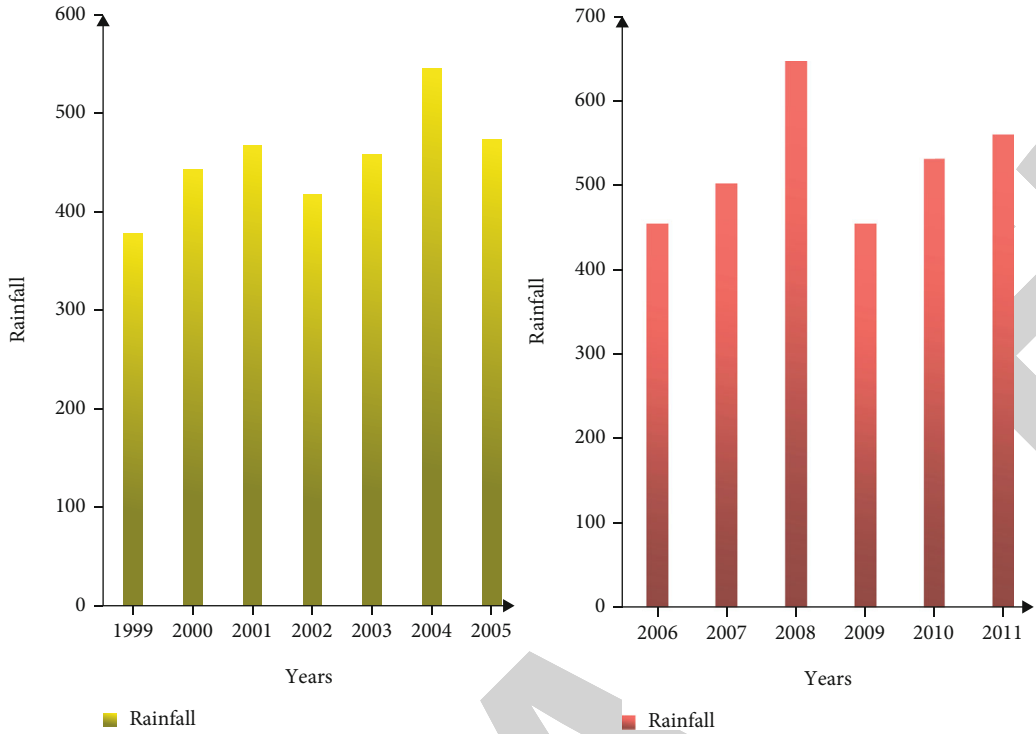



Figure 3: Statistical map of rainfall in Beijing from 1999 to 2011.

Table 3: Statistical table of rivers supplying surface water and groundwater.

| Water source | 1999 | 2001 | 2003 | 2005 | 2017 | 2011 |
|---|---|---|---|---|---|---|
| Guanting Reservoir | / | / | / | / | / | / |
| Miyun Reservoir | 2313 | 2931 | 4191 | 2650 | 3156 | 2716 |
| Groundwater | 149 | 1035 | 996 | 669 | 263 | 191 |
| Total | 2462 | 3966 | 5187 | 3319 | 3419 | 2907 |

and lake environmental water reached 440 million $m^3$. As the new reclaimed water plant continues to be put into use, the proportion of reclaimed water in the urban river and lake environment will continue to increase in the future.

*4.2. Water Environment Pollution.* Ammonia nitrogen (NH3-N) exists in water in the form of free ammonia (NH3) or ammonium salt (NH4+), and the composition ratio of the two depends on the pH value and water temperature of the water. When the pH value is high, the proportion of free ammonia is high. On the contrary, the proportion of ammonium salt is high, and the water temperature is opposite. According to the latest water quality monitoring results of water supply, in the lakes and rivers in urban rivers and lakes published in June 2017 on the official website of Beijing Municipal Environmental Protection Bureau (Table 4), there are 9 lake water quality monitoring points, 3 lakes with water quality II: Tuancheng Lake, Kunming Lake, and Houhu Lake of the Exhibition Hall; 2 lakes with water quality III: Zizhuyuan Lake and Tongzi River; and 3 lakes with water quality IV: Yuyuantan, Bayi Lake, and Yuanmingyuan. The water quality of the different waters of the six seas ranges from class II to class IV. From the monitoring data, first, the water quality of urban rivers and lakes is polluted to varying degrees. Eight of the 20 monitoring sites have water bodies above class III, among which Tuancheng Lake, Kunming Lake, the upper section of Yongyin Canal, and Kunyu River belong to the water source area, which indicates that the water quality of the source rivers is good. The water quality of the remaining 12 monitoring points did not meet the standard of direct human contact. Second, the overall improvement of urban rivers and lakes in recent years has not been great, and some areas have improved and deteriorated. Third, the water quality of water supply lakes is generally better than that of river courses, which is closely related to the local water quality improvement measures and ecosystems of various lakes: (a) rivers studied and (b) lakes studied.

*4.3. Countermeasures and Suggestions for River and Lake Water Environment Management.* The improvement of the water environment cannot be achieved overnight, nor can it be solved by a single department. It is necessary to strengthen the interdepartmental linkage and establish a cooperation mechanism. The model of government-led, industry supervision, territorial responsibility, and public supervision is adopted. From the aspects of water quantity and water environment management, it should be focused on how to use the existing conditions to integrate and utilize water resources. Deepening the reform of the management mechanism is a key issue that needs to be considered in the future water environment management.

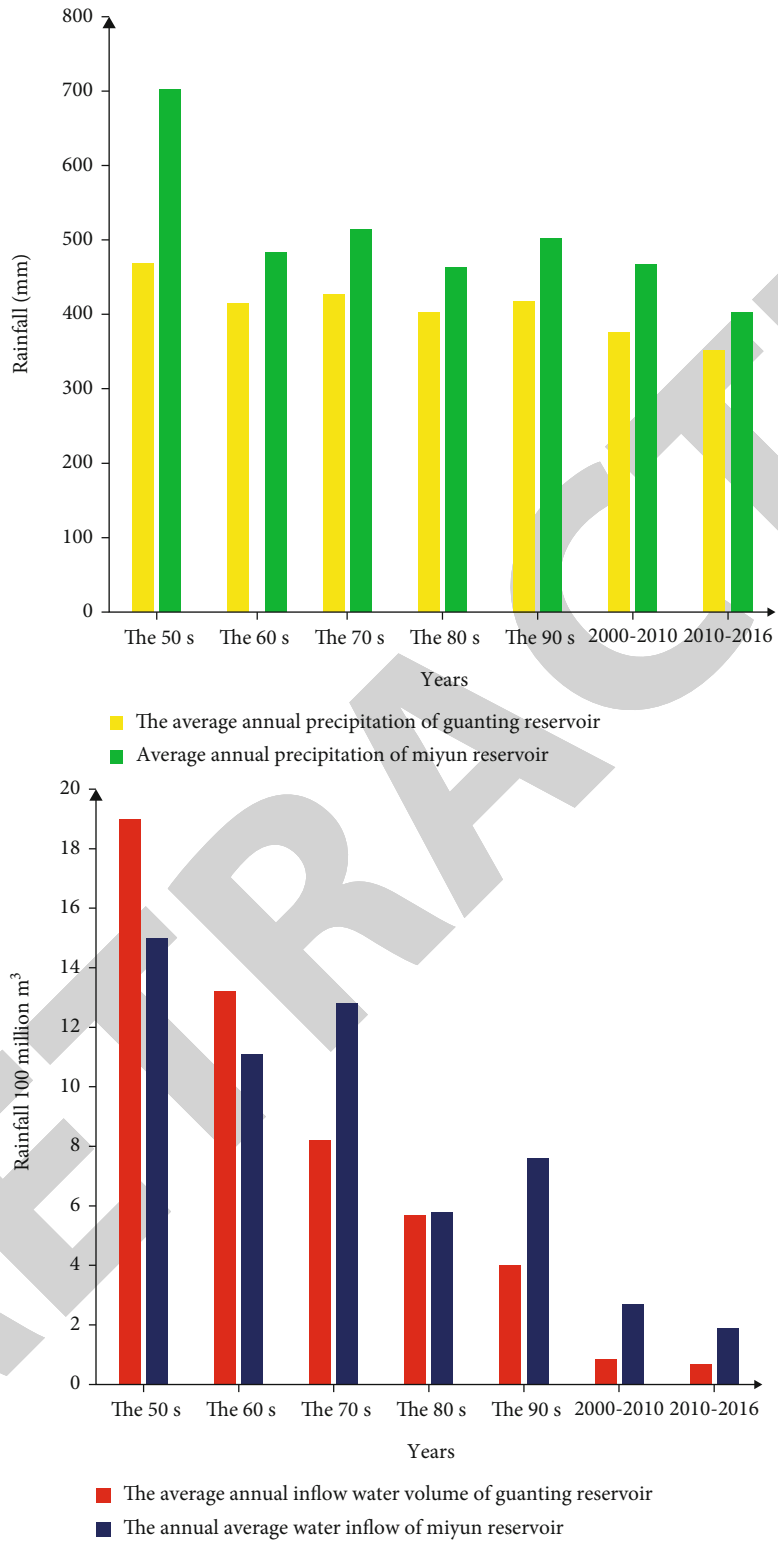



Figure 4: Statistics of the annual average precipitation and storage volume of Guanting Reservoir and Miyun Reservoir.



*4.3.1. The Water Resource Scheduling Configuration Is Optimized.* Through the analysis of the water resources problems of urban rivers and lakes, surface water and groundwater cannot be significantly improved in the short term. After years of scheduling operation, the feasibility of improving the configuration capability is low. The adjustability of reclaimed water and rainwater resources in the actual operation and management has become the most

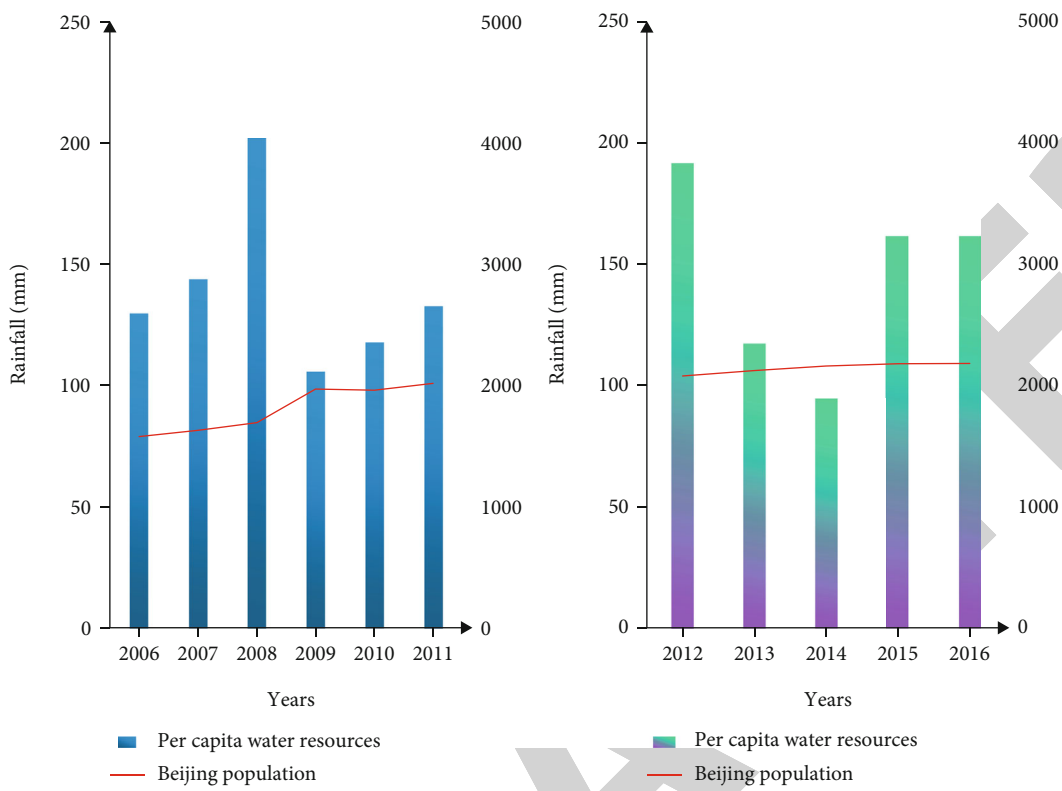



Figure 5: Population growth and per capita water resource trends in Beijing.

Table 4: Statistics on water quality of urban lakes.

| Serial number | Lake | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| 1 | Tuancheng Lake | II | II | II | II | II |
| 2 | Kunming Lake | II | II | II | II | II |
| 3 | Yuanmingyuan Hu | III | III | III | IV | IV |
| 4 | Bayi Lake | III | III | V | IV | IV |
| 5 | Yuyuantan Hu | III | III | V | IV | IV |
| 6 | Zizhuyuan Lake | III | III | II | III | III |
| 7 | Six seas | III | III | III | III | IV |
| 8 | The back lake of the exhibition hall | II | IV | III | II | II |
| 9 | Tongzi River | IV | V | III | IV | V |

feasible way to optimize the allocation of resources in the operation and management of urban rivers and lakes, to alleviate the shortage of water resources.

The water demand discussed in this paper includes five aspects: surface evaporation water demand, river base flow water demand, river bottom seepage water demand, river and lake water exchange basic water demand, and lake water demand. The minimum ecological requirement in Beijing is $10.45 \times 108\ m^3$. According to the changes in Beijing's actual water resources, urban economy, population development, and evaporation of 2 cm per day, the urban area of Beijing uses water 6 times a year. In the urban area of Beijing, water is used twice a year, 1.5 meters at a time. The urban area of Beijing uses 98.53 million cubic meters of water. The lake water is 61.2 million $m^3$. The river water consumption is 37.33 million $m^3$ (as shown in Figure 6).

*4.3.2. Optimize the Space Allocation of Reclaimed Water.* In 2006, reclaimed water was used for the first time in the landscape water use of urban rivers in Beijing. After 10 years of exploration, seven reclaimed water inlets including Gaobeidian Lake, Bayi Lake, Daguan Garden, Ganyu Bridge, Xituchenggou, Xiaoyuehe, and Erdaogou have been reconstructed. The upper section of Tonghui River, the lower section of Yongyin Canal, South Moat, Xiaoyue River, and Tucheng Ditch have successively used reclaimed water as replenishment, which has greatly eased the water shortage in the relevant river sections. However, at present, the water output of each outlet is affected by many aspects such as land use, pipeline laying, and reclaimed water treatment capacity, which is far from the optimal configuration. Among them, the reclaimed water outlet of Tonghui River, Gaobeidian Lake at the end of the central city accounts for about 80%

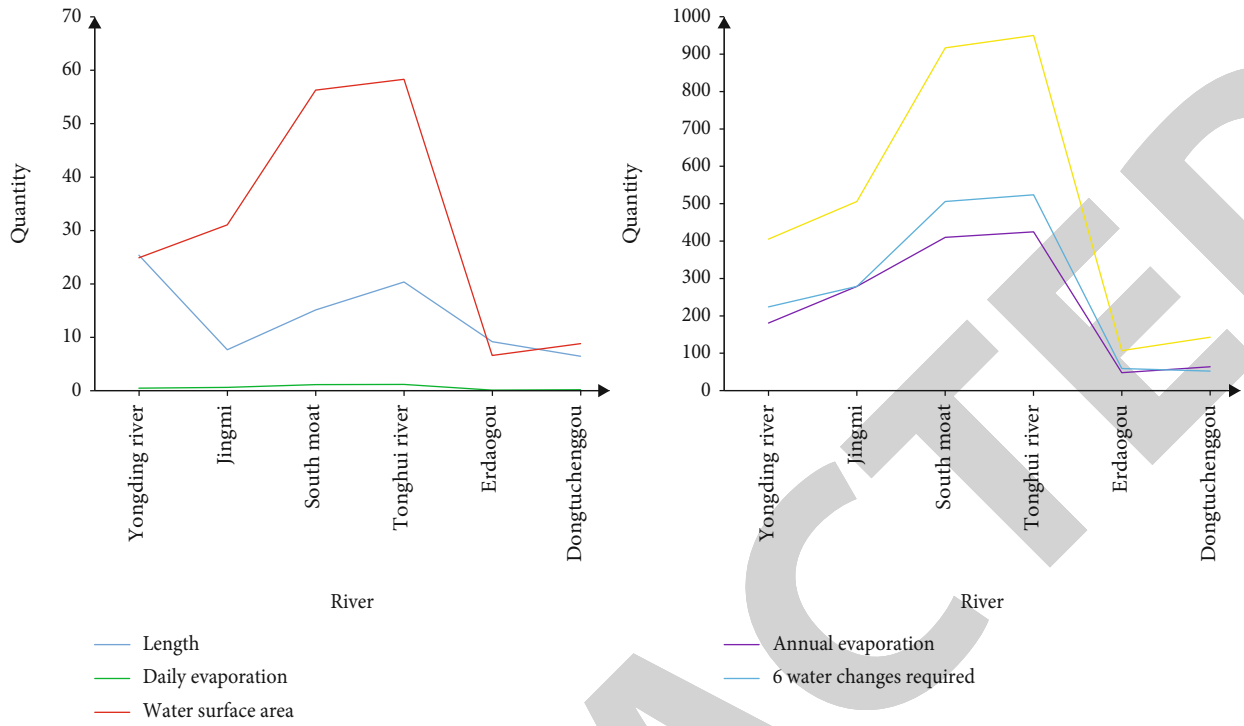



Figure 6: Prediction table of water demand for urban rivers, lakes, and rivers

of the reclaimed water supply. Its upstream Tonghui River has poor water quality and the water body cannot be replaced for a long time, which is not supplemented by reclaimed water.

*4.3.3. Optimize the Time Allocation of Reclaimed Water.* It is pointed out in the monthly statistical table of reclaimed water that the monthly distribution of water by some water outlets varies from month to month within the year. The high temperature periods in spring and summer coincide with the peak period of environmental water use. In addition, the demand for water evaporation and leakage is large, resulting in a decrease in reclaimed water instead of an increase. Taking the Bayi Lake reclaimed water outlet as an example, the largest month of water supply in 2016 occurred in February, at 850,000 $m^3$. The last month appeared in October, only 53,000 $m^3$. The trends in 2017 and 2016 were basically the same. This phenomenon also exists in Yongyin Canal and Xituchenggou. Therefore, the optimal configuration of time is a problem that needs to be studied and solved in the future.

*4.3.4. Improve the Discharge Standard of Reclaimed Water.* At present, Beijing's reclaimed water quality standards are still at a low level. The discharge of pollutants such as ammonia and nitrogen exceeds the tolerable capacity of the water environment, and it is also difficult to control the exit section. As a result, some rivers in the central urban area are still polluted, and algal blooms occur from time to time, which affects the overall improvement of the water environment in the downstream North Canal water system. Excessive content of total phosphorus and total nitrogen in water is the main reason for the occurrence of algal blooms. Water resources in urban rivers and lakes are in short supply. The water body is difficult to replace and flow, and the self-purification ability of the water body is poor. In recent years, algal blooms in the water bodies of rivers and lakes in Beijing are very easy to break out and produce water odors and other situations. Some studies have pointed out that some landscape water bodies have poor dilution ability and large amount of recycled water. In the long run, it is easy to cause the accumulation of nutrients and lead to the high concentration of nitrogen and phosphorus in the water quality standard. According to the current water concentration recommendations, the total phosphorus concentration should be reduced to below 0.1 mg/L, and the ammonia nitrogen concentration should be reduced to below 1 mg/L (at 20°C). Compared with foreign countries, due to the stage of China's economic development, China's sewage treatment standards put forward requirements for nitrogen and phosphorus nutrients. However, due to the current sewage treatment plant treatment process and other factors, indicators such as nitrogen and phosphorus are still relatively high. The reclaimed water is supplied to the river as a nondirect contact water body for the human body. Aerosols generated by some water landscape facilities, fountains, etc. and some hydrophilic actions of citizens may cause direct harm such as bacterial and virus pollution. These are the disadvantages of the current relatively low reclaimed water standards for urban river and lake landscape water use. As a city with severe water shortage, if Beijing wants to maintain steady development in the future, reclaimed water is bound to become the most important source of water for the environment. To improve the water quality of urban rivers and

lakes, the discharge standard of reclaimed water must be gradually raised. The indicators such as nitrogen and phosphorus in the reclaimed water are reduced. The renewal and dilution use of reclaimed water is planned scientifically. Only by stepping out of Beijing's unique road of reclaimed water utilization can we truly realize the goal of turning sewage into resources, recycling, and loving water.

*4.3.5. Strengthen the Utilization of Rain and Flood.* In recent years, Beijing has developed rapidly, and the urban area has reached 1040 $km^2$. The result of urbanization means that the area of the city's impervious subsurface continues to expand. This makes the urban rainwater runoff increasingly concentrated, and the river flood peak time is earlier. The flood discharge time will be shortened, and the pressure of flood control in Beijing's urban rivers will increase. To ensure the safe operation of the city and ensure smooth flood discharge, according to the flood control scheduling plan for urban rivers and lakes in Beijing, urban rivers, lakes, and rivers are generally operated in advance to lower the water level before the arrival of rainfall, and some water resources need to be drained away. After the rainfall, the river has to return to normal water level, which is very difficult to replenish due to the limitation of water sources. At the same time, the rainfall in recent years has been lower than the multiyear average, but the rainfall is more frequent. Especially in the flood season, the number of rainy days from June to September in the flood season in 2017 reached 43 days, of which there were more than 20 times of weather above the moderate rain level. In this case, the management department should improve the level of refined management of rainwater. The transition from flood control to flood management should be achieved. Risk should be taken in moderation. The research and judgment of rainfall process and hydrological data should be strengthened, and rainwater tail water should be scientifically intercepted. Drainage, discharge, stagnation, and retention of floodwaters should be handled properly. When facing new challenges, it can realize the utilization of urban, river, and lake flood resources and achieve comprehensive benefits such as flood control, water resources utilization, and water ecological environment. Of course, in the utilization of rainwater, the impact of urban nonpoint source pollution on rainwater quality should be fully considered. In the early rainy season, the quality of the rainwater discharged from the drainage pipe network is poor, so it is not recommended to store it. Rainwater resources should be utilized after the first heavy rainfall has fully scoured urban roads and pipe networks. There are certain risks in the interception of tail water, which requires the establishment of a more complete urban stormwater management data and information source system. At the same time, Kunming Lake, Bayi Lake, and the depressions in the upper reaches of urban rivers and lakes are used as flood detention areas. The rainwater collection system and the permeable system for coastal trails and green spaces are established in the residential quarters. It not only collects floods and reduces flood peaks but also recharges groundwater and realizes the utilization of rainwater resources.

## 5. Conclusion

The research process of Beijing's urban water environment is a process of continuous understanding and learning for this article. During the research, a large number of documents were reviewed, and field investigations were conducted to understand the history of Beijing city. The overall situation of urban rivers and lakes was sorted out, and the latest achievements and concepts of river management were studied. By analyzing the functional orientation of urban rivers and their role in urban development, the paper focused on the problems of urban water resources and water quality and proposes countermeasures. (1) With the historical changes and functional expansion of Beijing's urban rivers and lakes, it is not only necessary to meet the needs of flood control and water supply but also to improve the urban water ecology, water landscape, cultural heritage, tourism, and other functional needs. (2) The shortage of water resources is the first bottleneck restricting the normal operation of rivers and lakes in Beijing. Through calculation, the water resource gap in Beijing reaching the standard is 60 million $m^3$. By predicting the future trend of water resources supply, improving the standard of reclaimed water and optimizing the allocation of reclaimed water, and strengthening the utilization of rain and flood, the problem of water shortage in Beijing can be effectively solved. (3) At present, the water environment pollution in Beijing is mainly due to the excess of nutrients such as nitrogen and phosphorus and the large amount of garbage entering the river. Strengthening the treatment of sewage entering the river and reducing point source pollution are the fundamental ways to improve water quality. At the same time, the water environment quality can be effectively improved by using practical operations and management methods such as reducing sewage into the river, aeration of water bodies, planting aquatic plants, raising aquatic animals, and dredging sediment. (4) Promoting river ecological improvement is a basic work to improve the water environment. In the governance process, a clear multiobjective system of ecological governance should be established. Ecological governance standards and technologies need to be improved. And the corresponding management system should be established. (5) Beijing should establish a sound water environment operation management system and clarify departmental responsibilities. The coordination mechanism needs to be improved. The supporting water function area restriction system should be established. A stable input growth mechanism should also be established. These are institutional guarantees for solving water environment problems. Although the article introduces the issues of river water management in the city of Beijing, it has a certain representative ability, but it cannot be comprehensive. Moreover, the issue of river water management is still being improved, and the data has not been completely updated. I hope to update it later. Many people have studied this issue.

## Data Availability

The data underlying the results presented in the study are available within the manuscript.

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*Retraction*

# Retracted: Digital Protection of Historic Buildings in Urban Planning

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] S. He, W. Wu, and X. Wang, "Digital Protection of Historic Buildings in Urban Planning," *Journal of Environmental and Public Health*, vol. 2022, Article ID 3549769, 11 pages, 2022.

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*Research Article*

# Digital Protection of Historic Buildings in Urban Planning

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With the rapid development of urbanization, urban land has been expropriated and developed on a large scale. Moreover, people's awareness of the protection of historical buildings is relatively weak, so some historical buildings have been demolished or rebuilt. Historical buildings have played an important role in the spread of national culture, so how to use some methods to protect historical buildings from being destroyed has become an urgent problem to be solved. The protection of historical buildings includes a series of complicated and rigorous procedures, such as on-site drawing and mapping, survey and design, and scheme discussion and construction. The surveying and mapping of traditional historical buildings require people to do it by themselves, so it is inevitably time-consuming and labor-intensive. This paper first discussed and analyzed the significance of historical building protection, and then used digital technology to make up for the shortcomings of traditional manual surveying and mapping and historical building protection methods. Modern technologies such as three-dimensional laser scanning technology and virtual reality technology are used to restore the style and appearance of historical buildings. Among them, in terms of the color of historical buildings, the restoration degree of buildings based on digital protection technology has reached 56.1%; at the same time, the efficiency of information collection and processing, and virtual model construction has also been improved. Thus, the ultimate goal of historical building protection is achieved, and it provides a reference for the digital protection of historical buildings.



## 1. Introduction

Various historical buildings in the process of urbanization construction and development are the representative carriers of the city, and they carry the changing history of the entire city. The historical buildings have accumulated valuable culture and art, and fully reflect the regional traditional characteristics. In recent years, the rapid development of tourism has caused many historical buildings to be damaged to varying degrees, both man-made and natural. Therefore, the protection of historical buildings faces a relatively severe situation and challenges. With the rapid development of related digital technologies such as computers, surveying, and mapping, the digital protection methods of historical buildings based on technologies such as digital images, virtual reality, and 3D laser scanning measurement are gradually becoming the focus of attention. Digital technology is a powerful tool and effective means. It provides new ways and methods for the protection and research of historical buildings, and also greatly improves the efficiency of historical building protection work.

Strengthening the protection of historical buildings has played an extremely important role in the future development of the city. Many scholars have conducted research on this topic. Mager and Hein discovered through ongoing projects that the project is at the forefront of the history of the built environment. He showed how the combination of crowdsourcing, historical big data, and deep learning can simultaneously raise questions and provide solutions in the fields of architecture and urban planning history [1]. Antonio applied the test model to a specific case involving the definition of a portfolio of items for the valuation of buildings with historic architectural value in a southern Italian city. It confirmed the potential of the tool in the analysis [2]. For the protection and management of urban historical buildings, Guo et al. studied the management and

utilization methods of historical building information based on mobile GIS and introduced the use of mobile GIS terminals to quickly collect and manage historical building attribute information, multimedia information, historical archives information, and spatial information [3]. Sun et al. used the method of historical research to review and summarize the urban structure changes and design trends of representative buildings along Shennan Road in different periods. Based on the transfer path of the city center, he analyzed the unique roles played by streets and buildings in the urban construction and development of Shenzhen, and expounded other urban functions and symbolic meanings [4]. The above scholars have analyzed the effective methods of historical building protection. However, they have not evaluated and tested the effectiveness of these methods. Therefore, it lacks reliability.

Digital technology has made people more efficient at doing things, while also enabling things that were simply impossible to do before. Some scholars have done a lot of research on digital technology. Huo and Zhang proposed a new all-digital protection system component importance model and new measures. He further derived the function of the total cost of the all-digital protection system as a function of system reliability, and analyzed and discussed the importance of the components of a typical all-digital protection system [5]. Wang et al. proposed a technique to quantitatively analyze the reliability of digital protection. He defined protection availability and protection economic indicators, and established hardware and software failure models for digital protection devices. The results showed that the technique is suitable for quantitative assessment of digital protection reliability [6]. Pan and Dong-Ming proposed a series of mural preservation and restoration technologies, and then introduced the computer-aided mural reproduction system and computer-aided mural preservation and restoration system. Suggestions are given for future work on the digitization, conservation, research, restoration, and further application of cultural relics [7]. Zhao proposed a new method for digital protection of cultural heritage based on web technology, and adopted an improved four-tier architecture design pattern to plan a network-based digital protection platform for cultural heritage. On this basis, he combined web technology to reconstruct digital images of cultural heritage [8]. The above scholars applied digitization to various fields, but do not compare this technology with other technologies. The research is not comprehensive enough.

A series of experimental results show that the error fluctuation of the three-dimensional laser scanning method based on digital technology is small, and the concentration is between 0.2 and 0.59. In addition, there are obvious differences in the restoration degree of historical buildings under different protection methods. Among them, in the restoration of the exterior walls of historical buildings, the restoration performance of digital protection technology is slightly stronger, and the restoration degree reaches 44.7%. Under the unified urban planning, great progress has been made in restoring the color of historical buildings. In terms of the color of historical buildings, the restoration degree of buildings based on digital protection technology reached 56.1%. With the help of computer-aided restoration techniques, different bodies of the historic building have been restored. The restoration rate of historical buildings based on digital technology reached 44.1%. At the same time, since roofs and railings belong to the category of cultural protection, the restoration degree of these two aspects is relatively high, up to 52.5%. It can be seen that in the process of restoration of historical buildings, digital protection technology has incomparable advantages. With the blessing of digital technology, great progress has been made in the protection of historical buildings. Among them, in terms of history and culture, the development of communication technology has greatly promoted the spread of historical architectural culture, and the acceptance rate of the group has also risen from 33.9% to 42.6%.

## 2. Digital Technology and Historic Building Protection

*2.1. Importance and Realization Method of Digital Technology in the Protection of Historical Buildings.* The concept of historic buildings was proposed in the 15th century. After the 19th century, it specifically referred to buildings that needed to be protected. In the 1960s, it is referred to buildings of great historical significance and value. Today, historic buildings represent all architectural heritages. The value of historical buildings is reflected in the following three points: the historical stories it carries, the political background it reflects, and the national culture it contains. Historical buildings are a relatively special carrier of cultural information, representing the traces of urban development [9]. Over time, historical buildings have gradually become the artistic treasures of human civilization. Therefore, people need to shoulder the great responsibility of effectively protecting historical buildings. The protection of historical buildings has the following basic principles, namely, authenticity, integrity, functional diversity, and sustainable development. Historic buildings have outstanding historical and cultural value, high architectural art characteristics, and certain scientific and cultural value. Some of the current historical buildings have a history of more than 100 years, and the process they have gone through is shown in Figure 1.

Under normal circumstances, the protection work framework of historical buildings is mainly divided into the following five stages, as shown in Figure 2. With the rapid development of digital technology, there are new ideas, approaches, and platforms for the protection of historical buildings. This technology has laid an important foundation for the continuous preservation and recording of information and materials of historical buildings. Specifically, it can be divided into three points. First, digital technology solved the problem of preservation and comprehensiveness of historical building information; second, digital technology can transform the data information of historical buildings into data suitable for computers, and provide historical information for different regions. Third, the development of digital technology can not only respect the authenticity of historical buildings but also help to better

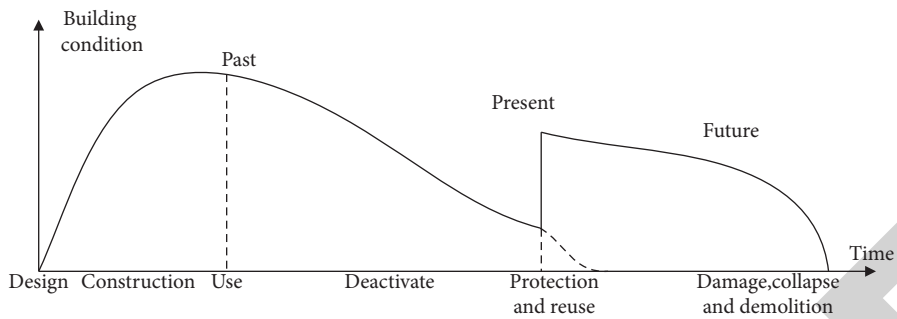


Figure 1: Process of historical buildings.

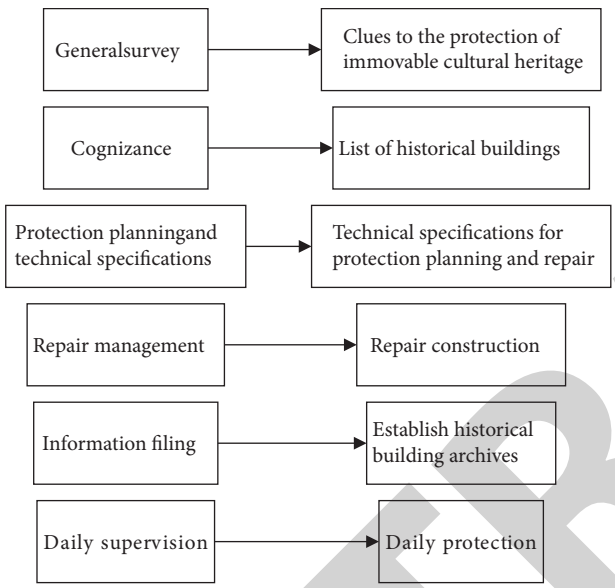


Figure 2: Conservation framework for historic buildings.

complete the protection and display of historical buildings [10].

Nowadays, the use of digital technology to protect historical buildings has become the mainstream development direction, and the application fields and prospects are very wide, such as education, medical care, and urban construction [11]. The digitization of historical buildings refers to the collection and restoration of basic information of historical buildings by means of a series of digital technologies of image acquisition and reorganization, so as to achieve the ultimate goal of protecting historical buildings. It includes 3D scanning technology, virtual reality technology, and real-time interactive technology. The basic goals and framework of the research on the digital protection of historical buildings are shown in Table 1. Digital technology is a kind of associated technology, which is produced with the development of computer information technology. Digital technology combines the mathematical theory of formal logic with electronic technology and computers. In essence, digitization is a formalized logical reasoning with symbols of 0 and 1 [12]. Digital technology has high precision, good confidentiality, and strong versatility. Digital technology is the driving force behind the current information technology revolution. The reason for this is that information technology is based on computers and networks, and computers and networks are premised on digitization.

Compared with traditional historical building protection technology, digital technology has the following advantages. First, the technology greatly improved the efficiency of data information processing of historical buildings. After the use of digital technology, the protection of historical buildings can be more deeply integrated with computers, and the powerful computing power of computers can improve the efficiency of historical building protection. Second, digital technology can make the protection of historical buildings more refined [13]. Traditional historical building protection work requires experienced professional and technical personnel to make judgments and evaluations. However, this judgment is generally subjective. After the use of digital technology, all the information of the historical building can be displayed, and the follow-up work also has detailed data for reference, instead of only some general information as before. Third, digital technology greatly reduced the talent standards required for the protection of historical buildings, and also saved and relieved a lot of labor costs and financial pressures.

There are many ways to protect historical buildings, such as strengthening publicity to raise people's awareness of protection, improving urban planning, and increasing investment in restoration funds. With the application of digital protection technology, historical buildings can be better integrated into modern society and truly achieve sustainable development. Digital technology can be used for the management protection and restoration protection of historical buildings [14]. Among them, the former mainly refers to the platform or system that provides digitization and informatization, and this kind of informatization system is unified management and adjustment by relevant departments or organizations. Digital technology has improved the efficiency, quality, and protection of management and protection, making management and protection standardized and systematic. Especially in regional protection, the protection of regional building complexes will be strengthened. The latter mainly refers to the restoration of historic buildings that have been damaged. Computer-aided restoration technology refers to the use of computers to improve the technical level of historical building restoration

Table 1: Basic goals and framework of research on digital preservation of historical buildings.

| Thinking | Research contents | Research methods |
|---|---|---|
| Theoretical construction | Theoretical system construction of digital protection of historical buildings<br>Research on digital record and preservation method system of historical buildings | Case study method<br>Scientific deduction<br>Practical investigation method<br>Literature analysis<br>Field work<br>Iterative development method |
| Methodology | Research on the method system of digital display of historical buildings | 3D laser measurement and modeling digital media technology<br>Virtual geographic environment technology<br>GIS spatial analysis<br>Augmented reality and animation technology |
| Application of achievements | Application of digital content of historical buildings in urban planning | System analysis method<br>Comparative analysis<br>In-depth interview method |

and the effectiveness of restoration and protection work. It can reduce the period of protection and restoration of historic buildings and improve the efficiency and quality of restoration and protection of historic buildings [15]. In addition, digital technology can also analyze the damage causes of historical buildings, provide corresponding and feasible repair methods, simulate the entire repair process, and clarify the final repair effect. The basic functional structural modules of the historical building digital protection system are shown in Figure 3.

*2.1.1. Information Collection and Processing of Historical Buildings.* People can use digital technology to perform a series of operations on the data information of historical buildings. Through the sorting of information materials, the digitization of historical building materials is realized. The information levels for historic buildings are shown in Table 2. The 3D laser measurement technology can scan the object through laser. It adopts the method of pulsed laser ranging and can obtain the basic information of the object without direct contact with the object. The measurement accuracy is also relatively high. This technology quantifies the data information of historical buildings and provides a detailed and comprehensive information support for the construction of digital technology systems [16]. If the damage of the historical building is serious, the technology can scan this area separately, so as to obtain the detailed information and basic situation of this area. It can carry out accurate measurement from the level of physical form, so as to carry out subsequent repair work.

In the process of information collection and processing, digitization mainly has the following functions. One is the digitization of documents, that is, converting the textual information related to historical buildings into digital information. Then, the cultural background of the historical building is supplemented by means of sound recording. The second is the digital imaging of entity information. This step can evolve into digital imaging through some photosensitive devices, such as scanners, digital cameras, and home camcorders. The latter two devices can directly convert historical buildings into digital information such as pictures and DV. Scanners are used for planning and design drawings and surveying drawings in historical buildings. The specific work organization is shown in Figure 4. The 3D laser scanner is divided into three parts, a high-definition camera, a reflective prism, and a laser rangefinder [17]. The accuracy and efficiency of 3D laser scanning and mapping technology are relatively high, and it has the characteristics of rich information, saving money, high data value, and wide application, so it is conducive to the construction of a digital database system for historical buildings. The third is to digitize the survey drawing and sort out the analysis drawing and detail drawing on the drawing. This kind of survey drawing can lay a good foundation for the construction of the virtual model. However, there is some historical building information that cannot be displayed through digital pictures, such as the size of the vertical section and the basic size of the components. At this time, it is necessary to use drawing software technology, such as Auto CAD technology [18].

*2.1.2. Construction of Virtual Models of Historical Buildings.* In recent years, virtual reality technology (VR) has been widely concerned and applied in many fields. It integrates a series of advanced technologies, such as image processing and pattern recognition, intelligent interface technology, artificial intelligence technology, multisensor technology, and real-time computing technology. Therefore, the computer digital mapping technology, multimedia information technology, and virtual reality technology can be used to process and handle various data of historical buildings, and establish three-dimensional digital models of historical buildings, so as to make the original appearance of historical buildings and the surrounding environment. The reproduction has the characteristics of multifaceted, multilevel, objective, and vivid images [19]. The role of digital media technology in the protection of historical buildings is mainly shown in Figure 5. The models constructed by these digital technologies can truly, intuitively, and comprehensively reflect the actual situation of historical buildings, so as to improve the efficiency of information interpretation. The process of using virtual reality technology to restore historical buildings is mainly divided into the following three steps. First, it is necessary to plan the entire restoration project in the early stage and clarify the presentation methods

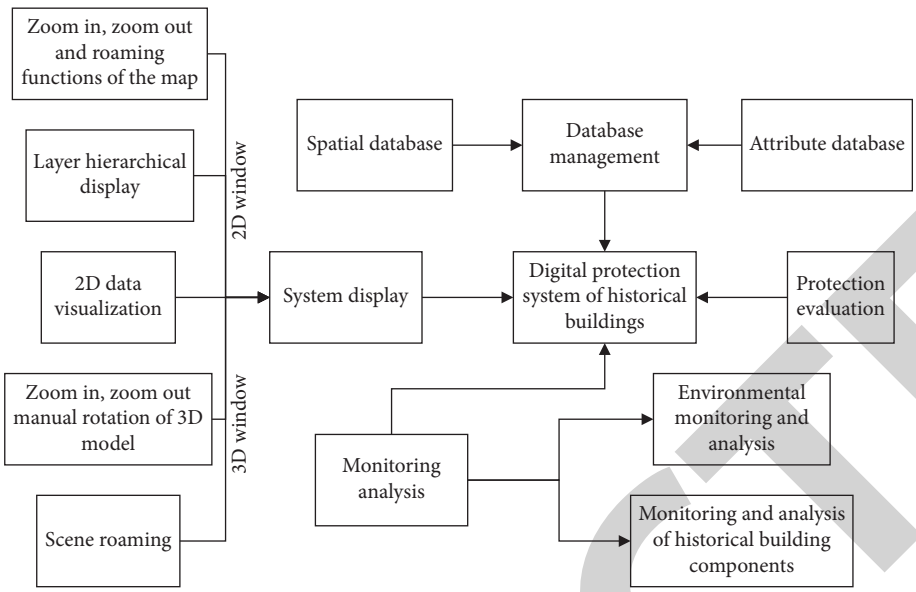


Figure 3: Basic structure of the digital protection system for historical buildings.

Table 2: Information levels of historic buildings.

| Grade | Historical building information |
|---|---|
| 1 | Geometric information of historical buildings (buildings, component sizes, shapes, and spatial relationships) |
| 2 | Historical building composition information (building structural, maintenance, dependent and decorative components, and building surrounding environment) |
| 3 | Physical information of historical buildings (materials of buildings and components, existing state, and damage degree) |
| 4 | Historical building value information (history, science, art information, etc.) |

of virtual reality, such as three-dimensional experience and picture browsing. In additional, it includes placements for historic building systems such as platforms on the Web and PC. Second, in the midterm, it is necessary to conduct on-the-spot investigation of historical buildings and record the internal and external structures and detailed textures of historical buildings. Third, in the later stage, it is necessary to test and adjust the virtual works on different operating system platforms and hardware configuration machines.

*2.1.3. Information Integration and Database of Historical Buildings.* Information integration refers to the coding of user information in the system using unified standards and specifications, so as to achieve the ultimate goal of system-wide information sharing [20]. "Standards" here includes standardization of protocols, data, networks, documents, and graphics. Integrated objects include various digital media such as images, documents, sounds, animations, and videos. The digital information of historical buildings generally appears in the form of multimedia such as text, audio, and video. In order to achieve accurate digital protection of historical buildings, it is extremely necessary to establish a database of historical buildings. The details of historical buildings are shown in Table 3. The extraction of these materials requires the use of many digital technologies, which are used to construct 3D models and video animations of historic buildings. The database technically helps the dynamic supervision of historical buildings and can play the role of the historical building database to the greatest extent.

The basic information of historical buildings combines spatial location information and attribute information, which are the important basis for the database of historical buildings. Spatial location information includes the following three parts, namely, remote sensing image map, building plan, and spatial data of 3D model. The spatial database of historical buildings includes point cloud data, and its basic structure is shown in Table 4. The attribute information mainly includes the statistical data of historical documents and the material, component type, size area, and geometric composition of historical buildings. The attribute database structure of historical buildings is shown in Table 5.

*2.2. 3D Laser Scanning Mapping of Historical Buildings and Restoration Evaluation.* The 3D laser scanner uses a special coordinate system, called the instrument coordinate system, in which the coordinate of the scanning point is $(\mathscr{L}, \mathscr{M}, \mathscr{N})$, and the calculation formula is as follows:

$$\begin{aligned} \mathscr{L} &= \mathscr{R} \sin \alpha \cos \beta, \\ \mathscr{M} &= \mathscr{R} \sin \alpha \sin \beta, \\ \mathscr{N} &= \mathscr{R} \cos \alpha. \end{aligned} \tag{1}$$

In the formula, $\mathscr{R}$ refers to the distance from the 3D laser scanner to the target historical building, $\beta$ refers to the

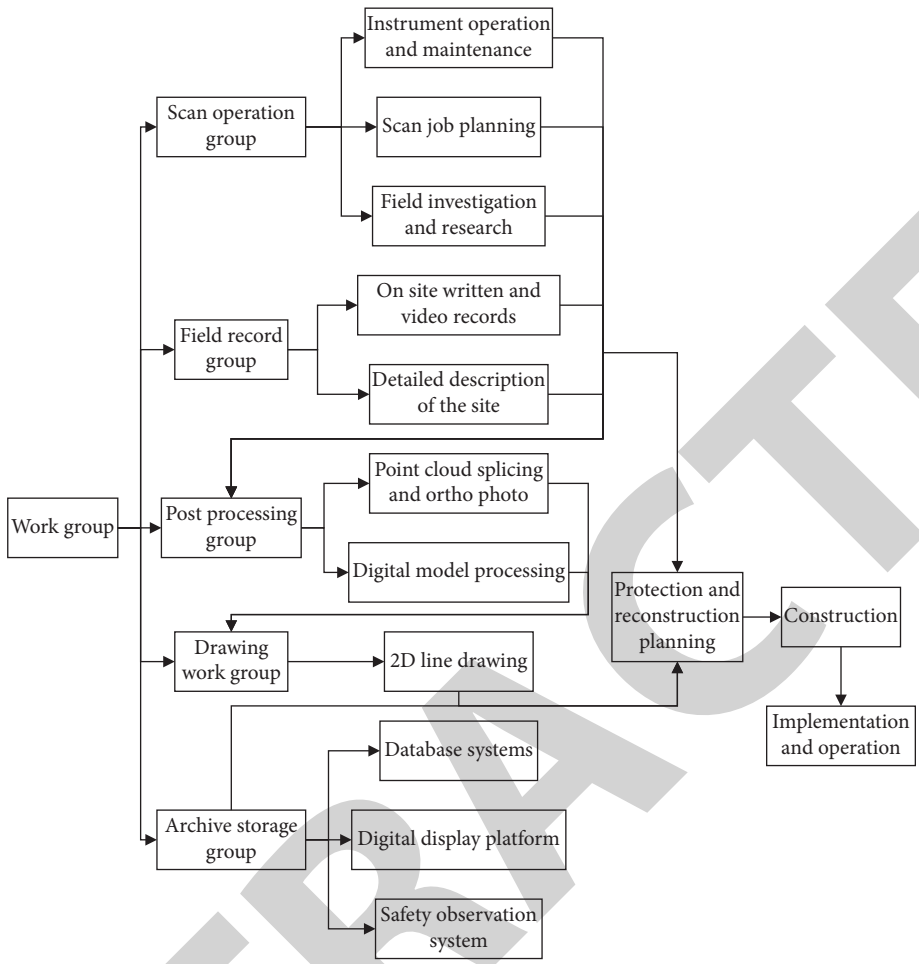


Figure 4: Work organization of 3D laser scanning mapping technology.

horizontal direction angle, and $\alpha$ refers to the vertical direction angle. Next, we calculate the accuracy of the 3D laser scanner. The calculation formula is as follows:

$$\overline{\phi}_{\mathbb{H}} = (\phi_{\mathbb{H}} + \mathbb{U}_{\mathbb{H}}) + \mathbb{B}_{\mathbb{H}} + \mathbb{H}_{\mathbb{H}}. \tag{2}$$

In the formula, $\overline{\phi}_{\mathbb{H}}$ refers to the horizontal angle obtained by the 3D laser scanner, and $\mathbb{U}_{\mathbb{H}}$ refers to the adjusted value. The formula for calculating the error is as follows:

$$\varrho_0 = \pm\sqrt{\frac{\sum_{\mathbb{H}} \mathbb{U}_{\mathbb{H}}^2}{\mathbb{M} - \mathbb{S}}}. \tag{3}$$

In the formula, $\mathbb{U}_{\mathbb{H}}^2$ refers to the plane data of the three-dimensional laser scanning, and $\mathbb{M} - \mathbb{S}$ refers to the surrounding brightness. After three-dimensional laser scanning and mapping, the basic information of historical buildings can be obtained, and the digital technology can be used to build their models. The resolution, clarity, and size of this virtual work model are as follows:

$$\mathbb{O}(\mathbb{T}) = \sum_{\mathbb{H}=0}^{\ell} \beta_{\mathbb{H}} \upsilon_{\mathbb{H}}(\mathbb{T}). \tag{4}$$

Among them, $\beta_{\mathbb{H}}$ refers to the resolution of the virtual model of the historical building, $\upsilon_{\mathbb{H}}$ refers to the resolution of the virtual model of the historical building, and $\mathbb{T}$ refers to the size of the model. After the virtual model of the historical building is constructed, the degree of protection of the historical building needs to be evaluated. Therefore, three concepts of restoration coefficient, restoration degree, and public acceptance are introduced. Their calculation formulas are as follows:

$$\begin{aligned} \mathscr{I} &= \sum_{\mathbb{J}=0}^{\mathbb{M}} \mathbb{G}_{\mathbb{J}} \left| \mathbb{O}(\mathbb{T}_{\mathbb{J}}) - \mathbb{O}_{\mathbb{J}} \right|^2 = \mathscr{G}(\mathscr{I}_{\mathbb{A}} + \mathscr{I}_{\mathbb{B}} + \mathscr{I}_{\mathbb{C}}), \\ P_{\mathbb{H}} &= \sum_{\mathbb{I}=1}^{\mathbb{M}} \mathbb{D}^{-\gamma \left\| \mathbb{O}_{\mathbb{H}} - \mathbb{O}_{\mathbb{I}} \right\|^2}, \\ \mathscr{T}_{ij} &= \frac{1}{\sum_{\mathbb{M}}^{\mathbb{B}} \left( \mathbb{C}_{\mathrm{IJ}}^2 / \mathbb{C}_{\mathrm{IJ}}^2 \right)^{1/(\ell - 1)}}. \end{aligned} \tag{5}$$

In the formula, $\mathscr{I}$ refers to the restoration coefficient of the historic building, $P_{\mathbb{H}}$ refers to the restoration degree of the historic building, $\mathscr{T}_{ij}$ refers to the acceptance of the public after the restoration of the historic building, and $\mathscr{I}_{\mathbb{A}} + \mathscr{I}_{\mathbb{B}} + \mathscr{I}_{\mathbb{C}}$ refers to the restoration degree of the different damaged areas of the historic building.

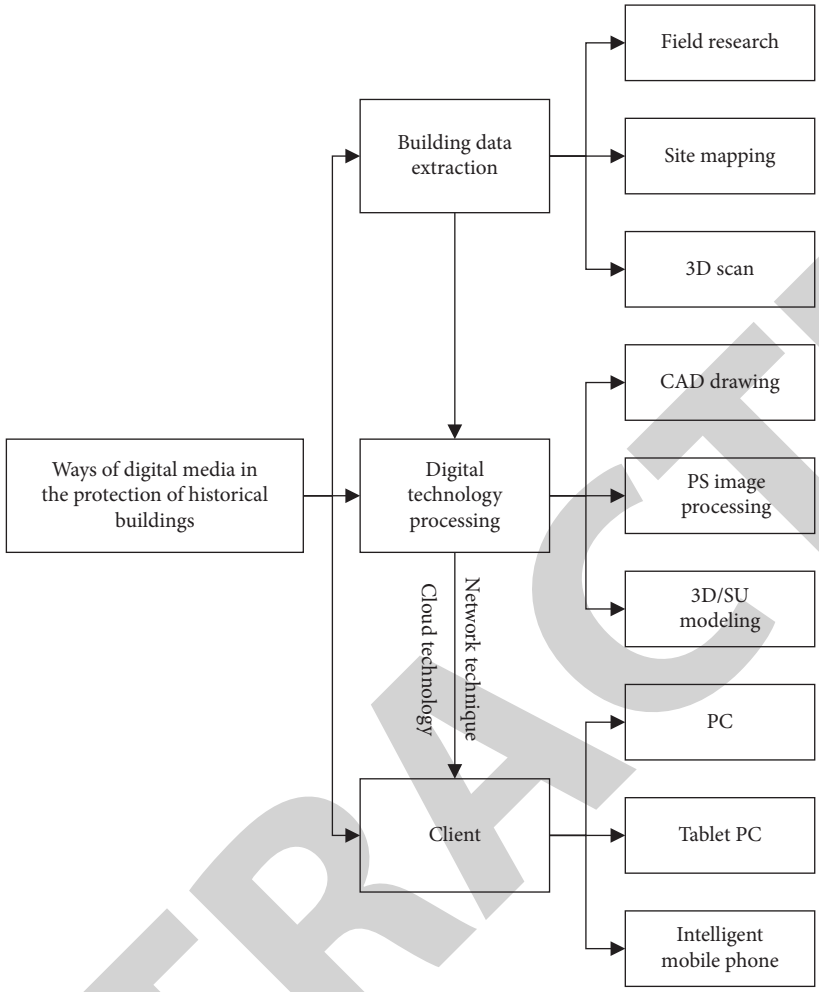


Figure 5: Role of digital media technology on the protection of historic buildings.

Table 3: Data on historic buildings.

| Items | Concrete contents | Items | Concrete contents |
|---|---|---|---|
| Basic building information | Name<br>Construction age<br>Address<br>Owner<br>Present situation | Historical features of architecture and changes in the development process | Change<br>Damage<br>Repair<br>Transfer<br>Sell |
| Historical anecdotes related to architecture, introduction to architects, and related design ideas | | | |

## 3. Effect of Digital Technology on the Protection of Historical Buildings

*3.1. 3D Laser Scanning Error Based on Digital Protection Technology.* 3D laser scanning technology is an important support for digital technology. In the process of realization, the use of 3D laser scanning can accurately map the relevant information of historical buildings and realize the protection of buildings. The 3D laser scanning error based on digital protection technology is shown in Figure 6.

Figure 6 shows that in the actual 3D laser scanning process, due to the comprehensive interference of external factors, laser scanning is prone to inevitable errors. Among them, during the first three experiments, the traditional 3D laser scanning method had different degrees of error, and the error fluctuated from 1.08 to 2.33. By contrast, the error fluctuation of the 3D laser scanning method based on digital technology is small, and the error is concentrated between 0.2 and 0.59.

*3.2. Restoration Degree of Historical Buildings Based on Digital Protection Technology.* With the introduction of relevant policies, historical buildings have been properly resettled

Table 4: Basic structure of point cloud database.

| Field name | Types | Name |
|---|---|---|
| Id | Int | ID number |
| x | Float | X coordinate |
| y | | Y coordinate |
| z | | Z coordinate |
| Filename | Char | Data file name |
| Source | | Data sources |

Table 5: Basic structure of the attribute information database of historical buildings.

| Field name | Types | Name |
|---|---|---|
| Layers | Int | Number of layers |
| FH | Float | Floor height |
| Diameter | | Diameter |
| DH | | Door height |
| Date | Date | Construction time |
| IMG | Image | Image information |
| Remark | Char | Remarks |

and protected. Digital protection technology can restore historical buildings without losing buildings. The restoration of historical buildings under digital protection technology is shown in Figure 7.

Figure 7 shows that there are obvious differences in the restoration degree of historical buildings under different protection methods. Among them, in the restoration of the exterior walls of historical buildings, the restoration performance of digital protection technology is slightly stronger, and the restoration degree reaches 44.7%. Under the unified urban planning, great progress has been made in restoring the color of historical buildings. In terms of the color of historical buildings, the restoration degree of buildings based on digital protection technology reached 56.1%, and the restoration degree of traditional building protection technology also reached 55.3%. In terms of the structure and material of historical buildings, due to the long history, the restoration degree of these two aspects is relatively low, with an average of 42.25%. In addition, it also can be seen from the building restoration coefficient that with the acceleration of the urban planning process, the restoration process of historical buildings is also speeding up, and the restoration coefficient of the building color alone has reached 3.4. The reason is that in the context of urban planning, historical buildings have been better protected and restored.

*3.3. Restoration Degree of Historical Buildings Based on Digital Protection Technology.* There will inevitably be many damages and problems in historical buildings. At this time, just the right repair can solve the urgent need. Digital technology can analyze the damage of the building without touching the building and without damaging the building, and then provide technical support for building repair. Among them, the restoration of historical buildings under the digital protection technology is shown in Figure 8.

Figure 8 shows that with the help of computer-aided restoration techniques, different bodies in the historic building were restored. Among them, for the walls and main walls of the building, the building restoration degree under the traditional protection method reached 31.9%. Affected by urban planning, the wall protection of historical buildings has been greatly improved, and the restoration rate of historical buildings based on digital technology has reached 44.1%. At the same time, since roofs and railings belong to the category of cultural protection, the building restoration degree in these two aspects is relatively high, up to 52.5%. It can be seen that in the process of restoration of historical buildings, digital protection technology has incomparable advantages.

*3.4. Acceptance of Historical Building Protection Based on Digital Technology.* On the one hand, digital protection technology can reproduce the splendor of historical buildings and realize the restoration and restoration of historical buildings. On the other hand, digital technology can also broaden the publicity channels for the protection of historical buildings and set off a wave of cultural protection. Among them, the acceptance level of historical building protection under digital technology is shown in Figure 9.

Figure 9 shows that with the blessing of digital technology, great progress has been made in the protection of historical buildings. Among them, in terms of history and culture, the development of communication technology has greatly promoted the spread of historical architectural culture, and the acceptance rate of the group has also risen from 33.9% to 42.6%. In the symbolic aspect of historical buildings, digital technology combined with digital media

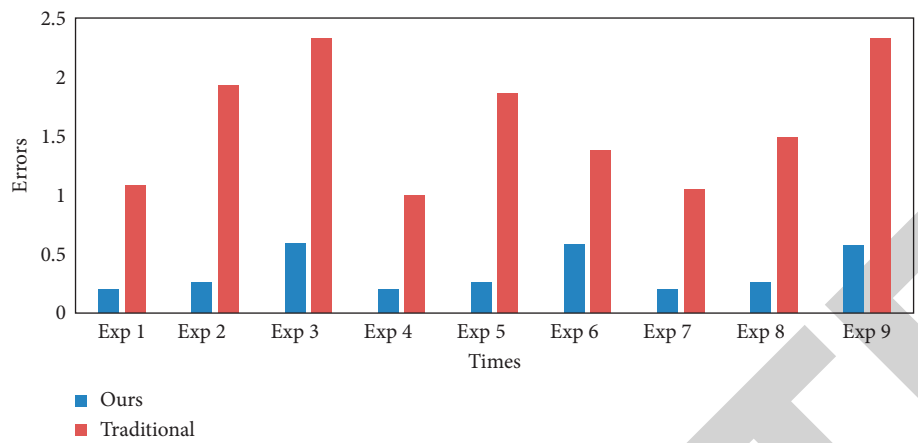


Figure 6: 3D laser scanning error.

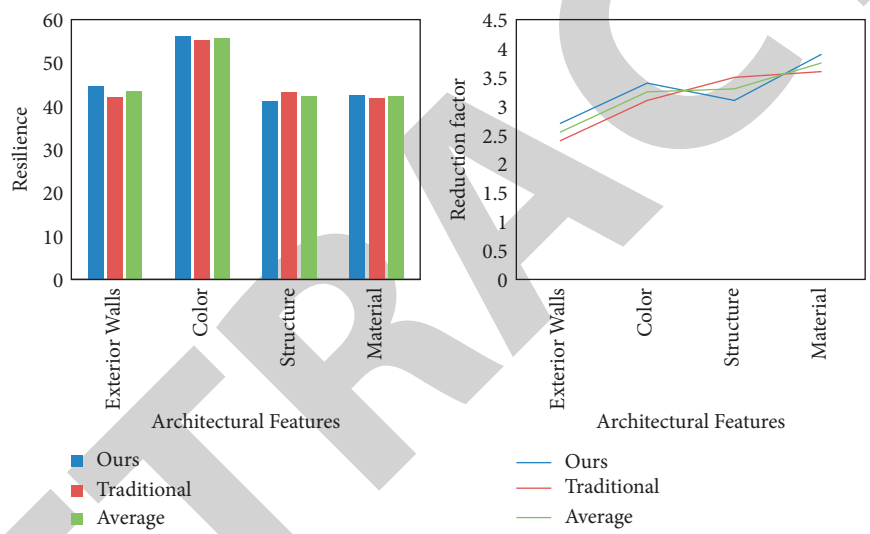


Figure 7: Restoration degree of historical buildings under digital protection technology.

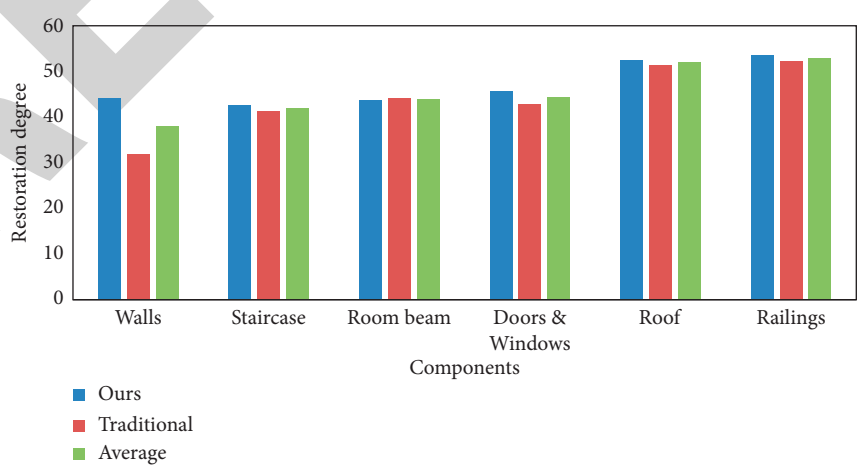


Figure 8: Restoration degree of historical buildings under digital protection technology.

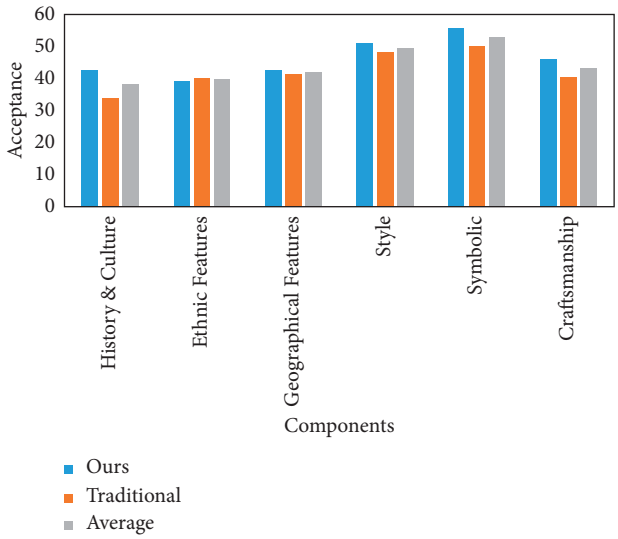


Figure 9: Acceptance of historical building protection under digital technology.

means further publicizes the cultural heritage of historical buildings and promotes the prosperity of culture. It can be seen that digital technology not only promotes historical buildings to the public but also enhances people's cultural self-confidence.

## 4. Conclusion

With the accelerating pace of urbanization, the protection of historical buildings is also facing extremely severe challenges. The application of digital technology in the protection of historical buildings provides new ways and ideas for the development of protection. The 3D and VR technologies in digitalization make up for the deficiencies and defects of traditional protection methods, and provide help for the comprehensive display of historical buildings. It builds a three-dimensional historical building restoration, virtual interaction, and electronic data database. At the same time, this paper made full use of digital surveying and mapping technology to establish a three-dimensional digital model of historical buildings, which makes historical buildings more intuitively displayed in front of people. It also injects new vitality into historical buildings, making them have historical, cultural, and economic values. It not only realized the data recording and storage of historical buildings but also realized the development and utilization value of historical buildings. The experiment in this paper confirmed the feasibility of digital technology in the protection of historical buildings and provided a reference for future digital protection work. After the 3D modeling of historical buildings in this paper, the rendering of the model is insufficient and the effect is average.

## Data Availability

The data used to support the findings of this study can be obtained from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgments

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*Retraction*

# Retracted: Analysis of Psychological Shaping Function of Music Education under the Background of Artificial Intelligence

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Y. Xiang, "Analysis of Psychological Shaping Function of Music Education under the Background of Artificial Intelligence," *Journal of Environmental and Public Health*, vol. 2022, Article ID 7162069, 14 pages, 2022.

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*Research Article*

# Analysis of Psychological Shaping Function of Music Education under the Background of Artificial Intelligence

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In order to solve the problem of integrating intelligent technology into music teaching, this paper puts forward the methods of using intelligent technology to optimize the music teaching system; to enhance the effectiveness of music psychological guidance, music intelligent creation, the development of Yi Guzheng platform, the integration of online sparring technology, and the rational use of Mu class platform, and to ensure the construction of loop curriculum system with "intelligent piano." RBF algorithm has strong data processing ability, which can ensure the operation quality of music score, music score and performance learning modules, and effectively strengthen the training effect of music psychological function. The artificial intelligence platform is more progressive in evaluation. It can use emotion to evaluate courses, grasp the course direction in advance, ensure the construction quality of psychological function, and improve the effect of music teaching; take 100 people as the basis of students, and measure the time proportion of students' music learning in the intelligent system. $c_j\sigma_j$ refers to the learning situation of music courses within the learning time $X$ of students with excellent psychological quality of music. This result is parallel. $Y$ represents the best score of music output by each algorithm. 2024 music intelligent platforms have collected various course resources with difficulty coefficients of 1 to 5, and the course resources of pictures and videos are sufficient. It can provide students with comprehensive music psychological education and give full play to the teaching advantages of intelligent technology. It can be seen from the data: the operation of music score, music score and performance module viewed in March 2021, with high transportation times and resource download times, indicating that the operation is in good condition; The error correction accuracy of the system is greater than 99%, indicating that the system has strong error correction ability.



## 1. Introduction

Artificial intelligence technology emerged in the 1950s. It is an equipment terminal built with the help of digital technology and intelligent algorithms. It can simulate human intelligence, capture environmental data, integrate environmental information, and obtain the best response scheme [1]. Artificial intelligence can help people make forward-looking decisions, optimize people's original work forms, and liberate part of the labor force, as shown in Figure 1. In 1990, Chinese music educators found a new teaching direction and tried to introduce the shaping process of psychological function into artificial intelligence technology to enhance the enthusiasm of music psychological guidance and give full play to the teaching auxiliary function of artificial intelligence. The new education system needs music education to change the original teaching thinking, improve the innovation of teaching work, try to change the initial teaching concept, and give full play to the psychological shaping role of music education [2, 3]. In the new era, from the perspective of artificial intelligence, a new music psychological guidance scheme is developed to effectively show the psychological counseling ability of music education and give full play to the educational integration significance of artificial technology [4].

## 2. Literature Review

D'mello and others combined with the new requirements of talent training in colleges and universities; music education integrates intelligent system, which can effectively optimize the overall development ability of professional courses,

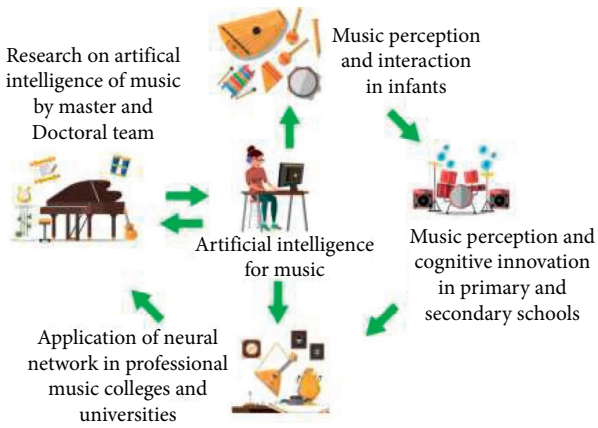


Figure 1: Relationship between artificial intelligence and music education.

create a school running idea in line with music education, ensure the overall quality of music education, and try to fully implement the shaping of psychological function from the perspective of high starting point and high level [5]. Dresp Langley and others combined with the overall development of music education, and focused on the construction of students' practical ability [6]. Knowles and others tried to shape the psychological function from the aspects of music creation and music experience to actively strengthen the students' practical willpower and achieve the effect of psychological shaping [7]. Hsu and others found that AI contains a variety of technology types and network algorithms, which can be used for human perception, music interpretation, music creation, and other applications, creating a precedent for music education in the form of human-computer interaction. As shown in Figure 2, it is the integration relationship between intelligent technology and music education [8].

From Figure 2, Ha and others found that the effective use of various technologies in cloud space and music intelligent system helps to change the music education system of information explosion and make the application and retrieval process of various music psychological shaping resources more intelligent. The integration of intelligent technology has significantly changed the education system [9]. Hélie and others found that the music psychological guidance work carried out in infants and young children mainly focuses on the music perception ability of infants and young children [10]. Combined with the life elements of infants and young children, select the corresponding background music, effectively play music works, and form a music edification process. D'mello and others believe that during the sleep of infants and young children, music is used to adjust the mood of infants and young children, form a music atmosphere and shape the stable and stable psychological function of infants and young children [5]. At this time, the selected music is quiet and soft, which increases the infants' perception of music rhythm and imitates it with the rhythm. Adarraga and others found that the music psychological shaping of infants aged 3–6 mainly focuses on intelligent development to form high-quality psychological literacy and increase physical coordination [11]. Mizoguchi and others found that the development units of various intelligent platforms have developed the "cute cat" game. Infants can operate the screen to participate in the game project, and the system will imitate the voice of infants. The design concept of this intelligent system is in line with the educational idea of shaping the new psychological function of infants and young children. In recent years, Mir technology is a music data retrieval technology with human-computer interaction. It takes music acoustics as the professional center, accurately captures audio features with the help of audio signal processing, and has strong machine learning function. This technology can effectively screen various resources of music psychological shaping, improve the material library of psychological function shaping, and establish a successful, comprehensive and standardized music intelligent education system [12]. Mackay and others found that the creation of 3D music classroom takes music situation as the starting point and actively stimulates students' music potential [13]. The music classroom integrates Dolby panoramic sound technology and the supporting application of Dolby panoramic sound raising equipment, which can build a multi-level music learning space and bring students a new psychological function shaping experience. The operation flow of music AI is as follows: (1) Set the beat speed. (2) Select the music module related to the assignment—music form, chord, etc. (3) Automatically generate tracks. Orb Composer (intelligent track creation program) can help students select styles, efficiently complete the creation tasks of music works, and enable students to actively feel the psychological counseling role of music in creation. The "information Philharmonic" platform has effectively changed the initial form of music performance and provided diversified bands with accompaniment in the form of human-computer interaction. This technology can cooperate with classical music to give accompaniment, has strong intelligent learning function, can form a variety of calculus forms, and can continuously optimize accompaniment in combination with the rhythm changes of performers.

With the development of productivity and the rapid development of science and technology, the music education has gradually been on the right track. The emergence of music is not accidental. In the production and life of showing human wisdom and talent, music becomes an indispensable part of people's life. From the liberal folk music to the folk music systematization to the integrated and professional form of contemporary music education, this is the development process of music education. Music education is essentially the promotion of human quality through music. An art form, music education is not only an art but also an important part of people's social life. The realization of music socialization is inseparable from the important contribution of music education. Among these widely and changeable music forms, the most noteworthy is the emotional education of music education. Emotional education can neutralize the various connotations of music education. No matter from the perspective of aesthetic appreciation, art, psychology and society, emotional education is an indispensable part of it. In the process of cultivating people's

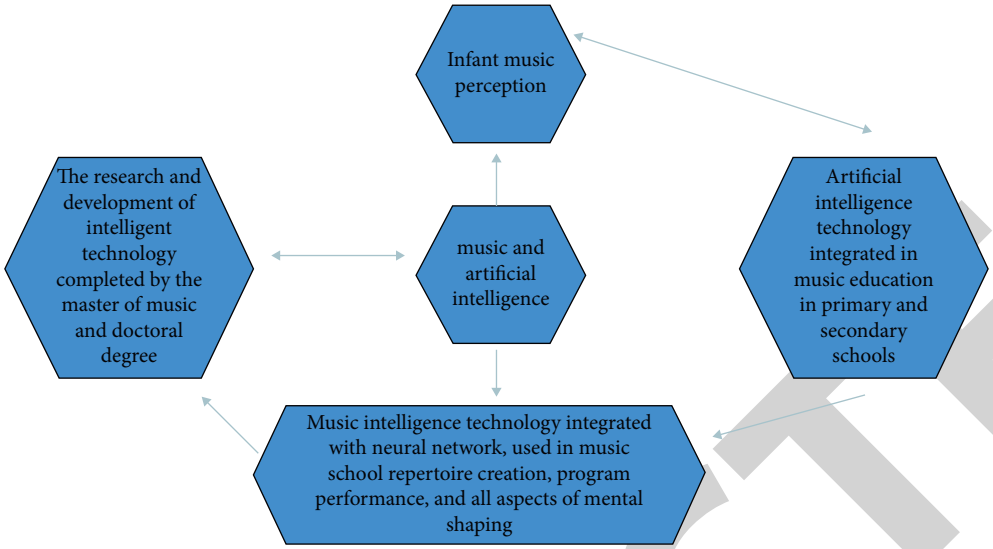


Figure 2: Integration relationship between intelligent technology and music education.

perception, experience, and enjoying beauty, music education subtly promotes the coordination and unity between people's inner world and the external world. It plays an inestimable role in shaping human emotion, cultivating human healthy psychology, enriching people's inner world, and promoting the integration of art and society. This is the result of emotional education, so music education can be included as emotional education in essence.

## 3. Method

Effectively optimize the music teaching system, give full play to the application value of artificial intelligence technology, and integrate the two majors of music and psychology. (1) With the help of intelligent platform, optimize the original teaching system, increase the comprehensiveness of music teaching system, actively integrate a variety of teaching measures, and improve the integration quality of teaching resources. Using big data analysis, cloud computing, and other technologies actively establish a resource integration platform, give resource retrieval methods, expand the total amount of music knowledge, and effectively improve the music education system [14]. For example, we should actively absorb all kinds of folk music works by means of systematic combination and keyword retrieval. Carry out in-depth data analysis on all kinds of music works, extract curriculum resources suitable for psychological shaping, and ensure the effect of psychological shaping. (2) Use the intelligent platform to create a new learning system, collect all kinds of learning information, fully implement the music evaluation, and dynamically obtain the mental health status of students. Use decision-making procedures to generate music teaching plans in line with students' psychological education, jump out of the limitations of initial education, and improve the classroom learning atmosphere. (3) Actively operate various intelligent platforms, such as MIDI (musical instrument digital interface) and track creation system, encourage students to create tracks independently, expand the scope of students' music learning, comprehensively enhance students' track innovation ability, give full play to the function of music edification, effectively strengthen students' practical ability of music creation, and form a cooperative idea of music creation.

The essence of music education is the art form that shapes and cultivates people. The ultimate goal of music education points to the comprehensive and free development of human beings, and promotes the improvement and progress of human all-round quality. Through aesthetic education, emotional education, and psychological education, music education has found the true essence of music education in the pursuit of human progress.

Nowadays, music intelligent education faces two difficulties. In this case, we should actively play the role of intelligent technology; use algorithms for data training; analyze the internal correlation of music data; carry out effective classification, efficient identification, and accurate prediction of music data; establish high-level algorithm content; improve the comprehensiveness of data integration; complete data types; refine work categories; and enhance the potential opportunities of re-creation. Quantitative processing of some music works is carried out in the way of sound Atlas to ensure the effect of music education and training and deeply obtain the grass-roots logic of music creation [15]. Promote the bottom creation algorithm in a large area, so that more people can become the creators of music tracks [16]. Using artificial intelligence technology, innovate the music teaching system, and divide the courses one by one from the aspects of repertoire appreciation, performance, and dance. Magenta studio platform has strong advantages in track creation. In the performance course, teachers use the intelligent platform to analyze the knowledge needs of students, select more appropriate content to carry out psychological teaching in combination with each student's learning state, reasonably analyze the students' mastery of classroom knowledge, give appropriate learning suggestions, and show the advantages of intelligent algorithm.

Music is a flowing art, and music education is also an educational process of sports and development. Compared with other artistic means, such as painting and calligraphy, music has abstract and dynamic advantages. Painting, calligraphy, and other art forms are vivid and intuitive, and the beautiful notes and smooth melodies give people more imagination space. Through the common combination of pitch and rhythm and other elements, the complete melody and style of music are formed. Although people cannot see it, people can perceive the existence of music through the consciousness instructions conveyed to the brain through the auditory organs, and this way of existence is more memorable, more lasting, and effective. Human consciousness, thinking, and subjective initiative are the prerequisites for the perception and understanding of music, and going back to the purpose of music education is also to realize the comprehensive development of human beings. Therefore, music education can only act on people's psychological state on the basis of perception.

Before the operation of music intelligent technology, people's way of music creation was cumbersome and needed to invest more creative energy. After the formation of music intelligence, music creation shows convenience and creative works are more diverse [17]. Today, music intelligence brings new opportunities for track creation. The composition content of "IAMAI" works is generated by intelligent technology, which brings people new music works [18]. In the process of composing, we can simulate the composing process systematically. The joint system of music intelligence education is gradually formed, so as to deepen the ability of music psychological education. With the help of network data, teachers can effectively master the music literacy of students and give personalized music psychological teaching plans. Teachers can use the "music exploration experiment" to actively shape students' music psychological literacy [19]. Transits into an abyss, performed by the London Symphony Orchestra, was performed in July 2012. What is different is that this marks the first time that a top band has played a work completely created by machines. The song was created by a computer cluster with intelligent algorithms called "Iamus," a figure in Greek mythology who is said to understand the language of birds. The system starts with the smallest information, such as the type of musical instrument playing music, and then without human intervention, it can create an extremely complex song, which can often arouse the emotional resonance of the audience in a few minutes. Iamos has created millions of unique works in modern classical style, and it is possible to adjust and try its music genre in the future. More than that, today's computer systems can write music with the same taste as master works through algorithms. For example, computer scientist, composer, and author of "music intelligence experiment" David Kopp designed the simulation robot Emmy, which created a large amount of convincing music, from Bach's Hymn, Mozart's sonata to Chopin's Mazurka, Beethoven's Tenth Symphony, and Mahler's five act opera. So many artificial intelligence technologies have been more and more widely used in the field of music [20]. Let us talk about the application in the field of music education.

Music is not only an art science but also lies in infiltrating into the process of social development and realizing the socialization of art. In educational psychology, the core of music education lies in cultivating and improving people's emotional and psychological functions, and promoting the rationality of people as social people. In music teaching, the core of emotional education and psychological education is necessary to deal with several pairs of relationships: teachers and students, experience and reality, exam-oriented education and quality education, knowledge transmission and ability training, etc. These are all related to the deep connotation of music and the correct expression of the emotional carrier. In modern teaching, priority should be given to students, with the overall improvement of students' quality as the core, from exam-oriented education to quality education, from a single teaching mode to multiple integrated teaching methods, from the empirical indoctrination method to students' autonomous learning, from one-sided knowledge to improve the ability. Teachers should teach students according to their aptitude, characteristics, and abilities. Take students as the main body of the classroom, give full play to students' enthusiasm, and integrate music education into students' self growth and development. On the basis of excavating students' interest in music and taking aesthetics as the foundation, cultivate students' interest in music learning and realize the popularization of music education.

The application of artificial intelligence in the field of Education (AI-ED) produced intelligent tutoring system (ITS) in the early stage. The main form of the combination of artificial intelligence technology and education is intelligent teaching system, which is the main research and development direction of teaching in the future [21]. At the same time, it is also one of the parts emphatically explained in this paper. The rapid development of information technology and the proposal and continuous improvement of new teaching system development mode promote people to comprehensively use hypermedia technology, network foundation, and artificial intelligence technology to develop new teaching system. It is a typical representative. It includes domain model, learner model, and teacher model, which reflects all the contents of teaching development. It can be said to have incomparable advantages and great attraction. Domain model focuses on the subject of learning. The learner model represents the students themselves. This model shows the interaction of computers or machines with learners, which can be used by the teaching part of artificial intelligence (i.e. teaching scholar model), so as to judge the course progress of teachers and learners, and determine the most efficient, appropriate, and interesting teaching activities and interactions [22]. More importantly, due to the continuous data accumulation and change, the learning behavior and performance of learners in the classroom will be continuously absorbed and fed back by the learner model, making the learner model richer and more accurate, as shown in Figure 3.

Applying this principle to music education, taking piano teaching as an example, it can be explained as follows: the learner model can be compared to the students who want to

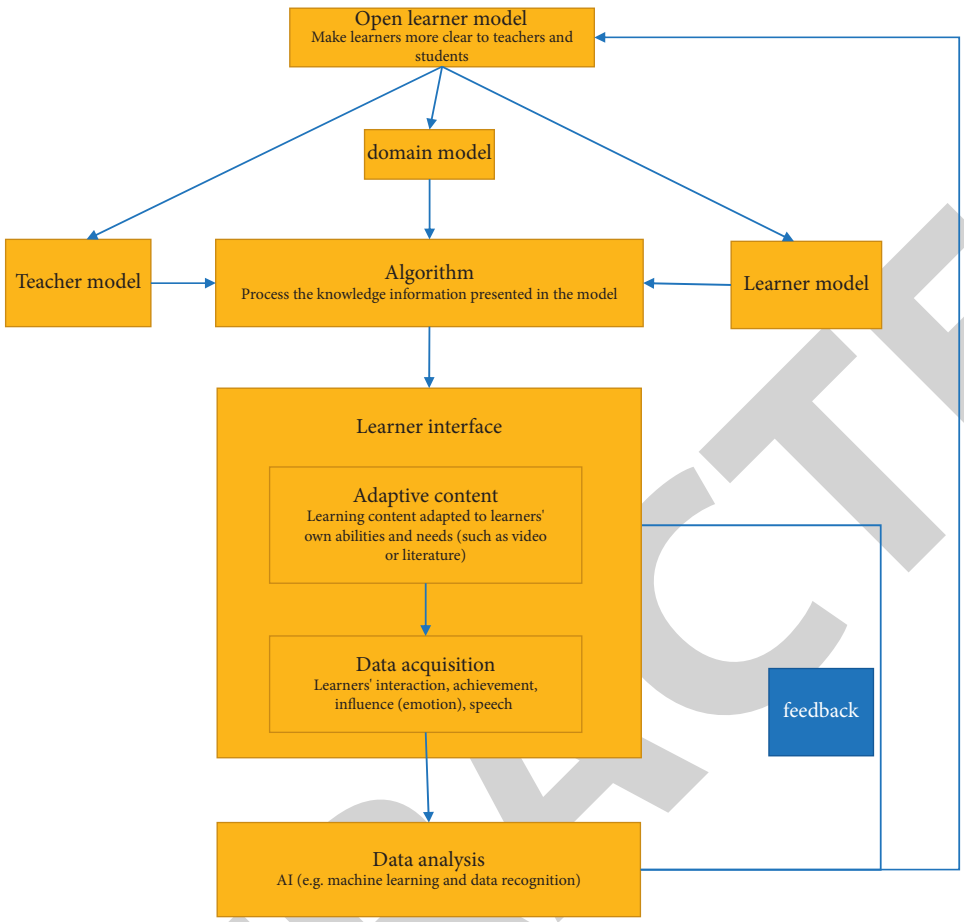


Figure 3: Learner model.



learn piano, the teacher model is the teacher or software who teaches piano, and the domain model is the knowledge related to piano subjects. Its own algorithm will analyze and process the content and information of these three parts, and select the most appropriate content to send to learners according to their learning needs and personal learning ability. Moreover, the continuous analysis of students' classroom performance (students' return to class status, emotion, accuracy, competition performance, etc.) can be used to put forward evaluation and effect feedback. For example, guidance or tips can be provided to assist students' progress in learning and have a continuous and stable effect [23]. Using artificial intelligence technology, continuous learning result analysis can be presented to teachers and students. Similarly, the convenience and efficiency brought by these artificial intelligence can help teachers understand students' learning behavior habits more quickly, effectively, and deeply, and use appropriate ways and methods for appropriate teaching, so as to better teach students according to their aptitude, be good, and save losses. The man-machine interactive learning model can help learners track and observe their learning process and progress, and can summarize and reflect on learning, so as to stimulate their learning enthusiasm and motivation. Now there are some intelligent learning robots like "zhixiaole" in the market. This kind of intelligent robot can establish dialogue scenes of interest to children according to their physiological and psychological years, unconsciously introduce children into scene topics, ask and communicate with children through a series of games or intelligent behaviors, impart knowledge and information in many human-computer interactive conversations, and analyze children's state, emotion, interests, and hobbies. At the same time, record children's mastery of knowledge points, intellectual development and mental development on the cloud data platform. In the process of interaction, the robot can process the relevant information obtained through various algorithms, constantly change and improve the information, and become an adaptive tutor more and more suitable for children. This kind of robot is very suitable for students who learn piano or other musical instruments and skills from scratch [24].

Under the influence of mechanical educational thinking, modern music education inevitably presents a tendency of instrumentalization. "Technology centered theory" has become the main mode of music learning, which makes the music learning activities that should be vivid and flexible become mechanical and rigid. Therefore, music education needs a new methodology. After music education is connected with artificial intelligence, it can use technology to enter the immersive virtual environment, feel the specific context of music learning, and ensure the deep investment of

students in the learning process, which has been advocated but cannot be achieved in music teaching. In addition, AI technology can also analyze the learning process and learning path of music learners. When learners fail to achieve the preset goals, it will help learners reselect learning methods and solve problems, so as to realize adaptive learning. "Teaching students according to their aptitude" on a large scale will no longer be a dream. After the combination of artificial intelligence and education, the learning content can be automatically generated according to the needs of students. Teachers will have more time to interact with students, which improves the educational ecology [25]. Therefore, the study of music learning mode under artificial intelligence has reference significance for the innovation of teachers' teaching methods and the reform of students' learning methods. "Artificial intelligence + education" has become a hot research in the new era. This paper mainly studies how human beings use the means of artificial intelligence to carry out self-organizing learning of music. The author draws lessons from the theory of "self-organizing learning" and combines it with artificial intelligence technology, hoping to make a breakthrough and practice in the research of music "intelligent" organizational learning, as shown in Figure 4.

The creation of Guzheng intelligent course mainly integrates the professional content of Guzheng, intelligent technology, audio recognition, and other resources to create a joint system of music intelligence. As shown in Figure 4, it is the function diagram of Yi Guzheng intelligent platform. Figure 4 contains four modules, including wireless track and teaching track, to dynamically update Guzheng works. Figure 4 illustrates that each music library contains several courses, which have the functions of listening, recording, playing music, and intelligent comparison with standard tracks. The performance of the zither can be accurately judged by the zither players. With the help of "Yi Guzheng" platform, teachers can dynamically view students' Guzheng performance data [26, 27]. Combined with the problems obtained by matching, the corresponding guidance is given. Human learning will not be limited to schools and classrooms, but can use various technologies and platforms for spontaneous learning, which is a future learning model. From the perspective of postmodernism, this ideal model has certain ecological value, and under this new learning model, the problems faced by personalized precision learning, interdisciplinary learning, and lifelong learning can be solved. Technology releases human teaching and learning, which is not only a deconstruction of modern music education, but also constructs an ecological music learning model.

## 4. Concept Definition and Description

Self-organization theory is a theory established and developed in the late 1960s. Self-organized learning is an existing way of human life autonomy and self-action. The "self-organization" of human life is the realization mechanism of learning and education. It has the characteristics of autonomy, openness, transcendence, nonlinearity, and

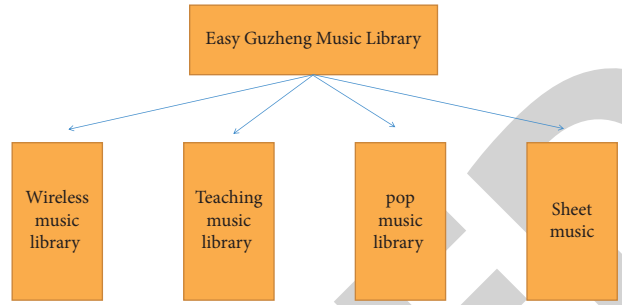


Figure 4: Functional structure of "Yi Guzheng."

sustainability. Self-organizing learning is the basis of realizing the psychological process of effective learning [27, 28]. The main forms of self-organizing learning are as follows: (1) the other creates a learning environment, such as a forum. Learners enter the forum and self-organizing forms a structure; (2) the other creates and participates in the learning environment, serving as a server, monitor, planner, and mentor, that is, guiding and restricting the future of the learning environment; (3) learners create their own learning environment. With the development of Internet technology and the continuous opening of educational resources, human learning is bound to develop to "self-organization," and self-organization learning will become the main way of human learning. Professor Sugata Mitra of the University of Newcastle in the UK has carried out famous "hole in the wall" education and learning experiments in India, Cambodia, the UK, and other places since 1999. This experiment is mainly aimed at children in primary and secondary school age. Children's learning is a kind of self-organizing behavior. The results show that after using the Internet to learn, even without the guidance of teachers, students in these poor areas can spontaneously learn English, computer, and other subjects. Moreover, it can also be seen from this experiment that self-organizing learning places students in the main position of learning, have different learning motivation, and learn actively [29, 30]. Learning and education activities are the transformation and construction of people's own spirit and energy, that is, people's practical activities of "self-construction," and the basis of this transformation is "self-organization." In addition, self-organizing learning is also the psychological basis of effective learning. More and more psychological research results show that real learning cannot happen without initiative. Bruner pointed out that the essence of learning is to actively complete the cognitive structure. Ausubel's meaningful acceptance of learning is not passive. Learning materials alone have no initiative in learning, so it is meaningless. That is, self-organization is the internal driving force of learning. In contrast to our current learning behavior, students passively and passively accept learning under exam-oriented education. In this kind of education mode that lacks flexibility and unified standards, students do not carry out "real learning." Over time, they will lose their ability to learn and become a machine for examination. Therefore, education has fallen into a crisis. Whitehead, the founder of postmodern philosophy and a great educator, rarely emphasizes external driving and

stimulation. He believes that the principle of progress comes from the inside, discovery is our own discovery, and the fruit is the result of our own innovation. However, the promotion of self-organizing learning model is very difficult. The voice of education reform has never stopped for decades, but in fact, there has been no fundamental change in education. How to carry out better self-organized learning when students' autonomous learning ability is not strong and educational resources are limited? Will the functions of teachers and schools change? How should the state and society respond? This series of linkage problems need to be solved by people. The road is blocked and long. Nowadays, with the rapid development of science and technology, the combination of science and technology and education is becoming closer and closer. This time, people saw the dawn of hope. Tao Xingzhi, a great educator in China, said: "teachers automatically organize themselves to study. As a result, they can create studious teachers and studious students." If in the era of Tao Xingzhi, the self-organized learning community cannot develop due to traditional concepts, regional restrictions, and political and economic environment, now, self-organized learning is not only an echo of Tao Xingzhi's call but also a post-modern ecological learning model. At present, the speed of knowledge renewal has a greater impact on learning than any other era. Knowledge can be accessed at any time in any networked place, and it is meaningless to instill rigid conceptual knowledge into the brain. People should learn to use the existing resources in the environment for their own use and create new social value. Therefore, the cultivation of self-organizing learning ability is urgent. With the help of AI (Artificial Intelligence), this paper studies the use of the concept of self-organization or "intelligent" organization, which comes from the creation of multiple social capital (enterprise) products, as shown in Figure 5.

With the continuous development of artificial intelligence technology, the field of education has gradually become one of the largest application scenarios. For example, the newly rich in squirrel AI, VIPKID, English fluency, and other industries have highlighted the encirclement in the field of education; 51talk, Hujiang English, and other online education companies have also rushed to list and expand users. In addition, Internet giants such as Baidu, Alibaba, and Netease are also competing to increase education, release intelligent education products, and provide education services. Moreover, iFLYTEK, Shangtang, yunzhisheng, and other AI leading enterprises also have a layout in the education industry, as shown in Figure 5. All over the country, various meetings such as "Ai+" have been held one after another. All this is announcing the same message: the field of education is in an active period of new technological change [31]. With the support of policies, artificial intelligence education enterprises bloom everywhere. At present, the development of innovative enterprises in tool-assisted learning, artificial intelligence discipline education, and smart campus has been relatively perfect, as shown in Table 1.

"Artificial intelligence + education" has become a hot research in the new era. The concept of "self-organizing learning" is introduced and combined with artificial intelligence technology. It is expected to make a breakthrough and practice in the research of "intelligent" organizational learning. In Sugat Mitra's experiment, children learn by relying on learning resources on the Internet, but there is no accurate learning orientation and personal direction. Even if children can complete the learning task in the end, there are inevitably some inefficient problems. The whole learning process depends on children's own metacognitive ability. AI + education has become a new wind vane. The attempts of various artificial intelligence + education and the implementation of educational products give us more reason to believe that we can better carry out self-organized learning with the help of advanced technologies such as artificial intelligence. In recent years, many "artificial intelligence + music education" enterprises have also emerged in China's market, and began to explore and accumulate in music education, as shown in Tables 2 and 3.

The long-term favorable policies and the vigorous promotion of quality education by the state have gradually cultivated the extensive demand for music education. The innovation of business model has brought new opportunities for the development of market music education. With the continuous entry of capital, new products, new models, and new playing methods of music education track emerge one after another. The birth of new things such as online 1-on-1 sparring, AI sparring, and smart piano has brought new vitality to the industry. With the help of technology, the traditional offline music education mode will be greatly impacted, and the mode and industry pattern of music education may usher in major changes. At present, the main forms of "artificial intelligence + music education" are intelligent sparring, double teacher teaching, intelligent instrument equipment, and master class. You can start music learning by connecting the app of giant products through smart instruments, tablets, and other tools. In the process of students' application, music recognition technology can identify students' wrong sounds, and big data technology can give personalized practice plans and generate personalized evaluation reports after analyzing wrong sounds, as shown in Figure 6.

The emergence of intelligent sparring, intelligent hardware, or various intelligent online music education systems, as shown in Figure 6, provides every music learner with the conditions for music "intelligence" to organize learning. Influenced by the concept of modern mechanical education, China's music education also shows the instrumental characteristics of single indoctrination of music skills and knowledge, and most students' music learning state is relatively passive. Compared with other disciplines, the resources of music education are unevenly distributed and difficult to popularize. This paper will focus on the impact of science and technology on the field of music education, think about the development direction of music teaching and learning in the future, and hope that the power of science and technology can lead us to realize the expectation of music "intelligent" organizational learning.

The best way to promote the development of music education and educational psychology is to combine music education and educational psychology to teaching practice.


Figure 5: Artificial intelligence learning diagram.

Table 1: Current situation of artificial intelligence industry.

| Instrument-assisted instruction | Artificial intelligence subject education | Smart campus |
|---|---|---|
| AI + big data, knowledge Atlas, voice semantic recognition, visual image recognition, and other technologies are gradually widely used, and online education products tend to be personalized. At the same time, intellectual adaptation education has become a new direction of technology research and development. | A subject curriculum system and teaching system based on artificial intelligence technology is called artificial intelligence subject education. Its main forms include programming education, aerospace education, robot education, and so on. | The campus work, study, and life based on the Internet of things will form an integrated environment, and take various application service systems as the carrier to fully integrate teaching, scientific research, management, and campus life. |

Table 2: Artificial intelligence education enterprises.

| Enterprise | Educational accumulation and exploration |
|---|---|
| Music notes | Its "big eye piano accompaniment" provides intelligent accompaniment services for piano for children aged 4–12. Using the combination of hardware and app, children wear smart wristbands during piano practice, collect exercise data through muscle electricity, and evaluate from eight dimensions: Pitch, rhythm, hand coordination, fingering, phrase, degree of relaxation, key touch strength, and performance method. The app will mark the weak points of children, design checkpoints, and recommend the next learning content. |
| Find smart piano | Visited nearly 20 teachers from nine major music colleges (Central Conservatory of music, Shanghai Conservatory of music, etc.) and recorded a set of self-study system from children, K12, and adults to the elderly. One to many teaching and learning system: disassemble the course into multiple steps, such as animation video shooting, demonstration playing, teacher explanation, etc. |
| Helen piano | Launch "6 + 1" smart piano classroom and ipiano smart piano products. Its app course adopts the EMP music enlightenment teaching method of Vienna University of music and performing arts, which is the first in Europe and the second in the world. |
| Philharmonic Society | Bring together the teaching resources of 2000 + top paper musicians and educators at home and abroad. On this basis, it carefully polished the online systematic teaching system suitable for Chinese music students and integrated with the imperial examination paper system. The course content is played by professional teachers and matched with multi-speed practice (slow/constant speed/fast), so that children can improve their learning efficiency step by step. |
| Cook music | Establish an online conservatory of music and an online cook intelligent piano education system. |
| The one smart piano | There are two smart sparring devices: smart piano and the one piano hi lite. Through the intelligent evaluation system, the player's pitch, rhythm, speed, strength, expressiveness, difficulty, and other dimensions are detected and analyzed. Smart piano refers to students who purchase smart piano, connect the piano with mobile phone or tablet, cooperate with app, and practice with the indicator light on the piano. Piano intelligent real-time recognition, playing and error correction. App will display real-time analysis results and evaluation results, and recommend customized learning programs. |

Music education should abandon the former closed teaching method; the open teaching means is more conducive to China's music education to absorb resources from other fields, not only from the knowledge field outside the music field but also from the integrated development of foreign countries and folk music to explore effective resources. At the same time, guide students to think independently and create independently. Students are encouraged to create their own bands and self-made music equipment to cultivate their interest in music. By participating in large-scale concerts, musicals, and other activities, students can grasp the overall connotation of music as a whole. Through research-based teaching based on certain music knowledge, we can learn book knowledge in the way of discovery, and form a learning mode of initiative, independent cooperation and independent inquiry. Further, students' inquiry ability, innovative spirit, and practical ability can be improved. On the one hand, students find the problems in the learning process, cultivate the problem awareness, and think independently about how to solve the problems; on the other hand, students should gather all the problems to form a problem chain, through the whole process of their own learning. In the communication with teachers and students, the main line of these problems is clearly sorted out, so as to achieve the dual improvement of thinking and learning effect. The change of teaching methods cannot be separated from the subject of students. In a variety of teaching methods, teaching students the consciousness of respect, sharing, cooperation,

Table 3: National policy statement.

| Date | File | Significance |
|---|---|---|
| January 19, 2017 | The 13th five year plan for the development of national education | It is pointed out that we should improve students' cultural cultivation and insist on educating people with aesthetics and educating people with culture, to cultivate students' artistic quality and improve students' aesthetic quality. |
| March 1, 2018 | Notice of the Ministry of education on the enrollment of colleges and universities in 2018 | Strengthen the use of high school students' quality files, and take the comprehensive evaluation of students' comprehensive quality as an important reference for enrollment in escorting students, independent enrollment, high-level art troupe and other types of enrollment. |
| July 8, 2019 | Opinions on deepening education and teaching reform and comprehensively improving the quality of compulsory education | We should strictly implement the courses of music, art, and calligraphy; set up courses with artistic characteristics in combination with local culture; and carry out extensive artistic activities. The long-term favorable policies and the vigorous promotion of quality education by the state have gradually cultivated the extensive demand of the market for music education. |

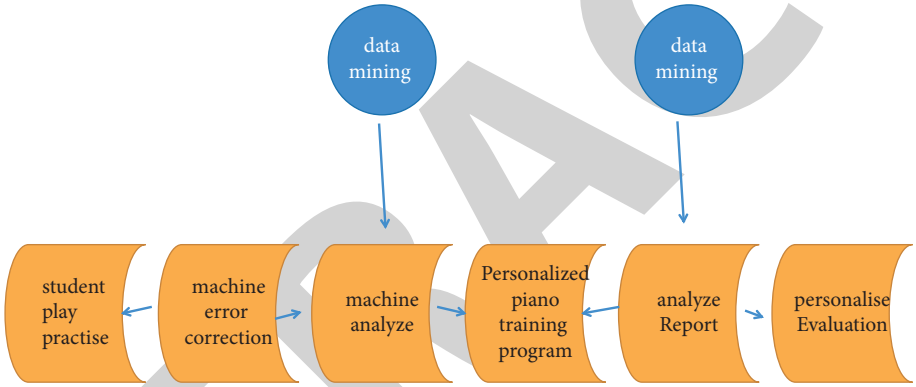


Figure 6: Intelligent sparring.

effectively adjusting personal psychological changes, and maintaining a healthy attitude are powerful weapons for them to face the complex and changeable social reality.

Under the intelligent technology environment, with the help of the network platform, we can effectively consult the latest resources and master the recent development of music education in various regions of the world. The artificial intelligence platform significantly improves the intelligence of music teaching, and the remote interaction function shows strong teaching advantages. It can carry out efficient interaction of audio materials and track creation materials. For example, the VIP sparring module is a one-to-one special training program, which can carry out online sparring of multiple musical instruments, such as piano, violin, etc. Teachers can start the software to create a simulated classroom and carry out interactive teaching. The network classroom carries out spectrum teaching guidance and voice communication to form a two-way interaction. As shown in Figure 6, it is the appointment layout of the VIP training platform. Figure 3 shows that the appointment module will collect information such as students' age, music learning time, types of musical instruments, and appointment time, so that teachers can accurately grasp students' music learning. The course learning adopts the form of one-to-one special counseling to support parents to attend. Figure 6 illustrates that the music intelligent learning system will comprehensively collect students' data to ensure the suitability of course difficulty and the training quality of psychological function. The VIP training system is highly integrated with intelligent technology and adopts three-party communication to increase the convenience of online training. During students' music practice, teachers can use the performance recognition system to comprehensively identify students' performance problems, carry out wrong sound statistics, and improve the pertinence of wrong sound guidance. Compared with the original sparring method, this sparring method can flexibly design the music performance environment. This kind of accompanying training system has strong intelligence, which can increase the convenience of music communication between teachers and students, and effectively break the space-time limit of music psychological counseling.

The use of Mu class platform increases the convenience of student information query. Mu class system has the functions of large resource storage scale, system openness, online learning, high-quality course recommendation, and so on. Mu class platform is the first choice for most students to learn online. Teachers can design online courseware

combined with the course content to let students communicate with each other. Based on the Mu class platform, Huaxia Yuefu website is open to all kinds of music education organizations in China, which can ensure the integrity of online course collection and facilitate music learners to choose courses independently. The music courses provided by Huaxia Yuefu cover various music teaching organizations. The courses are open. The course personnel come from various professional fields, which can ensure the quality of the courses. The establishment of Huaxia Yuefu platform has significantly improved the development of music intelligent education, effectively brought more high-quality music learning resources to students, and deepened the construction effect of music psychological function.

The "smart piano" system does not have piano performers, so it can perform efficiently with the help of intelligent programming. An intelligent system is added inside the piano. The intelligent piano can independently complete the performance process of music and simulate the playing strength of artificial fingers, which has a strong intelligent simulation effect. Intelligent piano key integration system, etc. The staff spectrum can be effectively loaded in the intelligent system to achieve the technical application effect of intelligent piano playing. Teachers can introduce "smart piano" into the course, which is convenient for students to choose tracks independently, guide students to self-study the piano process of various tracks, increase the intelligence of the course, overcome the confusion of students' piano key sequence, and shape students' confidence in playing the piano. The music education loop constructed by smart piano is shown in Figure 7.

It shows that AI intelligent technology integrates the educational function of intelligent piano, which can provide functions such as data capture and deep-level data analysis, so as to ensure the smooth progress of the educational loop.

With the development of the times, the definition, scope, and content of psychological education have changed accordingly, and its characteristics of diversified development have become more prominent. Under this development model, a single subject education obviously cannot meet the actual needs of education. Therefore, it has become the most popular educational guidance concept to actively carry out diversified development and realize the efficient integration of different disciplines. For psychological education, it is also necessary to actively adapt to the needs of the development and change of the times, follow the trend of social development, actively integrate with other different disciplines, and explore the effective teaching methods of psychological education from multiple perspectives. For music education, it also faces this problem. In the past, most music education focused on teaching students' various music knowledge and the cultivation of various music singing and performance skills. Related education and educational content is mostly limited to the scope of music, less related with other disciplines. As a common art form, music can implement auditory stimulation to the audience, and then arouse the inner resonance, and can more accurately grasp the psychological changes of the audience to appreciate the music works. In the process of music education, the learning of different types of music works can not only improve the individual's aesthetic ability but also cultivate the individual's sound psychology. Therefore, there is a very close connection between music education and psychological education.

Emotion is the main form of information exchange, including a variety of operating mechanisms, including "general knowledge," "thinking," "intelligence," and other requirements. This emotional communication mechanism confirms the feasibility of the development of music intelligent education. Emotional interaction is based on artificial intelligence technology, with the help of MIT Media System to carry out emotional computing, giving equipment operators strong information observation ability. Emotional interaction is a key research content in artificial intelligence industry, which aims to increase the smoothness of system communication. Combined with the needs of music psychological education, when students have psychological problems, they will be concentrated on the mistakes of music practice, and the intelligent system will carry out error correction dialogue. Music learners visit the platform, carry out human-computer interaction, and provide feedback of the interaction results to the teaching staff. Based on the feedback of learners, teachers formulate new teaching methods and form an interactive closed-loop psychological education system.

The key algorithm of music intelligent platform is the "RBF algorithm." This information processing method can be called "radial basis function," which is a network structure with multi-layer neurons. In most cases, this algorithm contains a five layer structure. The first layer is the data related to the analysis data. By inputting this kind of information, various music indexes can be obtained and effectively transmitted to the neural network system. The second layer is a membership function. The mathematical expression is shown in the following formula:

$$u_{ij}(x_i) = \exp\left[\left(x_i - c_{ij}\right)^2 * \left(\sigma_j^2\right)^{-1}\right]. \tag{1}$$

(1) Formula is an empirical formula. $I$ ranges from 1 to $r$ and $j$ ranges from 1 to $u$.

The third layer is to calculate the number of fuzzy rules, carry out various sample learning, and try to control the number of learning rules. The calculation method of fuzzy rules for the $j$-th position is shown in the following formula:

$$\begin{aligned}\varphi_j &= \exp\left[-\left(\sum_{i=1}^{r}\alpha\right)^2 * \left(\alpha_j^2\right)^{-1}\right] \\ &= \exp\left[-\left\|X - C_j\right\|^2 * \left(\alpha_j^2\right)^{-1}\right].\end{aligned} \tag{2}$$

(2) In the formula, the value of $J$ is 1 to $u$, $a = (x_i - c_{ij})^2$, and $c_j$ represents the midpoint of RBF at the position of serial number $j$. The main characteristics of RBF neural network: when the distance between neuron and center is short, it has high activatable ability. It is

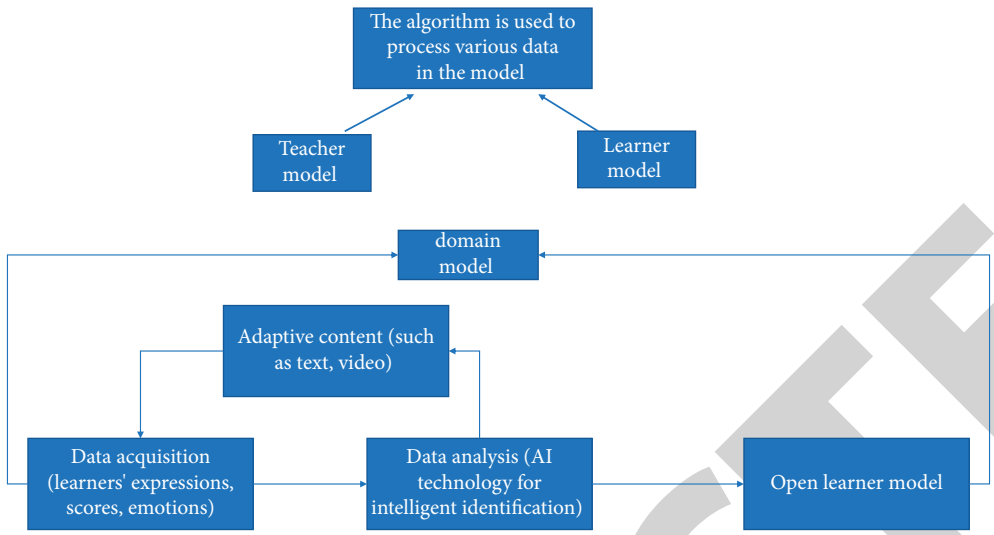


Figure 7: Music education loop diagram constructed by intelligent piano.

the teaching method most in line with music psychological education.

The fourth layer is a normalization stage. This layer node is equivalent to the design method of fuzzy rules. The rule output algorithm at the $j$ position of the fourth layer is shown in the following formula:

$$\psi_j = \varphi_j * \left( \sum_{K=1}^{N} b \right)^{-1}. \tag{3}$$

In formula (3), $b = \Phi_k$. The value of $j$ is 1 to $u$.

As the data transmission layer, the fifth layer outputs the evaluation results of learners' playing music skills. It is based on RBF algorithm and makes effective use of TS fuzzy rules. The calculation method of output is shown in the following formula:

$$y(x) = \sum_{i=1}^{u} \left[ (a_{i0} + a_{i1}x_i + \ldots + a_{ir}x_r) \exp\left[ -\left\| X - C_j \right\|^2 * \left( \sigma_j^2 \right)^{-1} \right] * \left[ \sum_{i=1}^{u} \exp\left[ -\left\| X - C_j \right\|^2 * \left( \sigma_j^2 \right)^{-1} \right] \right] \right]^{-1}. \tag{4}$$

$W_k$ refers to the $k$-th of the connection rule, which is the sum of multiple output parameter weight values. The calculation method is shown in the following formula:

$$Y(r) = \sum_{k=1}^{u} W_k * \psi_k. \tag{5}$$

With the support of RBF algorithm, build a new music intelligent learning system, effectively introduce algorithm rules into the learning platform, reasonably express the meaning of the algorithm during code writing, and improve the construction effect of interactive learning system. In the formula, $X$ represents the number of excellent students in the test results in music learning. Take 100 as the basis of students, and measure the proportion of students' time in music learning in the intelligent system. $c_j\sigma_j$ refers to the learning situation of music courses within the learning time $X$ of students with excellent psychological quality of music. This result is parallel. $Y$ represents the best score of music output by each algorithm. In order to improve the optimization of RBF algorithm system, one layer can be set as data import layer, five layers can be set as data export layer, and the other layers can be hidden. For the processing task of large data, take the first $m$ numbers of music information as the starting point, carry out data training, and actively build the RBF model of students' music psychological learning system. Gradually complete the evaluation with the help of the software platform to obtain a complete learning model.

In the process of music teaching and various kinds of music performance, it is very important to cultivate students' "independence." In the process of shaping students' psychology, constantly cultivating students' independence can better enhance students' musical ability. In the process of cultivating students' psychological quality, we should always pay attention to students' behavior mode and thinking mode.

The operation of the interactive system can be combined with the role levels of teachers and students, and the matching services show differences. The main subjects of music intelligent platform are music teachers, music learners, and curriculum resources. Integrate various teaching resources into the teaching management procedures; ensure the effectiveness of English psychological

Table 4: Operation feedback of interactive platform.

| System function | Evaluation items | | |
|---|---|---|---|
| Auxiliary training | Auxiliary test 10 points | Quality of learning resources 10 points | Accuracy of log recording: 9 points |
| Autonomous learning | Basic training 10 points | Exercise training 10 points | Piano score practice 10 points |
| Performance training | Performance training 9 points | Music sense recognition 10 points | Personal collection 9 points |

Table 5: Material introduction of interactive music intelligent platform.

| Project | Music material | Music score material | Performance material |
|---|---|---|---|
| Details | 120 | 200 | 2024 |

Table 6: Course resource design scheme of interactive music intelligent platform.

| Project | Picture resources | Video courseware | Course difficulty |
|---|---|---|---|
| Details | 12562 | 3021 | 1 to 5 |

Table 7: Operation data of music score module.

| Project | Number of runs (times) | Resource downloads (times) | Error correction accuracy (%) |
|---|---|---|---|
| Music score module | 33321 | 15557 | 99.25 |

Table 8: Operation data of music score module.

| Project | Number of runs (times) | Resource downloads (times) | Error correction accuracy (%) |
|---|---|---|---|
| Music score module | 25557 | 8647 | 99.41 |

education; strengthen the integration and processing of teaching information such as teaching organization, teaching management, and quality evaluation; and promote various roles to obtain corresponding knowledge services. The operation feedback of this teaching system is shown in Table 4.

As shown in Table 4, it is the feedback result of a music organization using the music interactive platform. There are 100 learners, and the full score of each item is 10 points. The operation of each module depends on the music course resources of the database, so as to ensure the intelligence of the system operation. The system functions include: Music exercise library, course textbook library, performance topic material library, etc. The database data contains a variety of information categories, such as music special information, piano score data, etc. Table 5 introduces the platform materials.

Table 6 shows the design scheme of platform curriculum resources.

Table 7 shows the operation data of music score module in March 2021.

Table 8 shows the operation data of music score module in March 2021.

Figure 8 shows the operation data of music score module in March 2021.

Combined with the feedback data in Table 4, it is found that in the auxiliary training module, students are relatively satisfied with the music auxiliary detection function and the quality of teaching resources. 100 students are given full marks, and the accuracy of learning diary is given 9 points, indicating that there are some errors in the system recording students' recent courses, which increases the difficulty for students to find courses. Therefore, the retrieval diary function should be actively maintained to maintain the intelligence of the system operation. In the autonomous learning module, the students were given full marks, which shows that there is no fault in the operation of the system when the students practice the basics, exercises and music scores, and can bring students high-quality music psychological learning experience. The score of music sense and course collection in the performance training module is full score, and the training unit is given 9 points, indicating that the calibration ability of students' performance errors is insufficient. The system needs to strengthen the pitch adjustment and test the performance recognition function to ensure the accuracy of error correction results. Table 5 divides the types of music score, music score, and performance materials. According to the data in Table 6, various course resources with difficulty coefficients of 1 to 5 are collected in the music intelligent platform, and the course resources of pictures and videos are sufficient. It can provide students with comprehensive music psychological education and give full play to the teaching advantages of intelligent technology. It can be seen from the data in Table 7 to Figure 8 that the operation of music scores, music scores and performance modules viewed in March 2021, the number of transportation and resource downloads are high, indicating that the platform is in good operation. The error correction accuracy of the system is greater than 99%, indicating that the system has strong error correction ability.

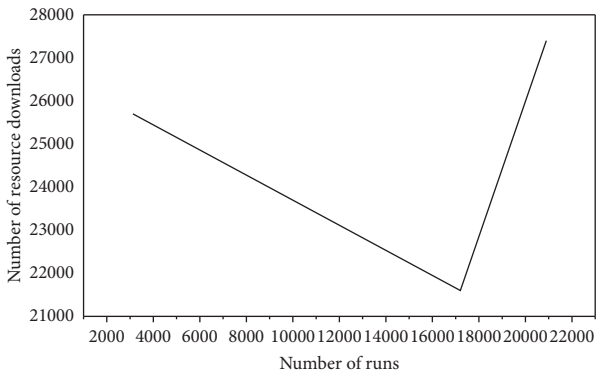


Figure 8: Operation data of performance module.

## 5. Conclusion

At this stage, the research of music intelligent system is still in the initial stage. It depends on the excellent academic team of science and engineering to strengthen the research and development of intelligent platform and strengthen the system development in the direction of psychological shaping. The number of research and development of intelligent music platforms has gradually increased. Based on big data technology, various educational analysis works have been carried out and a new teaching scheme has been formulated. Teachers can complete the education of psychological shaping by means of online guidance, one-to-one special counseling, one-to-many centralized explanation, and so on. Combined with the R&D needs of the new music education system, integrate vocal recognition technology, improve the effectiveness of teaching interaction, give students test answers, performance evaluation, skill learning suggestions, etc., and effectively control the education cost. The operation ability of intelligent platform is directly related to the comprehensiveness of music knowledge content and the standardization of teaching work. Therefore, it is necessary for music and technology R&D organizations to establish close cooperation and carry out interdisciplinary integration project research, so as to promote the development of music education. Successful cases of integrating artificial intelligence into composition projects include "magenta" and "flow machines," which can intelligently create music works. The creation system of "flow machines" can effectively collect all kinds of music resources and integrate them into a music material library. Users can give simple instructions to obtain all kinds of music materials and reduce the difficulty of music creation. For example, "Daddy's car" was created and formed, integrating 45 tracks in the music material library. The function of this system needs to be improved, and new learning modes and new algorithms need to be added to give more opportunities for the development of music intelligence. Music professional organizations can use intelligent technology to develop track generation and track creation systems with diverse music characteristics. The development of international music intelligent system needs to gradually enhance the perfection of music works from the perspectives of multiple levels, types, nationalities, and styles. Reasonably supplement the music database according to the regional type.

"Magenta" system shows the advantages of intelligent technology and does not carry out Turing test on the music system. Turing test is a way to evaluate the professionalism of the system from the perspective of IQ. This system does not fully carry out music creation according to the way of human thinking. System R&D members use nsynth Technology (neural algorithm to integrate audio resources) to create more than 100000 kinds of vocal music training units. The training method is different from the audio operation process and has high audio uniqueness. With the help of intelligent technology, the R&D members of this system integrate independent thinking and try to innovate the way of audio writing. At this stage, the system of creating works is not yet mature. This idea of creating works will stimulate more music lovers to engage in music creation and make the achievements of music creation more novel. All aspects of music creation, scientific and technological development, and psychological function shaping need to rely on n-dimensional space to carry out unconventional repertoire creation.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this article.

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*Retraction*

# Retracted: Rural Architectural Planning and Landscape Optimization Design under the Background of Ecological Environment Protection

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] W. Wu, X. Wang, D. Liu, and H. Su, "Rural Architectural Planning and Landscape Optimization Design under the Background of Ecological Environment Protection," *Journal of Environmental and Public Health*, vol. 2022, Article ID 5901718, 11 pages, 2022.

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*Research Article*

# Rural Architectural Planning and Landscape Optimization Design under the Background of Ecological Environment Protection

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The ecological problems faced by China's environmental protection are becoming more and more serious. Serious haze occurs frequently in some areas. Water pollution, soil pollution, and other new types of pollution are still relatively prominent problems. Therefore, rural architectural planning and landscape optimization design should be based on the premise of ecological environmental protection. This paper puts forward the evaluation of rural architectural planning and landscape in the context of ecological environment protection and uses the analytic hierarchy process to analyze and obtain the evaluation results. This method has a comprehensive and scientific powerful evaluation function. The experimental results of this paper show that after the evaluation of the analytic hierarchy process, it is found that the comprehensive score of the architectural planning and landscape of village A is not very high. The highest weight is 0.3210, the landscape diversity score of street A is 1.28, and the landscape diversity score of street D is 1.76. This is the highest score, indicating that the architectural planning and landscape of the village cannot meet the needs of contemporary ecological environmental protection. Aiming at the problems existing in the landscape, the corresponding measures are also given at the end of the experiment, which has certain significance for the landscape optimization design.



## 1. Introduction

The countryside has been an important foothold of Chinese landscape aesthetic art culture since ancient times. In recent years, the rural construction under the vigorous promotion of the state has provided a good opportunity for the improvement of the rural ecological environment and the development of the rural economy. At present, the main content of rural construction in most areas is reflected in a series of measures such as house reconstruction, village appearance improvement, and infrastructure facilities. With the nationwide development of rural construction, the problems of patternization, urbanization, and the loss of local characteristics are gradually exposed. Rural landscape is a unique natural and cultural resource rooted in the countryside, and it is an inevitable requirement for rural development to construct a landscape with regional cultural characteristics and ecological diversity.

The public's attention to rural construction is increasing day by day driven by the adjustment of national policies and the propaganda of local governments. In the previous Fifth Plenary Session of the 16th Central Committee, the major historical task of building a new socialist countryside was put forward to "build a beautiful countryside." People's overall understanding of the countryside is not only the pursuit of appearance but also the construction of inner beauty. At present, the issue of rural development has been widely publicized and discussed by the media, academia, and various social channels, and there are also complex interests and expectations in rural development. These different attitudes and social discussions constitute a more complex contemporary rural environment, adding complexity to the meaning

of the rural landscape. The innovation of this paper is that based on the background of ecological environmental protection, the analytic hierarchy process is selected to evaluate the rural architectural planning and landscape. The relevant indicators are constructed, and the impact of the indicators is analyzed, so as to achieve the purpose of giving scientific suggestions for landscape optimization.

## 2. Related Work

The landscape environment provides people with a green, healthy, and harmonious living place, which not only meets the material needs of users but also provides spiritual sublimation. Done found that the rural population is small and the rural road network is dense and not improved and maintained. A social and environmental security framework, national rural road standards, and overall planning for rural road management arrangements have now been established [1]. Han found that the optimization of rural living environment has made great achievements in the rapid development of society and economy, but from the overall effect, there are still many problems to be solved urgently in the construction of rural living environment. He hoped to provide some references for the future optimal design of rural living environment [2]. Zhang found that modern rural architectural planning increasingly emphasizes the premise of ecological infrastructure and the comprehensive benefits of economy, society, and ecological environment as the planning goal. How to organically combine environmental factors, human factors, and scenic tourism hubs has become a problem faced by rural architectural planning and landscape optimization [3]. Jin found that rural tourism resources are rich, and it has become an increasingly popular tourist destination. As factors of tourism value-added consumption, the proportion of shopping, sightseeing, and entertainment is very low. Therefore, improving the efficiency and quality of tourism is a top priority [4]. Fricker found that in the era of technological development, people are faced with the potential to redefine virtual reality in the field of landscape architecture. He has virtual reality tools in professional practice, which are increasingly used to test and communicate design decisions. More commonly, there has been a lack of research on integrating immersive environments into landscape architecture so far [5]. Scholars have found that with the development of economy in recent years, the country has begun to pay more and more attention to rural architecture and landscape. In the rural architectural planning and landscape optimization design, it should be based on the premise of ecological environmental protection, so as to make the rural development sustainable.

Analytic hierarchy process mainly starts from the evaluator's understanding of the nature and elements of the evaluation problem, which has more emphasis on qualitative analysis and judgment than the general quantitative method. AHP is a classic evaluation method, which can effectively and comprehensively evaluate the current buildings and landscapes in the countryside and provide scientific guidance. Based on the existing park green space map data in the countryside, Xu used GIS technology to establish a park green space database and calculated the corresponding landscape index through landscape pattern software [6]. Ren found that with the rapid development of human civilization in recent years, various environmental problems have appeared one after another. He took the botanical garden as the research object and then used the landscape analytic hierarchy process to evaluate the transformed landscape. The results show that when the plant landscape is diversified and the structure level is reasonable, the comprehensive evaluation of the garden is the highest [7]. Mishra tried to apply the analytic hierarchy process (AHP) algorithm to delineate whether rural buildings and landscapes can be sustainable [8]. Li proposed a network selection algorithm based on analytic hierarchy process (AHP) and similarity. He divided services into three categories: dialogue, flow, and interaction, and then used AHP to calculate network attribute weights [9]. Scholars believed that the application of AHP can effectively evaluate the rural architectural planning and landscape optimization design comprehensively, and according to the evaluation, the corresponding measures can be given to the current architectural planning and landscape optimization.

## 3. Architectural Planning and Landscape Evaluation Based on AHP

Since the reform and opening up, the past stable state of China's countryside has gradually changed in the rapid urbanization and economic development. The development of urban integration not only promotes economic development but also brings great changes to the landscape of rural areas [10]. The land use patterns, population, and basic functional composition of rural areas have all changed accordingly. Rural construction is in full swing across the country. All regions learn from each other, which leads to the increasingly templated urban style, the gradual loss of local characteristics, and the blurring of domain characteristics and recognition. The sense of intimacy and belonging of the rural landscape also declined [11]. The important principles of rural architecture are shown in Figure 1.

As shown in Figure 1, the construction of rural characteristics is the protection and inheritance of rural culture. By improving the construction of rural spiritual civilization and carefully planning the countryside, it creates a better environment for farmers. In a suitable environment, farmers' own value can be better realized. Rural buildings mainly include village houses, shops, ancestral halls, bridges, and other buildings. Rural buildings are closely integrated with regional characteristics and have local characteristics. Rural architecture is the finishing touch of the rural landscape, and it is the place in the rural landscape that can best reflect the regional characteristics and village culture [12]. Jiangnan water town dwellings, Xiangxi stilted houses, Hani mushroom houses, etc. are all unique landscapes formed by absorbing local culture and combining with the local natural environment for a long time. A schematic diagram of the rural landscape is shown in Figure 2.

As shown in Figure 2, the rural landscape has two sides; one is the idyllic idyll on the one hand, and the other is the

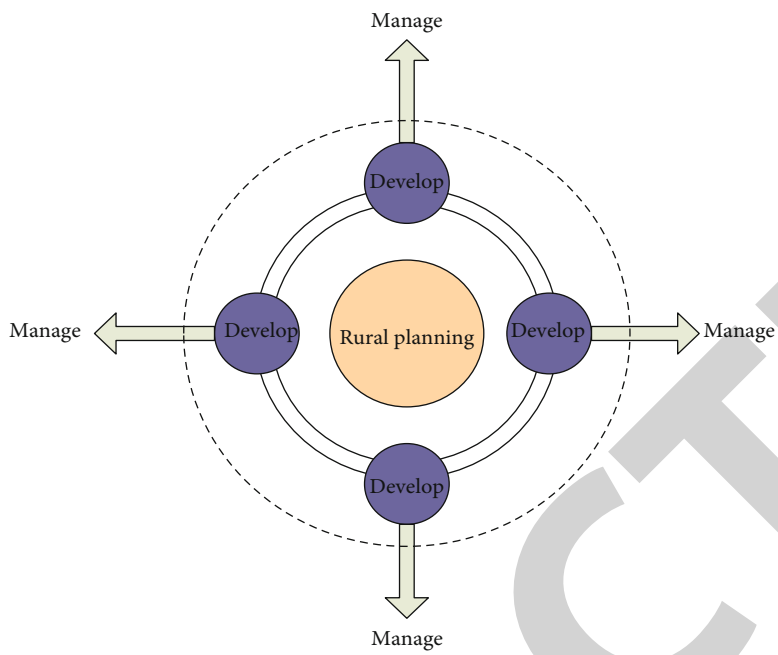


Figure 1: Important principles of rural architecture.

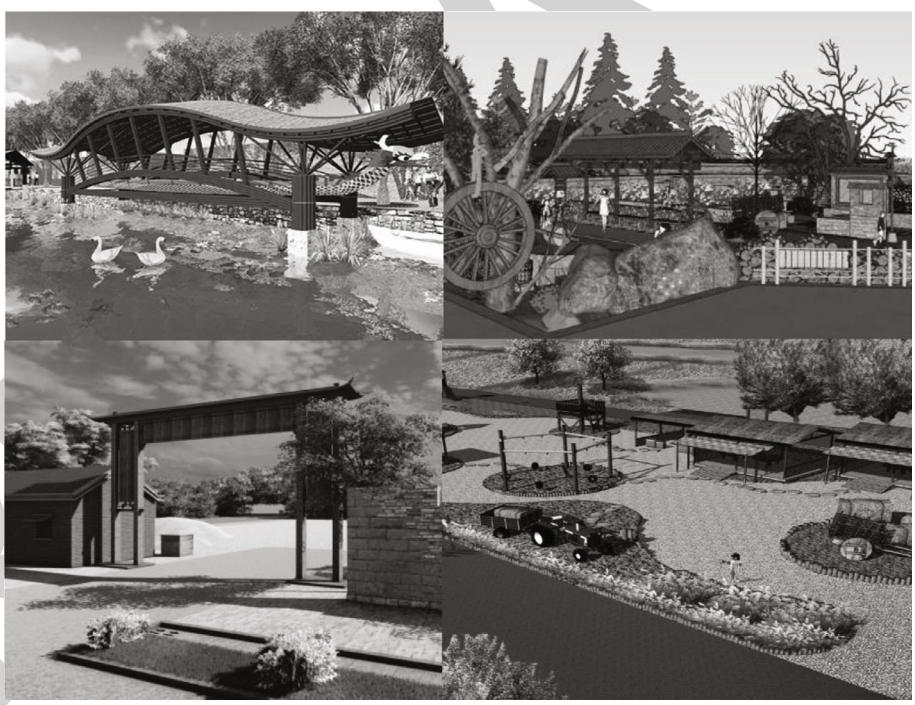

Figure 2: Schematic diagram of a rural landscape.

rural backward sanitary conditions, chaotic living environment, and uneven residential building quality. The lack of public services and municipal infrastructure cannot well meet the comfortable life pursued by modern people [13]. All human changes must be within the allowable range of the environment. If the ecological balance is unbalanced and the environment deteriorates, it is necessary to change the original production and way of life and establish a new balance with a more reasonable structure.

*3.1. Selection of Landscape Index.* According to the research objectives, this paper applies the principles of landscape ecology to select the landscape pattern analysis indicators of landscape ecology, analyze the rural landscape pattern,

and evaluate the street landscape pattern [14]. The analysis indicators and calculation methods selected in the landscape pattern research are as follows.

The total patch area (TA) counts the sum of the patch areas of each landscape type, and its calculation formula is

$$\mathrm{TA} = A. \tag{1}$$

In the formula, $A$ represents the total area of patches, and the number of patches is the number of patches in each landscape type. The calculation formula is

$$\mathrm{NP} = n_i. \tag{2}$$

In the formula, $n_i$ represents the number of patches of landscape type $i$, and the mean patch area (MPS) represents the average state, reflecting two aspects of landscape pattern analysis [15]. This survey found that changes in MPS values can feed back richer landscape ecology information such as

$$\mathrm{MPS} = \frac{A}{n_i}. \tag{3}$$

$n_i$ represents the number of patches of landscape type $i$. The largest patch index (LPI) helps determine the modal type and landscape dominance as

$$\mathrm{LPI} = \frac{(a_{ij})_{\max}}{A}. \tag{4}$$

In the formula, $a_{ij}$ represents the area of the plaque.

The largest patch index (LPI) shows how much the largest patches affect a single type or the entire landscape. The patch density (PD) represents the density of each type of patch, i.e., the number of patches contained in the device landscape. The index reflects the fragmentation degree of the landscape and the spatial inhomogeneity of the landscape [16]. The larger the PD value, the greater the degree of fragmentation and the higher the spatial inhomogeneity. Its calculation formula is

$$\mathrm{PD} = \frac{n_i}{A} \times 100\%. \tag{5}$$

Shannon's diversity index is a measurement index based on information theory, which is widely used in ecology. The Shannon diversity index (SHDI) reflects the richness and complexity of landscape types and is calculated as follows:

$$\mathrm{SHDI} = -\sum_{i=1}^{m} (P_i * InP_i). \tag{6}$$

$P_i$ represents the proportion of patch $i$ to the total area of the patch. SHDI values reflect changes in the number of debris patches and the proportions of various patches [17]. If the urban landscape is composed of patches, the landscape is uniform and the diversity index is 0.

Shannon's evenness index reflects the evenness of the distribution of individual numbers of each species. It is equal to the Shannon diversity index divided by the maximum possible diversity at a given landscape abundance. The Shannon evenness index (SHEI) reflects the uneven distribution of patches in the landscape, which is usually expressed as the ratio of the diversity index to the maximum value [18]. The landscape uniformity index mainly measures whether the proportion of green patches of different levels in the area has been adjusted. Its calculation formula is

$$\mathrm{SHEI} = \frac{-\sum_{i=1}^{m} (P_i * InP_i)}{Inm}. \tag{7}$$

$P_i$ represents the proportion of patch $i$ to the total area of the patch. Obviously, if the SHEI value tends to be 1, the uniformity also tends to reach the maximum value.

Fragmentation represents the fragmentation degree of landscape segmentation and reflects the complexity of landscape spatial structure. To a certain extent, it reflects the degree of human disturbance to the landscape. Fragmentation index (FI) is an important characteristic. Landscape fragmentation is closely related to human activities and to the pattern, function, and process of landscape [19]. At present, the fragmentation index is usually used to indicate the degree of green space fragmentation, and its calculation formula is

$$F = \frac{\sum N_i}{A}. \tag{8}$$

In the formula, $N$ represents the total number of patches in landscape $i$, and $F$ represents the fragmentation degree of landscape $i$. Aggregation index (AI) is one of the indicators describing the physical connectivity of each patch type [20]. The larger the AI value, the higher the plaque density. If the AI value is equal to 100, the plaques will gather on one patch. Its calculation formula is

$$\mathrm{AI} = \frac{g_{ii}}{(g_{ii})_{\max}} \times 100\%. \tag{9}$$

$g_{ii}$ represents the connectivity number of patch type $i$, and $(g_{ii})_{\max}$ represents the maximum possible connectivity number between pixels with patch type $i$ based on the single-parameter counting method.

The dominance index reflects the changes in the population of each species. The larger the ecological dominance index, the more uneven the distribution of species in the community, and the more prominent the status of the dominant species. The dominance index LDI was used to represent the importance of patches in the landscape. The larger the value, the more dominant one or more types of landscapes are, and its calculation formula is

$$\mathrm{LDI} = H_{\max} + \sum_{i=1}^{m} (P_i * InP_i). \tag{10}$$

$H_{\max}$ represents the maximum diversity index.

*3.2. Analytic Hierarchy Process (AHP).* Analytic hierarchy process (AHP) is to decompose the decision-making

problem into different hierarchical structures according to the overall objective, subobjectives, and evaluation criteria. Then, the priority weight of each element of each level to an element of the previous level can be obtained by solving the eigenvector of the judgment matrix. Its characteristic is to organize various factors in complex problems by dividing them into orderly levels that are related to each other. It quantitatively describes the importance of pairwise comparison of elements at a level. Finally, the weighted sum method is used to obtain the final weight of the total objective, and the one with the largest final weight is the optimal solution. The AHP is shown in Figure 3.

As shown in Figure 3, AHP is a simple, flexible, and practical multicriteria decision-making method for quantitative analysis of qualitative problems. AHP has several factors per layer. The relative importance of the factors in each layer is judged by pairwise comparison, so as to judge the relative weight value of each factor in the target layer. Ultimately, the problem boils down to the determination of the relative importance weights of the lowest layer relative to the highest layer or the arrangement of relative superiority and inferiority order. The evaluation factors are as follows.

*3.2.1. Ornamental.* Ornamental attributes are an important factor in creating a comfortable and beautiful environment and a prerequisite for attracting people to appreciate the landscape. Because eye perception is the most important way to receive external information, the analysis of landscape is mainly based on the perception of visual image. It represents whether it conveys beauty, comfort, and harmony with the environment. On the basis of fully understanding relevant theories and drawing on relevant practices, 10 ornamental evaluation factors were initially selected.

*3.2.2. Functionality.* As an organic concatenation from the countryside to the city center, the greenway connects numerous natural and human landscape resources. This provides people with a place close to nature, so whether the function of the greenway is sound is particularly important. Functionality is mainly from the user's psychological point of view, considering the convenience of its use. In this paper, 10 functional evaluation factors are preliminarily selected from the comprehensive consideration of greenway connectivity, recreational service facilities, and sanitation facilities.

*3.2.3. Cultural.* While the greenway is open to the public as a public facility, it will also become a carrier of local culture and show it to the public. When the landscape of pure plants or geographical features lacks the filling of cultural content, it is always lacking in Chinese traditional aesthetics, and it has a beautiful shell and no soul.

*3.2.4. Ecological.* Considerations of ecological function must be incorporated into the overall assessment of the landscape. This paper preliminarily screened the following six evaluation factors, namely, patch density (PD), Shannon diversity index (SHDI), Shannon evenness index (SHEI), fragmentation degree (FI), aggregation index (AI), and dominance index (DI).

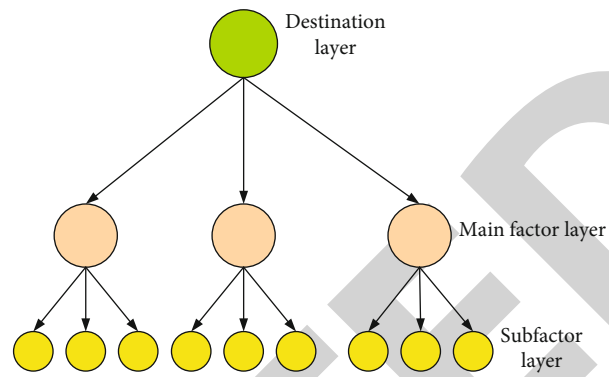


Figure 3: AHP.

Ecology refers to the unity of organisms with the environment. At the macroscopic level, the individual and group of organisms are absolutely dependent on environmental conditions. Because ecology is the most important part of the landscape, this paper evaluates the six evaluation factors of ecology. The indicators selected in this paper are shown in Figure 4.

As shown in Figure 4, after establishing the analytic hierarchy process (AHP) structural model, when determining the weights between the factors at each level, the relative proportions are used to compare the factors with each other. A comparative judgment matrix can be constructed to compare factors of various natures and improve the accuracy. Its operation as a prelude to integer multiplication and division seems to be very simple, but it is flexible and changeable in practice.

The exact calculation in the strict sense requires the use of power calculation, and the process is very complicated and tedious. Generally speaking, the maximum eigenvalue of the judgment matrix and the corresponding eigenvector do not need high precision, and the calculation can be simplified.

First, the $C$ factors are normalized by a column vector, and then, the factors are aggregated by row. The row and vector are renormalized to obtain the sorted weight vector denoted by $W$. The maximum eigenvalue is calculated as

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(cw)_i}{nw_i}. \tag{11}$$

The so-called consistency check is to determine the acceptable range of $C$ inconsistency. First, the integrity index CI is calculated. The CI calculation formula is

$$\mathrm{CI} = \frac{\lambda_{\max} - n}{n - 1}. \tag{12}$$

$\lambda_{\max}$ is the largest eigenvalue of the judgment matrix. The random consistency ratio (CR) is

$$\mathrm{CR} = \frac{\mathrm{CI}}{\mathrm{RI}}. \tag{13}$$

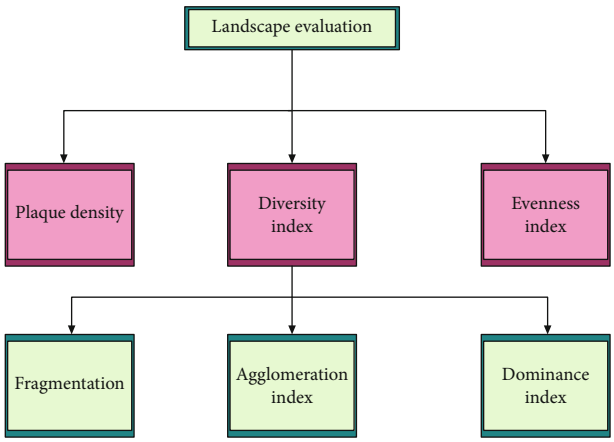


Figure 4: Rural landscape hierarchy model.

When CR = CI/RI ≤ 0.10, it is considered that the degree of inconsistency of the judgment matrix $C$ is within the allowable range. The consistency ratio for hierarchical total ordering is

$$\mathrm{CR} = \frac{c_1\mathrm{CI}_1 + c_2\mathrm{CI}_2 + \cdots + c_n\mathrm{CI}_n}{c_1\mathrm{RI}_1 + c_2\mathrm{RI}_2 + \cdots + c_n\mathrm{RI}n}. \tag{14}$$

Data dimensionless processing mainly solves the comparability of data. After standardization, the original data are converted into dimensionless index evaluation values for comprehensive evaluation and analysis. For the above factors, the specific index of each factor is calculated according to the mathematical formula and then normalized by standard deviation calculation. The formula is

$$A_i = \frac{A_i - A_{\min}}{A_{\max} - A_{\min}}. \tag{15}$$

Data are converted into pure quantities without units to eliminate the influence of dimension (units) on data judgment and comparison. Then, according to the conventions in use, the grades are assigned and the corresponding points are assigned.

Entropy generally refers to a measure of the state of certain material systems, and the degree to which certain material system states may appear. Entropy is a measure of the degree of disorder in a system. In system theory, the greater the entropy, the greater the disturbance of the system, and the smaller the weight. The smaller the entropy, the more the opposite. The entropy value method calculates the entropy value of the index according to the characteristics of entropy, determines the influence degree of the factor on the whole system, and determines the weight of the factor. The indicator weight is positively correlated with the relative change degree of the indicator. The evaluation process of the entropy method is as follows:

$$A_{ij} = \frac{A_{\max} - A_j}{A_{\max} - A_{\min}}. \tag{16}$$

Table 1: Final ranking weight values.

| Target layer A | Evaluation standard then layer B | Weights | Rank |
|---|---|---|---|
| Landscape evaluation | B1(PD) | 0.2546 | 6 |
| | B1(SHDI) | 0.3210 | 1 |
| | B1(SHEI) | 0.2562 | 5 |
| | B1(FI) | 0.2670 | 4 |
| | B1(AI) | 0.2879 | 2 |
| | B1(LDI) | 0.2765 | 3 |

Among them, $A_j$ represents the $j$th index, $A_{\max}$ represents the maximum value of the $j$th index, $A_{\min}$ represents the minimum value of the $j$th index, and $A_{ij}$ represents the standardized value. The proportion of the indicator value is shown in

$$B_{ij} = \frac{B_i}{\sum_{i=1}^{m} B_{ij}}. \tag{17}$$

Calculate indicator weights:

$$W_i = \frac{d_j}{\sum_{j=1}^{n} d_j}. \tag{18}$$

The expert scoring method is to select the best plan by scoring the plan by experts. For AHP, the expert's rating is the importance ordinal data as an evaluation factor, and the relative size is needed. In the subsequent use and evaluation, the final ranking weight value for each evaluation coefficient in the landscape evaluation was obtained, as shown in Table 1.

As shown in Table 1, the weights in the evaluation factors are different, that is, the importance of each factor to the rural landscape is not equal. The top two are diversity index (SHDI) and aggregation index (AI), which are basically consistent with the importance ranking of evaluation factors.

The ecological index has the heaviest weight at the criterion level, which shows that experts believe that a good ecological environment and a harmonious natural background have a greater impact on the landscape. At the same time, it also shows that the landscape not only has an impact on the overall ecological environment of the city but also its own ecological environment makes a contribution to the landscape that should not be underestimated. The fact that the weight value of the factors under the base layer is relatively high reflects people's requirements for a good ecological environment, and the factors of "vegetation coverage" and "landscape plant diversity" reflect the public's requirements for green. This is also an inevitable choice under the background of environmental degradation at this stage. Therefore, in the planning and design of the landscape, the influence of the natural background must not be ignored, and it can provide assistance for the development of the landscape.

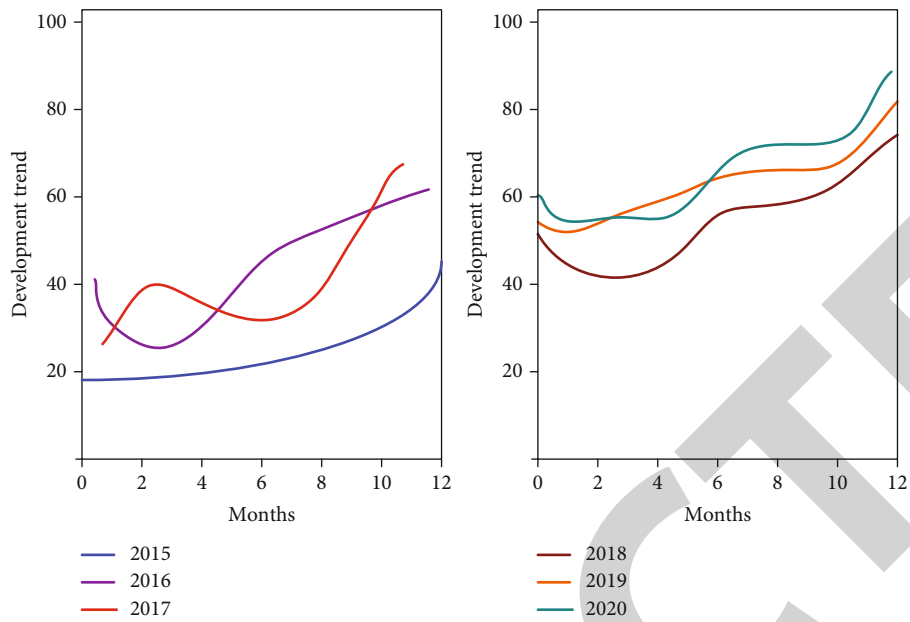


Figure 5: Rural A building planning and landscape development trends from 2015 to 2020.

Table 2: Landscape diversity index table of each street under the classification of green space functions.

| Areas | Area A | Area B | Area C | Area D | Area E |
|---|---|---|---|---|---|
| PR | 8 | 3 | 3 | 5 | 5 |
| PRD | 0.12 | 10.06 | 2.20 | 1.99 | 2.08 |
| SHDI | 1.28 | 1.20 | 1.47 | 1.76 | 1.36 |
| SHEI | 0.60 | 0.83 | 0.80 | 0.75 | 0.71 |
| D | 1.31 | 0.60 | 0.64 | 1.03 | 1.22 |

## 4. Rural Architectural Planning and Landscape Optimization Experiment

*4.1. Landscape Diversity in Rural A.* In order to make the landscape fully play its function, maintain the balance of rural ecology, and create a beautiful rural landscape, rural buildings such as the number and spatial distribution pattern of the matrix environment need to be optimized to become a healthy resting place for rural residents.

In order to better plan the rural buildings and give optimization suggestions after a comprehensive evaluation of the landscape, this paper selects village A as the experimental object. The village is vigorously developing architectural planning and landscape. In recent years, the village's investment in architecture and landscape is shown in Figure 5.

As shown in Figure 5, from a geographical point of view, villages generally have the following characteristics: the use of rural land is extensive, and the use of agriculture and forestry is its unique feature. Small- and low-level settlements profoundly reveal the relationship between the building and its surroundings, which have an important relationship with the expansive landscape.

As the organic composition of rural landscape, with the improvement of urbanization level, the rural lifestyle has changed a lot, and the rural regional space has undergone dynamic changes, generally showing a shrinking trend. The landscape diversity index of each street under the green space function classification is shown in Table 2.

As shown in Table 2, in the green space system classified by green space function, the landscape abundance of street A is 8, the landscape abundance density is 0.12, the Shannon diversity index is 1.28, and the Shannon uniformity is 0.60. The landscape diversity of street B and street C is not very high, but the distribution of green space is relatively uniform. From the statistical data, the landscape diversity of the six streets is not very high, indicating that although the types of green space in the village are complete, the distribution of various types of green space is uneven. Street D has the highest green landscape diversity index, which is mainly due to the relatively uniform distribution of green landscape types in street D. The area distribution of each type of street E is relatively uniform, and the landscape diversity index is medium. It is concluded that the village has a lot of green space, and the possibility of improving the landscape diversity index is high.

*4.2. Landscape Dominance and Uniformity.* In order to verify the comprehensiveness of the evaluation of the tomographic analysis method, this paper then analyzes the landscape dominance and uniformity, as shown in Figure 6.

As shown in Figure 6, in the green space system classified by green space function, the street E landscape dominance degree is relatively small, which is 1.54, indicating that the street E landscape type composition and area distribution are relatively uniform. Among the five streets, street A has the largest dominance index, reaching 2.35, which is mainly because more than 90% of the green spaces in street A are other green spaces. Both street B and street C are controlled by the park landscape to varying degrees, so the

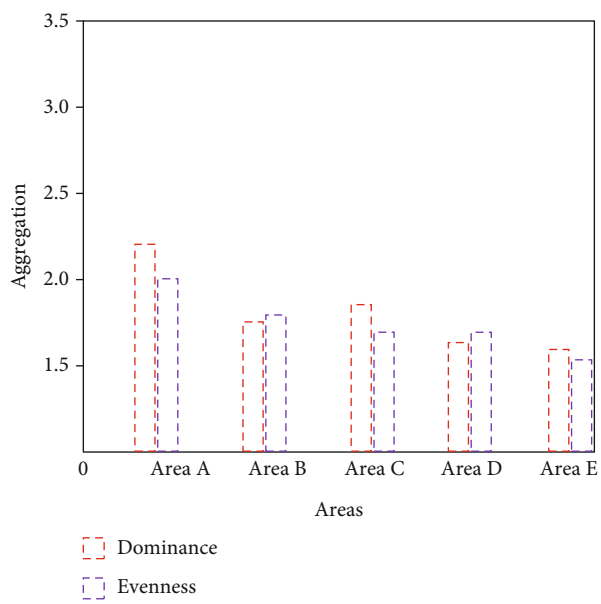


Figure 6: Comparison of dominance index and Shannon evenness index under each street green space function classification.

dominance index is higher. Street D has less green space, and the distribution of green space is relatively uniform, with the lowest degree of dominance.

The evenness index of street A landscape is 0.87. The uniformity comparison of each street landscape is street A, street B, street C, street D, and street E. Xiangjie A has the largest landscape uniformity index, which is consistent with the diversity index analysis. Although there are 6 types of green space in street E, the area of other green space accounts for 92.91%, and the uniformity is the smallest.

The comparison of landscape fragmentation index of different green space types in each street is in order of small green space, medium green space, medium and large green space, and large green space. The analysis results of the fragmentation degree of different streetscapes are basically consistent with the classification analysis results by green space function, as shown in Table 3.

As shown in Table 3, in the urban green space system classified by the scale of green space, the fragmentation degree of small green space in street A is 57.37. The fragmentation index of small- and medium-sized landscapes in the four types of green spaces is the largest. This is because there are no green patches and other green patches in the small green spaces, and the total area is small. It is mainly composed of small, large, and scattered residential green spaces, some road green spaces, and other auxiliary green spaces. The total area of medium-sized green space ranks third among the four types of green space, but the number of green space patches is relatively large, so the degree of fragmentation is also higher. The total area of medium and large green space ranks second, but the number of patches is less, and the landscape fragmentation index is smaller. The extralarge green space is mainly composed of other auxiliary green space patches and road green space patches with large area, large park green space, and more than 99% of

Table 3: Street landscape fragmentation index table under the classification of green space functions.

| Areas | Area A | Area B | Area C | Area D | Area E |
|---|---|---|---|---|---|
| Small | 57.37 | 55.41 | 53.00 | 56.65 | 55.81 |
| Medium | 10.19 | 10.18 | 10.02 | 10.42 | 10.03 |
| Medium and large | 2.83 | 3.88 | 2.75 | 3.02 | 3.07 |
| Large | 0.23 | 0.64 | 0.68 | 0.34 | 0.27 |

production green space and other green space. In addition, it also contains a certain amount of protective green space, with a large area and the least number of patches, so the landscape fragmentation index is the smallest.

Small-scale green spaces are characterized by large numbers, high density, and concentrated large-scale green spaces in various streets. The analysis results of the aggregation degree of different streetscapes are completely consistent with the classification analysis results of green space functions, as shown in Figure 7.

As shown in Figure 7, in the landscape classified by the scale of green space, the overall aggregation degree of street A green space is higher, which is 91.03. Among the four types of green space, the aggregation degree of small green space is the lowest, which is mainly caused by the large number and wide distribution of small green space patches. The agglomeration index of medium-sized green space and medium-large green space is relatively high, but still lower than the total green space agglomeration index of the study area. Due to the large area, small number of patches, and concentrated distribution of large-scale green patches, the aggregation index is the highest, which is higher than the overall level of the study area, indicating that large-scale green patches dominate the landscape and play a controlling role. In the comparison of the aggregation degree of different types of green space in each street, the aggregation degree of the four types of green space in each street is large green space, medium and large green space, medium green space, and small green space.

*4.3. Landscape Overall Evaluation Results and Optimization Countermeasures.* This paper conducted a survey of 100 people in the street and analyzed their satisfaction with the current building and landscape, as shown in Figure 8.

As shown in Figure 8, users (the public) are not satisfied with the greenway content covered by these factors. The satisfaction of seasonal changes is very low, which reflects that the seasonal changes of the plant landscape of Guangzhou greenway are not obvious and cannot reflect the seasonal changes well. The low satisfaction with the explanation and indication facilities indicates that the current greenway guidance is problematic, and there are problems such as the inability to accurately reach the destination and the unreasonable setting of relevant facilities in use. The low satisfaction of landscape space creation shows that the introduction of landscape design elements in the current greenway is not enough, especially the low utilization rate of garden design techniques. At the same time, it reflects the unreasonable

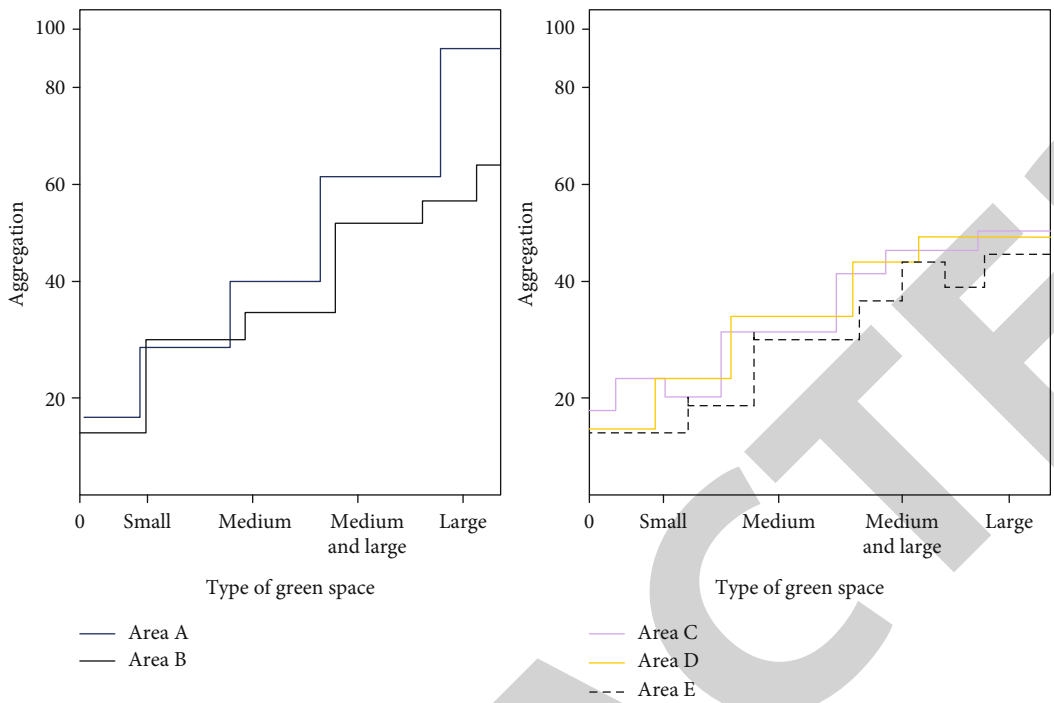


Figure 7: The aggregation index table of each street landscape under the classification of green space functions.

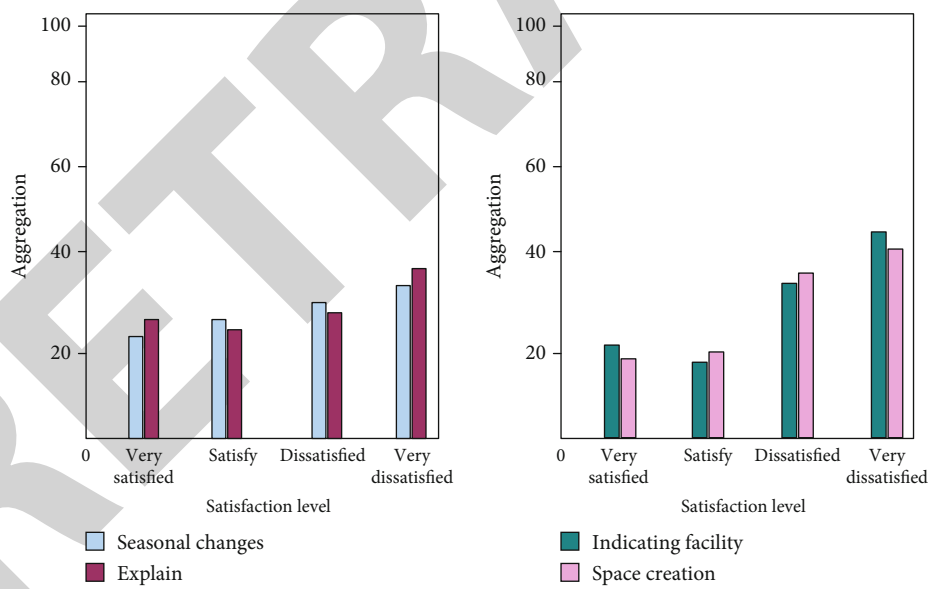


Figure 8: Satisfaction survey of 100 people.

and ineffective configuration of landscape plants, an important medium for the shaping of landscape space.

The satisfaction of factors such as the use of native tree species and the connectivity of greenways is only at the "general" level, which indicates that the current utilization rate of native tree species in greenways is low. It also indirectly leads to the inconspicuous regional characteristics of the landscape and serious homogeneity. The traffic connection of greenway is inconvenient, which reduces the frequency and satisfaction of users.

In view of the above problems, it is suggested to improve and improve from the following aspects.

(1) *Sort Out Blind Spots and Carry Out Key Construction*. The greenway sections that were originally roughly built due to construction period and funding

reasons were renovated and upgraded. For those with better original natural conditions, it is necessary to do a good job in the finishing of the landscape. In particular, it is necessary to build infrastructure, improve the functions of greenways, and lay out the attention points such as recreational facilities, traffic accessibility connections, street lights, slope protection, and safety patrols. For the areas with poor self-conditions and insignificant geographical location, at least the street trees should keep up with greening, there should be some shade, and basic safety and sanitation and guidance facilities should be done well. For those with poor congenital conditions, but there are many surrounding landscape resource points that need to be collected and connected here, it can focus on building new landscapes from the aspects of viewing, function, ecology and culture.

(2) *Build a Reasonable Ratio of Trees, Shrubs, and Grasses and the Structure of Landscape Plant Community*. Native plants can be added. In the vertical structure, the species and quantity of plants in the shrub layer and ground cover layer can be appropriately increased. In particular, more flowers and shrubs should be used, and when flowers are reasonably matched, trees, flowers, and local quilts should be used to create a multilevel composite plant landscape. In the selection of tree species, more native tree species with high ornamental value should be used, and native tree species and imported plants should be fully combined and used in combination, and landscape plant communities with more local characteristics, beautiful scenery, and reasonable functions should be configured.

## 5. Conclusion

The purpose of landscape evaluation is to grasp the actual situation of landscape resources as a whole, which provides a comprehensive scientific basis for architectural planning and landscape optimization. For rural landscape evaluation, it is conducive to scientific planning of rural landscape and rational use and effective protection of rural landscape resources. It provides scientific guidance for the formulation of national policies and regulations on rural areas, which is an important basic link in the development of rural construction. Therefore, in order to understand whether the current rural architectural planning and landscape optimization are feasible, this paper applies the analytic hierarchy process to evaluate it. After evaluation, it is found that in the current rural architectural planning and landscape optimization, the diversity score of landscape is not high. Therefore, in order to improve the overall function of rural architectural planning and landscape, this paper gives corresponding solutions in the experiment. In the experimental part, this paper conducts an experiment on village A, and the five streets do not score very high in terms of landscape agglomeration, advantage, and diversity. Therefore, in the construction of rural areas, we should focus on these aspects to achieve sustainable rural development. Due to the limited professional knowledge of the author, there are still many problems in the text. It will continue to study and achieve better results in the future work.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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*Retraction*

# Retracted: Occupational Health Development and Safety Management of Enterprise Employees Based on the Perspective of Sustainable Environment

**Journal of Environmental and Public Health**

Received 3 October 2023; Accepted 3 October 2023; Published 4 October 2023



This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Q. Chen, H. Li, and X. Pan, "Occupational Health Development and Safety Management of Enterprise Employees Based on the Perspective of Sustainable Environment," *Journal of Environmental and Public Health*, vol. 2022, Article ID 3792356, 10 pages, 2022.

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*Research Article*

# Occupational Health Development and Safety Management of Enterprise Employees Based on the Perspective of Sustainable Environment

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In recent years, the economy of enterprises has developed rapidly. Most enterprises focus on economic interests and ignore the occupational health of employees, resulting in an increase in the occupational morbidity rate of employees. Occupational insecurity of corporate employees will reduce the work efficiency of employees. In turn, it will affect the economic development of the enterprise. Paying attention to the occupational health and safety development of corporate employees is a necessary measure for corporate economic development. The main reasons that endanger the occupational health of employees are the unreasonable discharge of pollutants and the substandard treatment of pollutants. The sustainable environmental strategy of enterprise development can well control the risk factors that endanger the occupation of enterprise employees, and it is conducive to the health and safety development of enterprise employees and enterprises. This paper studied the impact of sustainable environmental factors on the occupational health and safety development of enterprise employees through the fuzzy analytic hierarchy process and analyzed the impact on the occupation of enterprise employees according to the larger influencing factors. The experimental results showed that heavy metal wastewater, dust, hydrogen sulfide gas, and high-temperature radiation are the four most weighted impact indicators. Different concentrations of these four indicators are tested; when the concentration value of these impact indicators is low, it has little impact on the occupational safety and development of enterprise employees. However, when the concentration increases, the occupational safety and development of enterprise employees are seriously reduced. When the safety is the lowest, it is only 20%, and the development is only 23%. Carrying out sustainable environmental development can reduce the discharge of industrial waste; hence, while protecting the environment, the occupational health and safety and development potential of employees can be improved.



## 1. Introduction

Under the influence of the Industrial Revolution, human production and life have developed rapidly, and industrialized industries have brought people a lot of convenience. Early enterprises did not pay attention to the protection of the environment in the production process, which led to the random discharge of pollutants from the enterprise. And the employees of the enterprise would inevitably inhale the pollutants discharged by the enterprise, causing serious bodily harm to them. In recent decades, the excessive exploitation of natural resources by enterprises has forced the employees of enterprises to overwork, which has seriously affected the occupational safety of employees. Even in some enterprises, the excessive mining of radioactive elements has damaged the environment and caused irreparable harm to employees. There are serious problems in the occupation of enterprise employees. Only by following the sustainable development strategy can the enterprise develop the occupational health and safety of enterprise employees. By analyzing which factors from the perspective of sustainable environment have an impact on the occupational

health and safety management of employees, different measures can be implemented according to different situations of the enterprise to ensure the occupational health and safety development of enterprise employees. Therefore, this paper has research significance.

There are many dangerous problems in the occupation of enterprise employees. The relevant researchers have analyzed the occupational health development and safety management of enterprise employees. Among them, Evangelinos et al. analyzed the occupational safety issues of employees in 50 large enterprises. The employee injury rate of enterprises that implement the occupational health development and safety management strategy of enterprise employees will be relatively lower, which is conducive to the career development of the company's employees [1]. Almost et al. found that by establishing a safety management system for the occupational health and development of employees, the company's annual investment in employee injuries was greatly reduced [2]. Fagbe et al. pointed out that the occupational health development and safety management of enterprise employees can reduce the risk of employee injury and improve the economic benefits of enterprises [3]. Mouras and Badri showed that, in some industrial enterprises, occupational health development and safety management is very necessary, which can effectively protect the safety of enterprise employees [4]. Skad used the method of fuzzy analysis to improve the effectiveness of occupational health development and safety management of enterprise employees [5]. The application of occupational health development and safety management can effectively reduce the probability of employee injury and improve employee occupational safety, but there is a lack of in-depth research on specific directions.

The natural environment affects the occupational safety development of enterprise employees, and the occupational health development and safety management of enterprise employees in a sustainable environment is studied. Among them, Marzaleh et al. pointed out that the development of sustainable environment can improve the occupational safety of enterprise employees [6]. Research of Mohammadfam et al. showed that there is a coupling relationship between the environment and the occupation of enterprise employees, and the occupational healthy development of enterprise employees must rely on a sustainable environment [7]. A sustainable environment can effectively improve the efficiency of the occupational health development of enterprise employees. Jilcha and Kitaw believed that sustainable development to improve environmental issues can help employees to bring more development potential [8]. Sarkheil pointed out that a sustainable environment can provide better safety and development for the career of enterprise employees [9]. Shammi et al. believed that by reducing the discharge of industrial waste liquid and adhering to the principle of sustainable environment, the occupational health and safety development of employees can be improved [10]. Although a sustainable environment can improve the occupational health and safety development of employees, there is a lack of evaluation methods to qualitatively or quantitatively analyze the occupational health and safety management of employees in a sustainable environment.

Sustainable environmental development and occupational health and safety management of employees are related to each other. The factors that affect the occupational health and safety development of enterprise employees are analyzed. Corresponding measures are taken to improve the efficiency of occupational health and safety development of employees in the enterprise according to the relevant factors analyzed [11]. The innovation point of this paper is as follows: using fuzzy analytic hierarchy process to analyze the related factors of sustainable environment and occupational health development and safety management of enterprise employees.

## 2. Methods of Relevance Evaluation of Occupational Health Development

In the current enterprise form, enterprises should not only focus on improving the economic benefits of the enterprise but also pay more attention to the employees of the enterprise. The competition between enterprises is actually the competition among the employees of the enterprise and the competition of the positions of the enterprise. In the process of development, the enterprise can effectively improve the comprehensive ability of the enterprise by carrying out the healthy development and safety management of the occupation of the enterprise employees [12]. The sustainable environmental policy is a strategy to effectively reduce the pollutant discharge of the enterprise. It can effectively affect the occupational health development and safety management of employees [13]. The evaluation and analysis of indicators for the occupational health development and safety management of enterprise employees from the perspective of sustainable environment can effectively improve the occupational safety of enterprise employees. From the perspective of sustainable environment, the occupational health development and safety management structure of enterprise employees is shown in Figure 1.

It can be seen from Figure 1 that the sustainable environment and the occupational health development and safety management of employees of the enterprise work together and develop together. Therefore, it is very important to analyze the occupational health development and safety management of enterprise employees from the perspective of sustainable environment. Common evaluation and analysis methods include AHP, percentile analysis, fuzzy analysis, and fuzzy AHP [14].

*2.1. Analytic Hierarchy Process.* Analytic hierarchy process (AHP) is a qualitative and quantitative analysis method for complex model problems, which can be well applied to the occupational health development and safety management of enterprise employees from the perspective of sustainable environment [15]. It mainly decomposes complex problems, compares the decomposed indicators with mathematical methods, determines the weight of the indicators, and then realizes the quantitative analysis of multiple indicators of the research system. The structural model of AHP is shown in Figure 2.

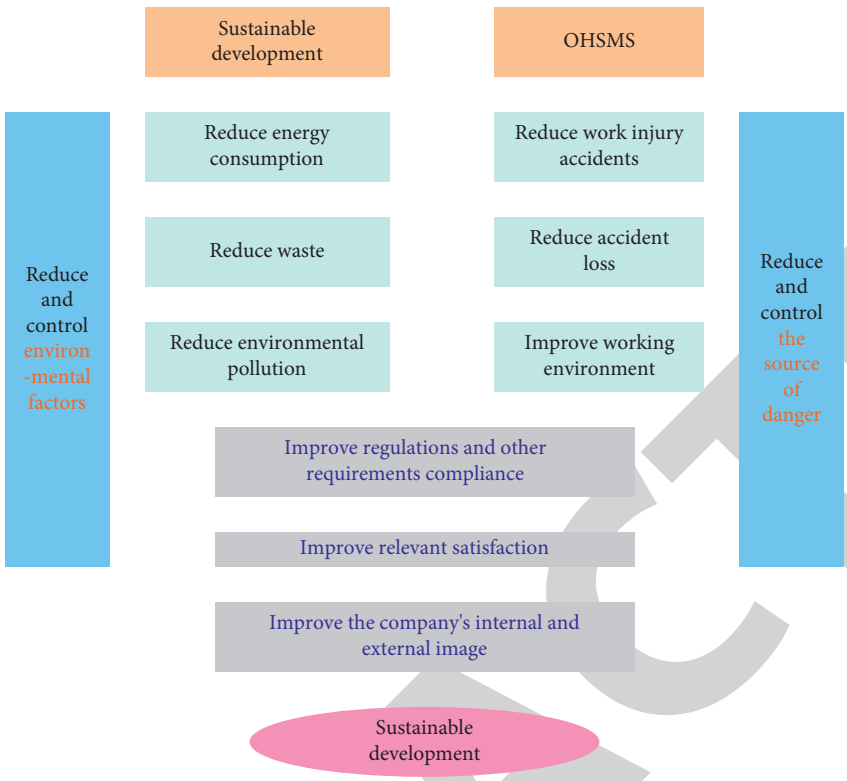


Figure 1: Structure diagram of occupational health development and safety management of enterprise employees.

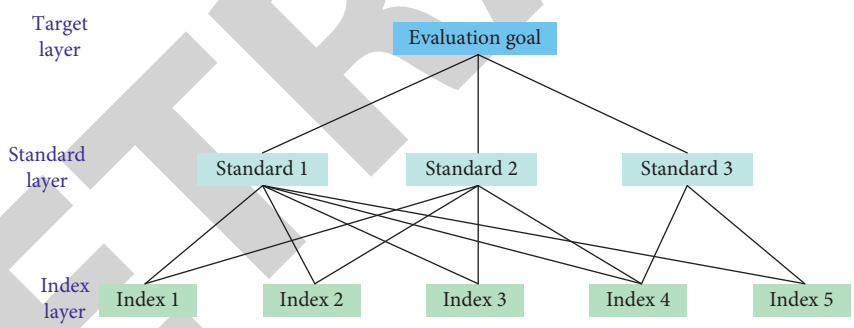


Figure 2: AHP structure model diagram.

The general steps of AHP are as follows: decomposing the analysis system according to the level, testing the validity of each level and the overall analysis data, and analyzing the weight of each index. The first layer of the analytic hierarchy process is the goal to be achieved by the system. In this paper, it is the occupational health development and safety management of enterprise employees. The second layer is the preliminary analysis of the goal, and the third layer is the specific analysis of the goal. There is a subordinate relationship between layers, and the indicators between layers are independent of each other [16].

The analysis of AHP usually requires the help of judgment matrix. The judgment matrix is a method for weight analysis of each index in the index layer, and it is a way of quantitative analysis. The process of using the judgment matrix in AHP is as follows:

Let there be $n$ indicators $S = \{s_1, s_2, \ldots, s_n\}$, taking the influence of any two indicators $s_i$ and $s_j$ on the target, and using element $k_{ij}$ in the matrix to represent the ratio between the two indicators. Therefore, the judgment matrix can be expressed as follows:

$$K = \left(k_{ij}\right)_{n\times n}. \tag{1}$$

Here, $k_{ij}$ represents the influence ratio of the $i$th indicator and the $j$th indicator.

Then, in turn, the ratio of the influence of the $j$th indicator to the $i$th indicator is as follows:

$$k_{ji} = \frac{1}{k_{ij}}. \tag{2}$$

The setting of the median value of the judgment matrix is the analysis basis of the judgment matrix. And the setting

Table 1: Interpretation table of the meaning of judgment matrix.

| Score | Influence relationship | Degree |
|---|---|---|
| 1 | Indicator 1 = Indicator 2 | degree 0 |
| 2 | Indicator 1 > Indicator 2 | degree 1 |
| 3 | Indicator 1 > Indicator 2 | degree 2 |
| 4 | Indicator 1 > Indicator 2 | degree 3 |
| 5 | Indicator 1 > Indicator 2 | degree 4 |
| 6 | Indicator 1 > Indicator 2 | degree 5 |
| 7 | Indicator 1 > Indicator 2 | degree 6 |
| 8 | Indicator 1 > Indicator 2 | degree 7 |
| 9 | Indicator 1 > Indicator 2 | degree 8 |
| Reciprocal | Indicator 1 < Indicator 2 | Corresponding positive degree |

rule of the median value of the judgment matrix is a scoring rule. The meaning of the judgment matrix is shown in Table 1.

The process of validating the judgment matrix is as follows:

The maximum eigenvalue of the judgment matrix needs to be solved, and the solving process is a matrix solving method. The maximum eigenvalue is set to $\mu_{\max}$.

Then, the index of validity test can be expressed as follows:

$$A = \frac{\mu_{\max} - n}{n - 1}. \tag{3}$$

Here, $n$ represents the total number of indicators.

Find the corresponding effectiveness index:

$$B = \frac{\mu_{\max}' - n}{n - 1}. \tag{4}$$

Here, $\mu_{\max}'$ is the average maximum eigenvalue of the judgment matrix.

Then, the validity ratio of the judgment matrix can be expressed as follows:

$$R = \frac{A}{B}. \tag{5}$$

When $R$ is less than 0.1, the judgment matrix is considered to be valid; on the contrary, the judgment matrix is invalid.

The calculation of the weight of each index adopts the arithmetic mean solution method, that is, the arithmetic mean of each column vector in the judgment matrix represents the weight of the index. The formula is expressed as follows:

$$v_i = \frac{k_{i1} + k_{i2} + \cdots + k_{in}}{n}. \tag{6}$$

Here, $v_i$ represents the weight of the $i$th index.

AHP is widely used in analyzing, evaluating, and predicting the target system under study due to its advantages of simple design and quantitative analysis.

*2.2. Percentile Analysis.* It is a scoring mode based on the initial value of the index and the weight of the index, and the impact on the occupational health development and safety management of the employees of the enterprise is reflected through the score. The higher the score, the greater the impact of this indicator on the occupational health development and safety management of employees. The evaluation process of the percentile analysis method is as follows:

Let the decision-making set be $B = \{b_1, b_2, \ldots, b_m\}$, the indicator set be $C = \{c_1, c_2, \ldots, c_m\}$, the judge set be $R = \{r_1, r_2, \ldots, r_h\}$, and the score of the judge $i$ to the index $j$ be $s_{ij}$.

Then, the average score for indicator $j$ is as follows:

$$\bar{s}_j = \frac{1}{h} \sum_{i=1}^{h} s_{ij}. \tag{7}$$

Here, $h$ represents the total number of judges.

The scoring deviation for metric $j$ is as follows:

$$e_{ij} = \left| s_{ij} - \bar{s}_j \right|. \tag{8}$$

Here, the smaller the value of $e$, the more accurate the evaluation.

Standardize on scoring bias:

$$g\left(e_{ij}\right) = \frac{e_{ij} - \min e_{ij}}{\max e_{ij} - \min e_{ij}}. \tag{9}$$

Then, the objective score of the judge can be expressed as follows:

$$M = \sum_{i=1}^{m} g\left(e_{ij}\right). \tag{10}$$

Let the judge's fairness be $N$.

Then, the criteria of the judges for the indicators are as follows:

$$L = \frac{1}{2} M + \frac{1}{2} N. \tag{11}$$

Then, the weight parameter of the score can be expressed as follows:

$$W = 1 - \frac{L}{\sum_i^h L_h}. \tag{12}$$

The percentile analysis method is a process of using judges to analyze qualitatively and then to score and evaluate each index according to the corresponding weight of the index. This method is simple to operate, but the subjective opinions of the judges of this method can interfere with the scoring results [17].

*2.3. Fuzzy Analysis.* Fuzzy is a commonly used analysis method, and statistical analysis of data using fuzzy allows causal analysis of conditions and targets fuzzy theory is developed on the basis of discrete mathematics, which is uncertain and extensive. Because fuzzy theory does not require precise analysis of the object under study, it is widely used. It is often used in sustainable environmental development, occupational health development of enterprise employees, and natural language processing. It can very well

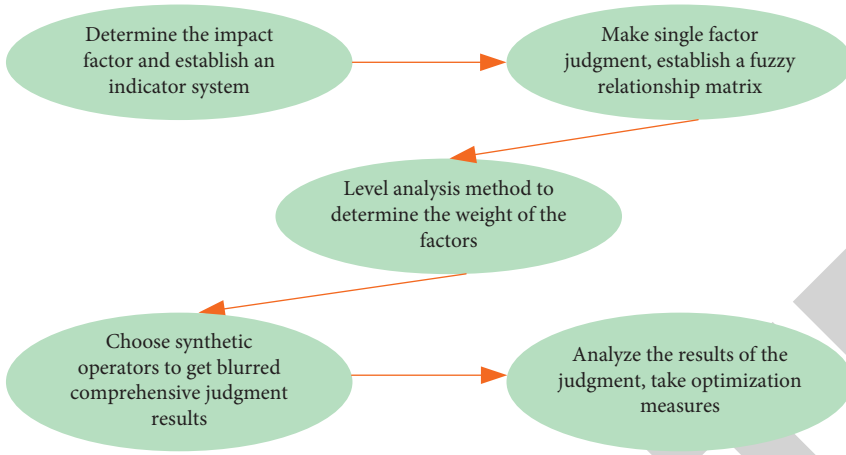


Figure 3: Fuzzy analysis structure diagram.

analyze the occupational health development and safety management issues of enterprise employees in a sustainable environment. The structure of fuzzy analysis is shown in Figure 3.

As can be seen from Figure 3, the general process of fuzzy analysis is as follows: determining the impact index, establishing the fuzzy matrix, analyzing the weight, obtaining the fuzzy judgment result, and optimizing the judgment result. Fuzzy theory is used in conjunction with AHP, using fuzzy analysis index factors to calculate the weight of judgment index through AHP [18].

*2.4. Fuzzy AHP.* Fuzzy AHP is to add fuzzy characteristics on the basis of AHP. The indicators that affect the occupational health development and safety management of enterprise employees are analyzed through fuzzy AHP. The structure model of fuzzy AHP is shown in Figure 4.

The analysis process of fuzzy AHP is as follows: determining the index, analyzing the index weight according to the judgment matrix, and analyzing the fuzzy decision-making [19].

There are $m$ indicators $A = \{a_1, a_2, \ldots, a_m\}$, the evaluation level of the indicators is $B = \{b_1, b_2, \ldots, b_n\}$, and the weight set of each indicator is $W = \{w_1, w_2, \ldots, w_m\}$.

$$\sum_{i=1}^{m} w_i = 1. \tag{13}$$

The membership degree of the impact index and the studied system is analyzed, so the membership degree of the index constitutes a fuzzy judgment matrix, and the fuzzy judgment matrix is expressed as follows:

$$H = \begin{bmatrix} h_{11} & h_{12} & \cdots & h_{1m} \\ h_{21} & h_{22} & \cdots & h_{2m} \\ \cdots & \cdots & \cdots & \\ h_{n1} & h_{n2} & \cdots & h_{nm} \end{bmatrix}. \tag{14}$$

Burring the judgment level, let the decision-making level be C.

$$C = W \times H, \tag{15}$$

$$C = (c_1, c_2, \ldots, c_n). \tag{16}$$

Here, $c_n$ represents the weight of the $n$th index.

## 3. Experimental Design of Occupational Health and Safety Development of Enterprise Employees

*3.1. Experimental Data.* In order to analyze the relevant factors of occupational health development and safety management of enterprise employees from the perspective of sustainable environment, 500 enterprise employees in 50 enterprises were randomly investigated. And the causes of occupational diseases of enterprise employees were investigated without the employees' knowledge [20]. The causes of occupational diseases of enterprise employees are shown in Figure 5.

In Figure 5, the causes of occupational injuries of enterprise employees are mainly divided into four aspects: industrial wastewater, industrial waste, industrial waste gas, and industrial radiation. Through a questionnaire survey of environmental protection experts and occupational disease-attending physicians, the detailed reasons for occupational hazards of enterprise employees can be concluded [21]. The detailed occupational hazards of enterprise employees are shown in Table 2.

*3.2. Experimental Design.* The experiment will use the fuzzy analytic hierarchy process to analyze the indicators that affect the occupational health of enterprise employees in a sustainable environment [22, 23]. Then, a judgment matrix is constructed to analyze the impact weight of each index on the occupational health development and safety management of employees. Among them, the hazard type is represented by Y, and the hazard index is represented by X. The occupational health and safety development of enterprise employees with the largest weight among the four impact aspects is analyzed [24]. The judgment matrix of industrial

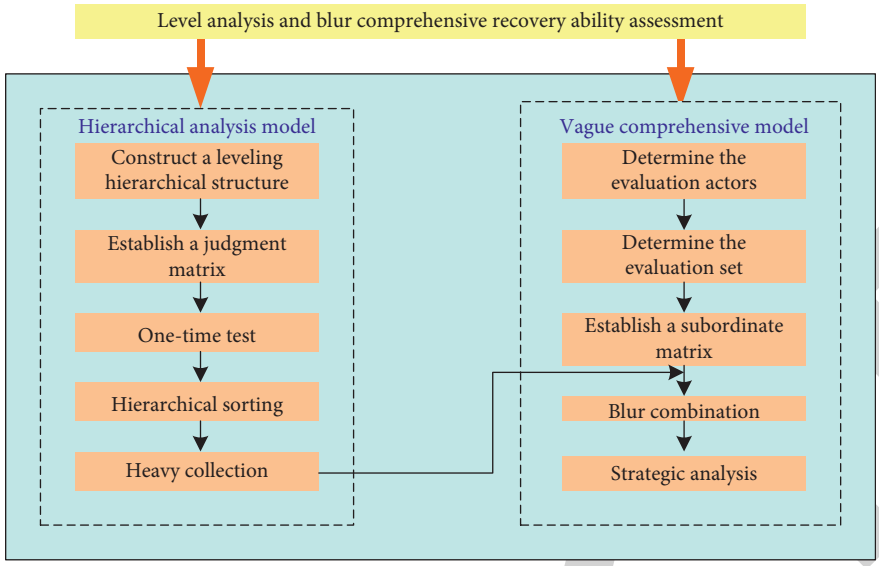


Figure 4: Structure model diagram of fuzzy AHP.

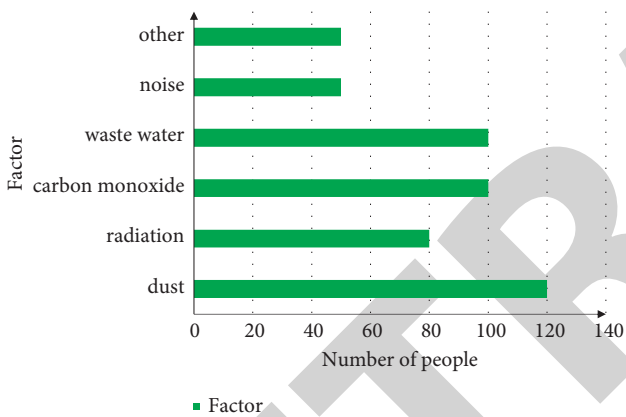


Figure 5: Causes of occupational diseases of employees in enterprises.

Table 2: Detailed table of the occupation hazards of enterprise employees.

| Hazardous objects | Hazard type | Hazard indicator |
|---|---|---|
| Occupational health development of enterprise employees | Industrial wastewater | Heavy metal wastewater |
| | | Mercury wastewater |
| | | Sulfuric acid wastewater |
| | | Lead-containing wastewater |
| | Industrial waste | Dust |
| | | Cinder |
| | | Waste plastic |
| | | Rubber waste |
| | Industry exhaust | Carbon monoxide |
| | | Carbon dioxide |
| | | Hydrogen sulfide |
| | | Sulfur monoxide |
| | Industrial radiation | High-temperature radiation |
| | | Infrared radiation |
| | | Microwave radiation |
| | | UV radiation |

wastewater and industrial waste impact indicators is shown in Table 3.

Performing an arithmetic mean solution on each column vector in Table 3, the relative weight of each index is obtained. The judgment matrix in Table 3 is tested for validity. The test result is as follows:

$$R = \frac{A}{B} = \frac{0.135}{1.41} = 0.096. \tag{17}$$

Because the obtained test result is less than 0.1, the judgment matrix of the impact indicators of industrial wastewater and industrial waste is effective. Similarly, the validity of the judgment matrix of industrial waste gas and industrial radiation and the weight of each index can be obtained. The weight results of all indicators are shown in Table 4.

In Table 4, the weights of the four types of criterion layers are 0.3, 0.25, 0.25, and 0.2, respectively. The indicators with the largest weights in each criterion layer are heavy metal wastewater, dust, hydrogen sulfide, and high-temperature radiation. Therefore, the experiment will analyze these four impact indicators for large enterprises and small enterprises, mainly by analyzing the change trend of the occupational safety of enterprise employees and the career development potential of enterprise employees when the gradient of the indicators changes [25].

## 4. Results and Discussion of the Impact of Indicators on the Occupation of Employees

*4.1. Influence of Heavy Metal Wastewater.* The discharge of heavy metal wastewater is the result of improper treatment of industrial wastewater by enterprises. Heavy metal wastewater contains substances that are harmful to human body. Long-term exposure to heavy metal wastewater environment is very harmful to people [26]. Figure 6 shows the effect of the content of heavy metal wastewater with different

Table 3: Judgment matrix of impact indicators.

| Y1 and Y2 | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 |
|---|---|---|---|---|---|---|---|---|
| X1 | 1 | 1/5 | 1/2 | 1 | 1/2 | 2 | 4 | 5 |
| X2 | 5 | 1 | 2 | 5 | 3 | 4 | 1/2 | 3 |
| X3 | 2 | 1/2 | 1 | 2 | 1/5 | 6 | 3 | 1/2 |
| X4 | 1 | 1/5 | 1/2 | 1 | 1/3 | 1 | 1/4 | 4 |
| X5 | 2 | 1/3 | 5 | 3 | 1 | 2 | 1/5 | 1/3 |
| X6 | 1/2 | 1/4 | 1/6 | 1 | 1/2 | 1 | 4 | 2 |
| X7 | 1/4 | 2 | 1/3 | 4 | 5 | 1/4 | 1 | 1/5 |
| X8 | 1/5 | 1/3 | 2 | 1/4 | 3 | 1/2 | 5 | 1 |

Table 4: Weighting result table of each indicator.

| Criterion layer | Indicator layer | Weights |
|---|---|---|
| Industrial wastewater | Heavy metal wastewater | 0.12 |
| | Mercury wastewater | 0.04 |
| | Sulfuric acid wastewater | 0.08 |
| | Lead-containing wastewater | 0.06 |
| Industrial waste | Dust | 0.09 |
| | Cinder | 0.05 |
| | Waste plastic | 0.05 |
| | Rubber waste | 0.06 |
| Industry exhaust | Carbon monoxide | 0.06 |
| | Carbon dioxide | 0.05 |
| | Hydrogen sulfide | 0.08 |
| | Sulfur monoxide | 0.06 |
| Industrial radiation | High-temperature radiation | 0.06 |
| | Infrared radiation | 0.05 |
| | Microwave radiation | 0.05 |
| | UV radiation | 0.04 |

gradients on both large- and small-scale enterprise employees.

In Figure 6, when the concentration of heavy metal wastewater is less than 0.05 mg/L, the occupational safety and development of employees in mass-scale enterprises have a high level, and when the concentration of heavy metal wastewater is greater than 0.05 mg/L, the safety and development of this method are severely limited [27]. When the concentration of heavy metals is 0.10 mg/L, the occupational safety of employees in the two companies is 32% and 38%, respectively. The career development potential is 21% and 30%, respectively. Therefore, sustainable environmental strategies should be adhered to, so that the discharge of wastewater can effectively improve the occupational safety and development of employees.

*4.2. Influence of Dust.* Dust is a substance that is easily produced in industrial production and is harmful to human body. When the concentration of dust reaches a certain amount, it is very easy to cause employees to suffer from tuberculosis and other diseases. The concentration of dust with different gradients is set, and the effect of different concentrations of dust on both large- and small-scale enterprise employees is shown in Figure 7.

In Figure 7, when the dust concentration is below 4 mg/m$^3$, the occupational safety and development of employees of the enterprise can reach a level of more than 70%, whether it is a large or a small enterprise. However, when the dust concentration is greater than 4 mg/m3, the occupational safety and development of the employees of the enterprise are seriously threatened. The occupational safety and development of employees in the two types of enterprises drop sharply, reaching the lowest when the dust concentration is 7 mg/m3. The average enterprise security for both sizes is only 36%, and the average career development force is 35%. Reducing the generation of dust in a sustainable environment can effectively improve the occupational health development and safety management of enterprise employees [28].

*4.3. Influence of Hydrogen Sulfide Gas.* In chemical enterprises, the generation of toxic gases is very common. Although there are professional protective measures, the harm of toxic gases to enterprise employees cannot be avoided. Among them, hydrogen sulfide is a common enterprise hazardous gas. Detecting the concentration of hydrogen sulfide gas in different enterprises, the influence of the concentration of hydrogen sulfide gas on both large- and small-scale enterprise employees is shown in Figure 8.

In Figure 8, the turning point of the change in employee occupational safety and development is when the concentration of hydrogen sulfide gas is 4.6 ppm. When the concentration of hydrogen sulfide gas is less than 4.6 ppm, the hydrogen sulfide gas does not cause harm to the human body or the harm caused is not high. The occupational safety of employees of both large- and small-scale enterprises can reach more than 70%, and the development power of employee enterprises can also reach more than 60%; however, when the concentration of hydrogen sulfide gas is greater than 4.6 ppm, the occupational safety and development ability of employees in both enterprises plummet, which has threatened the health of employees. The minimum average occupational safety is 16.5%, and the average enterprise development power is 30%. Reducing the generation of toxic gases such as hydrogen sulfide in the perspective of sustainable environment can effectively protect the occupation of enterprise employees.

*4.4. Influence of High-Temperature Radiation.* High-temperature radiation is a common problem in the industrial production of enterprises. The detection of high-temperature radiation duration is carried out on both large- and small-scale enterprises. The results of the impact of high-temperature radiation on the occupation of enterprise employees under different durations of high-temperature radiation are shown in Figure 9.

In Figure 9, when the employees of the enterprise are protected by professional protective clothing, the impact of high-temperature radiation on the employees of the enterprise for 2 consecutive hours is not very large. At this time, the average occupational safety of employees in both the enterprises is 68%, and the average employee career development ability is 72%. When the duration of high-temperature radiation exceeds 2 hours, it will pose a serious

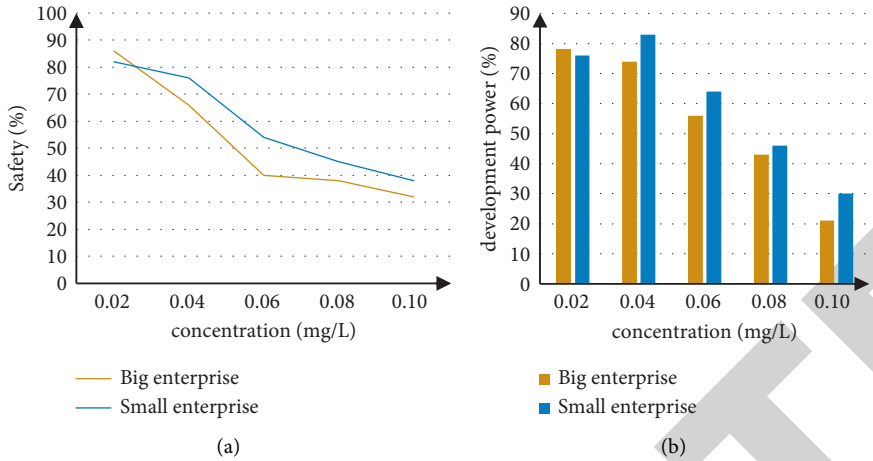


Figure 6: Impact of heavy metal wastewater: (a) occupational safety and (b) occupational development potential

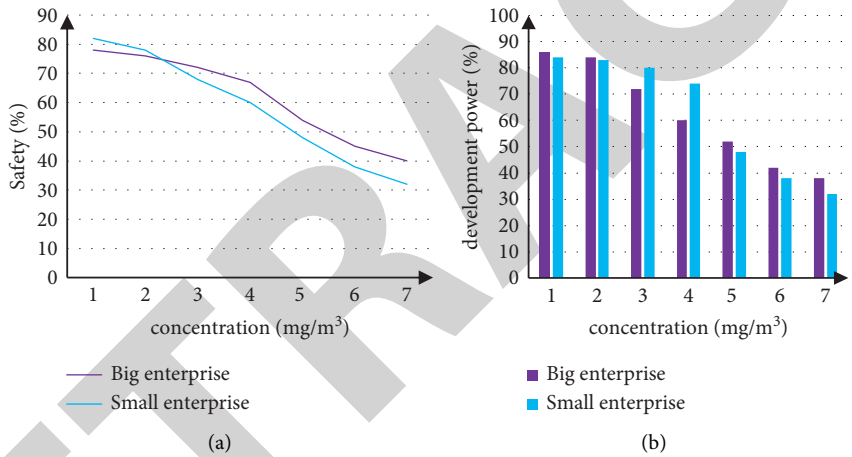


Figure 7: Dust effect: (a) occupational safety and (b) occupational development potential

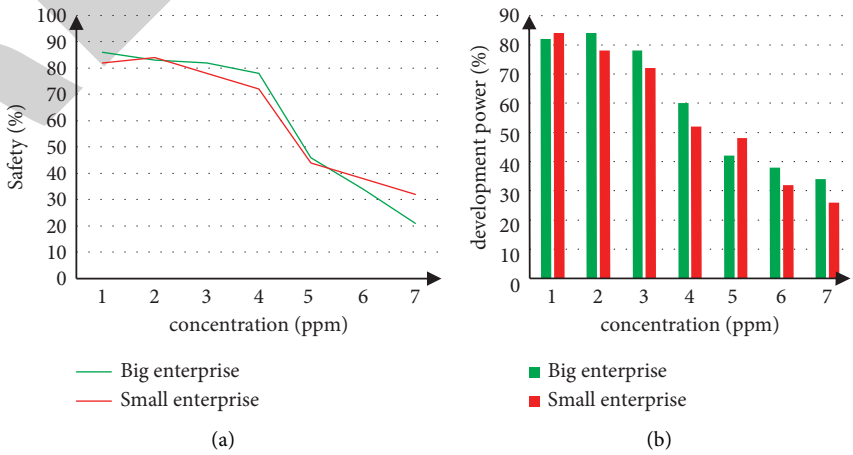


Figure 8: Influence of hydrogen sulfide gas: (a) occupational safety and (b) occupational development potential

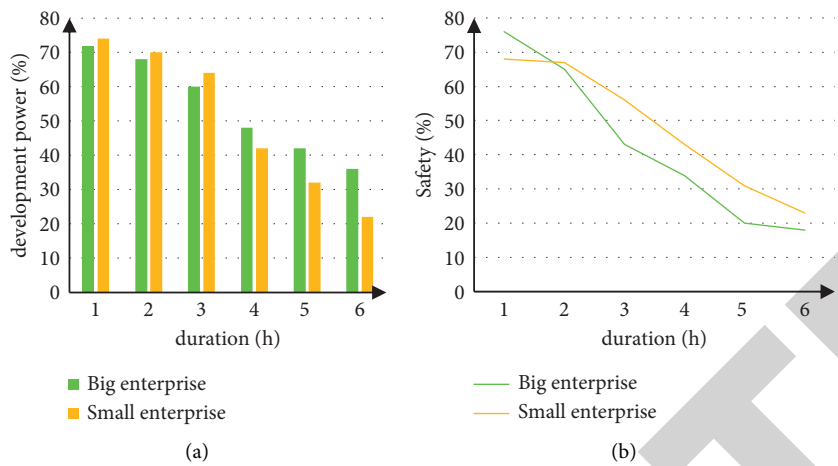


Figure 9: Influence of high-temperature radiation: (a) occupational safety and (b) occupational development potential.

threat to the occupational safety of employees. When the duration of high-temperature radiation increases, the occupational safety and development of employees of the enterprise will plummet, and the lowest at 6 hours. At this time, the average occupational safety of enterprises of both sizes is 20.5%, and the average development force is 29%. Reducing the high-temperature radiation of enterprises under the sustainable environmental development strategy can improve the occupational health development and safety management of enterprise employees.

## 5. Conclusion

This paper analyzed the indicators that affect the occupational health development and safety management of employees in a sustainable environment through the fuzzy analytic hierarchy process. It summarized four aspects: industrial wastewater, industrial waste, industrial waste gas, and industrial radiation. Using the judgment matrix to analyze the index weight of this impact, four largest weight indexes are obtained. The impact index is set to gradient to analyze the occupational safety and development of the employees of the enterprise. The test results showed that when the concentration of the four indicators—heavy metal wastewater, dust, hydrogen sulfide gas, and high-temperature radiation—is low, the occupational safety and development of enterprise employees is higher; however, when the concentration of these indicators increases, the occupational safety and development ability of employees cannot be guaranteed. The average occupational safety of enterprise employees is 23%, and the average development ability is 25%. Adhering to sustainable environmental development and effectively reducing the generation of waste liquid, waste, waste gas, and radiation can not only effectively protect the environment but also guarantee the occupation of enterprise employees, so that the occupational health and safety of enterprise employees can develop. However, the analysis of the impact indicators in this paper is not detailed enough; for example, the types of dust can also be analyzed in detail to improve more accurate experimental data. Therefore, further details on the impact indicators will be the direction of future research.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgments

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*Retraction*

# Retracted: Sustainable Development of Green Reverse Logistics Based on Blockchain

**Journal of Environmental and Public Health**

Received 10 October 2023; Accepted 10 October 2023; Published 11 October 2023



This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] Z. Wu and Z. Zhao, "Sustainable Development of Green Reverse Logistics Based on Blockchain," *Journal of Environmental and Public Health*, vol. 2022, Article ID 3797765, 10 pages, 2022.

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*Research Article*

# Sustainable Development of Green Reverse Logistics Based on Blockchain

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With the depletion of global resources and the deterioration of the ecological environment, the implementation of green reverse logistics management has become a necessary means. Green reverse logistics is a new type of reverse logistics that aims to improve resource utilization and protect the ecological environment. While promoting sustainable development, "green reverse logistics" also has certain social and economic significance. This paper compared the green reverse logistics system based on blockchain with the current green reverse logistics system. Taking drug recycling as an example, this paper mainly analyzed the waste rate, utilization rate, and enterprise income. The comparison results showed that the efficiency of drug recycling based on blockchain has increased by 20.1% compared with the current stage, and the waste rate has decreased by 16%. The utilization rate has increased by 14%, and corporate income has also increased by 19.5%. It is greatly indicated that green reverse logistics based on blockchain is of great significance to enterprise income and environmental protection, which also produces great social benefits.



## 1. Introduction

The rise of green reverse logistics stems from people's widespread concern about environmental issues. After the Second World War, the rapid development of the world's productive forces also had a serious impact on the Earth's ecological environment, including the poorer quality of the world's environment, unclean air quality, widespread industrial waste, waste products, and so on. The massive consumption of resources has a great impact on human life and economic development.

The best way to realize green reverse logistics is through recycling and reproduction. It is a recyclable regeneration system that can fully recycle various renewable resources and can also reduce the disposal cost of waste, thereby obtaining huge economic benefits. In addition, due to the reduction in the amount of garbage, the pollution to the environment is also reduced, and the ecological environment is protected, thereby promoting ecological balance. Reverse logistics is a system of utilization, remanufacturing, and recycling. It can not only make full use of resources but also effectively protect the ecological environment, which brings great economic and social benefits.

In this paper, by comparing the current reverse logistics with the green reverse logistics based on blockchain, it was found that the recycling efficiency of green reverse logistics based on blockchain has increased significantly from 61.3% to 81.4%. In terms of abandonment rate and utilization rate, the abandonment rate has been effectively reduced. The utilization rate has been significantly improved, and corporate income has also been improved.

## 2. Related Work

Global technology continues to develop, but nonrenewable energy sources are becoming less and less, which makes people begin to pay attention to sustainable development. Feris tried to make good management decisions at the environmental level. He understood and explained the relationship between environmental management and sustainable development in South Africa. The report critiqued recent cases and sought to understand how Chinese courts

evaluate environmental decision-making [1]. Multinational corporations play a pivotal role in achieving the sustainable development goals. Kolk et al. explored their behavior in implementing SDGs. He reviewed the positive and negative impacts of human beings on the prosperity and peace of the Earth as determined by the United Nations 2030 Agenda and summarized 61 related research results. The result was that the number of positive impacts is greater than the number of negative impacts, but the negative impacts may bring about insecurity on the Earth [2]. Sustainability issues are increasingly the focus of global organizations and stakeholders. In this context, eco-efficiency has become a means of constant transformation into sustainable development. Caiado et al. systematically reviewed sustainable development issues from the perspective of eco-efficiency and used knowledge of the knowledge development process to identify and construct the latest eco-efficiency and sustainable development technologies. A statistical analysis of the selected BPs was carried out, and a thematic synthesis was carried out, combining ecological benefits and sustainable development with other approaches [3]. Plessis and Rautenbach offered several legal perspectives on sustainable development issues. Taking sustainable development as an environmental concept, in the living space, a specific concept and culture can be better integrated into the formula of sustainable development. The study found that in the context of sustainable development, the fluidity and importance of culture need to be differentiated from the role of culture and the role played in sustainable development [4]. The issue of sustainable development has attracted the attention of scholars around the world. In sustainable development, some of them have discussed the issue of green reverse logistics.

In terms of green reverse logistics, many scholars have discussed it. Due to the shortage of resources, air and environmental pollution and the sustainable development of the environment has become a common concern of people. The logistics industry has added green logistics concepts and functions such as green logistics and reverse logistics. The purpose of Ali et al. was to understand the drivers and obstacles of reverse logistics and to analyze the impact of reverse logistics in terms of time, cost, technology, and green concept [5]. Diversified design and production have played a significant role in reducing the amount of electronic waste in waste electronic products. A green supply chain management framework combines environmentally friendly practices with sustainable production and consumption. Khor et al. explored eco-design, reverse logistics, demolition design, and business performance (eco-efficiency and profit). Using the variance structure equation model, the survey data of 89 electric power and electronic enterprises that have obtained IS014001 certificates were analyzed. The research results showed that the disassembly design has a certain impact on the environmental design and has a certain impact on the realization of reverse logistics. Further research found that reverse logistics has a significant relationship with environmental benefits and profits, but the ecological design did not bring similar effects [6]. With the negative effect of environmental pollution, environmental sensitive issues have become increasingly prominent. To achieve a sustainable life, people's production and lives must adapt to the environment. In this context, Yldz and Avdar studied the impact of reverse logistics on environmental and economic performance. The data were surveyed by 191 production enterprises. The collected data were analyzed using structural equation modeling and the macroprocess method. Using structural equation modeling, the significant impact of green production on environmental and economic performance was studied [7]. Relevant scholars have conducted research on the issue of sustainable development but not under the blockchain technology. In this regard, this paper discusses the sustainable development of green reverse logistics based on blockchain.

## 3. Green Reverse Logistics

*3.1. Significance of Sustainable Development of Green Reverse Logistics.* Minimizing waste can achieve sustainable development [8]. Waste management is generally aimed at reducing residues in industrial production, and there are two ways to reduce waste generation. One is to "turn waste into treasure" for existing garbage, and the other is to recycle it. The specific methods are a reduction in the amount of waste and recycling of waste. Generally speaking, the best way is to use the waste generated by resources as much as possible and try to avoid the generation of waste in one place. If garbage has already been created, then it needs to be sure to maximize its meaning, preferably reusing it. If not, it should be recycled. In order to maximize the utilization of resources, it has laid the foundation for the sustainable development of resources. At the same time, achieving the balance of material and energy ecology will be the development trend of China's industrial manufacturing.

Good management of reverse logistics can promote the sustainable development of the economy [9]. Among the many activities of reverse logistics, the most important is the management of customer returns. For reverse logistics in the field of circulation, the following methods can be taken to reduce the amount of commodity recycling as much as possible. First, a recycling logistics system can be established in the whole supply chain. The management of reverse logistics should start by preventing the backwardness (that is, returning) of products. As long as the logistics company can make strategic demands on each employee, it can prevent (or reduce) the backwardness of certain products. Second, it is necessary to establish the disassembly-oriented design idea. That is, in the design of the product, the reprocessing and reuse of the product should be fully considered.

The reverse development of green logistics [10]: The greening of reverse logistics can be started from two aspects. One is the green reuse of waste, and the other is environmental protection. In other words, the recycling of waste products is an environmentally friendly behavior. If the whole world is one-way, then the domestic waste of producers and consumers will spread to the entire planet in a short period of time, causing unimaginable environmental pollution and waste of resources. Generally speaking, the best way for the green development of renewable logistics is

recycling and reproduction. It is a renewable material that can effectively recover various useful resources and reduce the disposal cost of waste, thereby achieving high economic benefits. In addition, due to the reduction in the amount of garbage, the pollution to the environment is reduced, so that the ecological environment can be maintained. This creates a broad development space for the sustainable development of the enterprise and realizes the strategic goal of sustainable development of the enterprise. The significance of the sustainable development of green reverse logistics mainly lies in the aforementioned three points: minimizing waste, managing reverse logistics, and the reverse development of green logistics, as shown in Figure 1.

*3.2. Development Strategy of Green Reverse Logistics under the Concept of Sustainable Development.* Taking green reverse logistics is an important way to achieve sustainable development, as shown in Figure 2. The sustainable development of society is inseparable from the strong support of society. Therefore, it is necessary to strengthen the social awareness of environmental protection and resource conservation and establish the concept of sustainable development. The government should change its attitude of emphasizing economic development, ignoring the ecological environment, economic benefits, social benefits, immediate interests, and long-term interests. Instead, it should establish resource and environmental awareness and adhere to the strategy of sustainable development [11].

As the main body of the implementation of reverse logistics, enterprises should start from the perspective of sustainable development, attach importance to the operation of reverse logistics, and raise reverse logistics to the level of an enterprise development strategy. At the same time, people must pay attention to the research and development and design of products to make them more environmentally friendly and easier to recycle. It is also necessary to strengthen the control of the production process and strictly check to minimize the problems of products entering the market caused by improper production management, thereby reducing the return caused by product quality problems. Through the introduction of reverse logistics, enterprises can effectively reduce the waste of resources and reduce environmental pollution. Consumers should start with the concept of sustainable development and advocate "green" reverse logistics [12]. For example, people can replace plastic bags with vegetable baskets as much as possible, consume simple packaged food, and reduce disposable consumer goods. It is necessary to understand the grading standards of waste disposal and to divide waste into recyclable and nonrecyclable to facilitate reuse. Household appliances, computers, and other durable goods can be recycled by way of "trade-in." In addition, consumers themselves should not only engage in green consumption but also actively participate in the recycling of renewable resources and environmental protection. They can vigorously promote the concept of resource recycling and green consumption in society, advocate the behavior of green reverse logistics, and supervise the government to strengthen reverse logistics management. There are three main factors to achieving green reverse logistics, as shown in Figure 3.

Technology is the key to realizing green reverse logistics [13]. It is necessary to strengthen green technical support to ensure the production process has green logistics. At present, domestic waste recycling, disposal, and recycling technology is relatively backward. The cost of reverse logistics is high, and the utilization rate of renewable resources is not high. Because much waste cannot be recycled and processed due to technical reasons, it directly enters the ecological and social system, causing serious environmental pollution. Therefore, technical problems have become a "bottleneck", hindering the development of reverse logistics in China. At present, while actively promoting independent innovation, China should also strengthen research on technologies related to reverse logistics, as shown in Table 1. There are three main aspects: improving quality, strengthening recycling technology, and creating energy-saving technologies. First, enterprises should be encouraged to improve product design, improve product quality, green production, promote green packaging, and secure the door to "reverse logistics." Second, the development of recycling technology determines the way and method of recycling. Third, creating technologies such as new energy-saving technologies, clean energy, and environmentally friendly vehicles has positive significance for improving energy consumption and exhaust emissions in the logistics process.

Strengthening informatization [14]: The uncertainty and complexity of reverse logistics can be seen from the operation mode of reverse logistics. In the process of reverse logistics, there is uncertainty about the information on the recovery and reprocessing of the product. For example, product composition, recycling quantities, remanufactured parts, and material requirements, product recycling processing operations, etc., are all unclear. To a certain extent, the informatization of reverse logistics is more important than forward logistics. Therefore, strengthening information construction and building a reverse logistics information network can help enterprises understand the operation status of reverse logistics in a timely manner and enhance their enthusiasm for participating in reverse logistics. First, reverse logistics uses advanced information technology. The basic information of the product (basic product information, quality status, the reason for return, etc.) can be effectively tracked, for example, using barcode technology. Second, the use of advanced modern logistics information networks, such as GPS and network technology, can effectively track and manage the entire process of reverse logistics. It greatly reduces the processing time of logistics, which is conducive to optimizing the optimal design of the logistics system, optimizing the sharing of logistics resources, and reducing ineffective logistics, which will reduce energy consumption and pollution, thus realizing the greenness of the logistics process.

Choosing an appropriate way for the development of reverse logistics [15]: From the perspective of a logistics organization, there are three main logistics methods: One is the company that produces the waste to carry out the logistics. Another is the company that needs the waste to

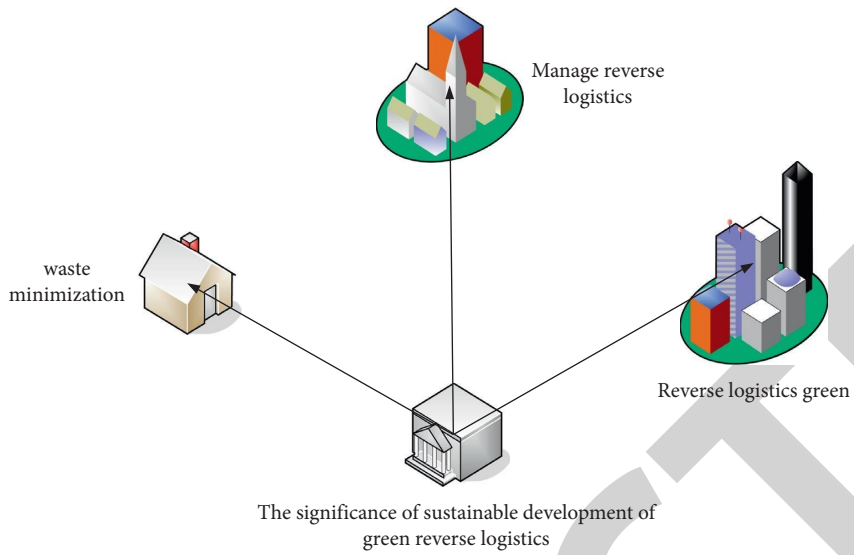


Figure 1: Significance of "green reverse logistics."

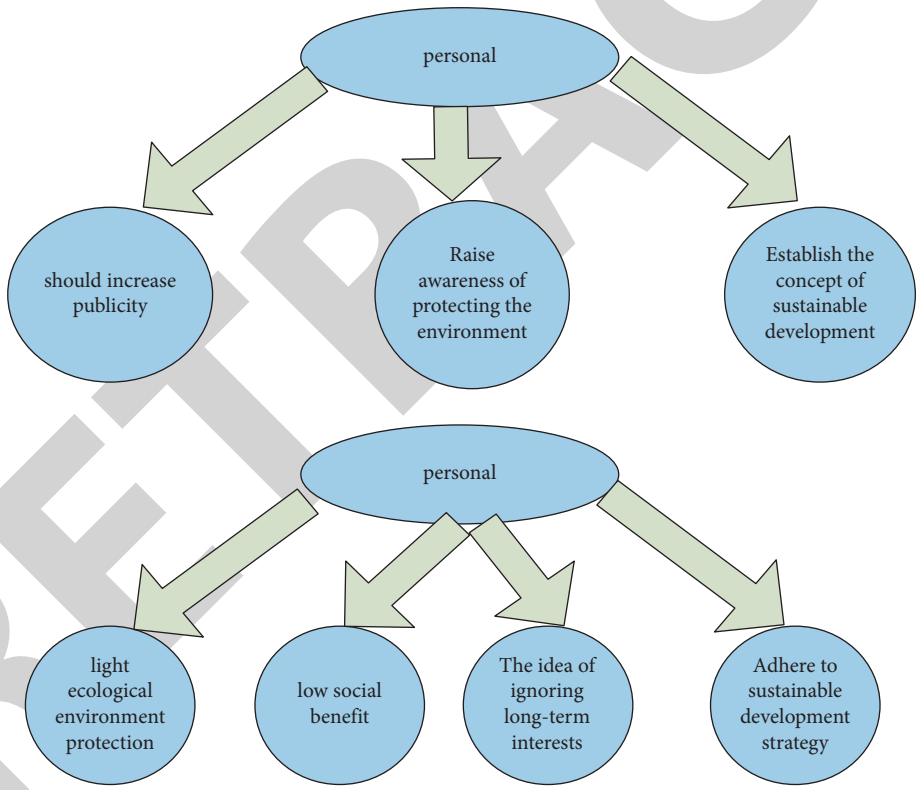


Figure 2: Important pathways to sustainable development.



operate and recycle the required waste. The third is the reverse logistics of the third party. At present, the development of reverse logistics is still in its infancy, and the market for reverse logistics is not yet fully mature. Enterprises should conduct comprehensive thinking and decision-making from the perspectives of enterprise scale, strength, reverse logistics cost, reverse logistics technology, and reverse logistics capabilities. Generally, products with a high unit value are recycled, such as waste copiers, electrical assembly products, etc. After reprocessing or assembly, these products can be reused for high profit. At the same time, the company will also consider the confidentiality of core technologies as well as the impact of the recycling network on the company's reputation and brand. For enterprises with lower unit value but higher requirements for postrecycling processing equipment and processes, higher processing costs, smaller scale, and less capital, they usually cannot complete recycling. They take the second way of operating

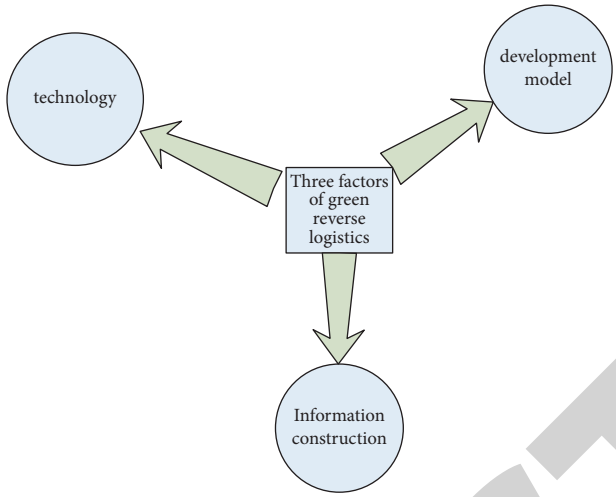


Figure 3: Main factors of green reverse logistics.

Table 1: Relevant technical directions in the field of reverse logistics.

| Relevant technologies in the field of reverse logistics and method | Companies should be encouraged to improve product design | Advances in resource recycling technology | New energy-saving technology |
|---|---|---|---|
| 1 | Improve product quality | Waste recycling | Use clean energy |
| 2 | Improve product quality | Develop reverse logistics | Use environmentally friendly vehicles |
| 3 | Promote green packaging | — | Purification of waste gas and wastewater |

independently, or the government appoints professional institutions to undertake it. For processing equipment with a certain scale economy value, packaging materials with simple processes, wine bottles, and so on, a third-party logistics company can be entrusted for distribution. This is mainly due to the professional logistics network, advanced logistics management system, and professional management level of third-party logistics enterprises, which can determine the reverse logistics and how to carry out logistics activities according to specific enterprises and can collect, classify, and process recycled products in a centralized manner to achieve economies of scale. Second, it can provide a relatively complete reverse logistics management system for third-party logistics enterprises without spending time and costs. The supply and demand sides of reverse logistics can establish a strategic partnership through contracts and determine the allocation of their costs, benefits, and risks so as to achieve the purpose of risk sharing and benefit sharing. Third, in order to enhance the company's competitiveness, it can concentrate its strength and resources on developing its own core business.

*3.3. Reverse Logistics of Drug Recall Based on Blockchain.* In fact, the blockchain is a distributed system. It is a group of computers with independent functions. They cooperate with each other to complete a common task, but in the eyes of the end user, it is like a computer [16]. Blockchains have more and more records that are controlled by multiple entities that do not trust each other. Data is allocated to a block in batches or blocks. Each block contains the cryptographic hash of the previous block, which embeds the secure representation of the existing block into the block. Blockchain is a distributed system, and its consistency depends on FLP and CAP. In a distributed system, it is best to satisfy two of the three conditions of consistency, availability, and partition fault tolerance [17]. Typically, consensus algorithms in blockchains assume three roles, which are proposer, receiver, and executor.

(1) Adviser: it usually refers to the leader whose role is to propose.

(2) Recipient: it hears the request for a proposal and provides a response.

(3) Executor: it refers to other processes that accept the final decision in the system.

If the following conditions are met, it can be called "distributed consistency." If the conditions are not met, it will be output directly at that corresponding stage. The first is consistency. That is, all nodes that have not failed will choose the same output. The second is the end. All fault-free nodes will choose an output that cannot exit. The third is completeness. If all nodes give the same value, the value is finally output by the system.

This article illustrates the problem of drug recovery in reverse logistics. For a long time, China has not paid enough attention to the reverse logistics of medicine, and most expired medicines are discarded or thrown directly into the trash can. This not only causes great waste but also has a

great impact on human health. At present, scholars at home and abroad have discussed the related issues of reverse logistics, but they mainly focus on the connotation and causes of reverse logistics while ignoring the application of information technology in pharmaceutical reverse logistics [18]. The whole process of reverse logistics of drug recovery can be summarized into four major links mainly including collection, statistics, transportation, and processing, as shown in Figure 4.

According to the randomness of drug quality, a network model of point-of-sale for drug sales is established, as shown in Figure 5. The center is a point-of-sale for drugs In order to facilitate the collection and analysis of drugs, data is collected by suppliers and then distributed to various distribution centers [19], so that the collection and processing centers are centralized and equipped with special personnel and equipment, which saves transportation costs, reduces warehouse management costs, and improves space utilization.

At retail locations, problematic drugs are sent to a centralized location where there are no capacity constraints, and the quality of the drugs can also be detected and then transported through different transportation nodes to the drug company's recycling depot. In this process, each node has a limit [20]. These stages are modeled and described below.

From the retail point to the recycling center [21], at this stage, the distribution fee is only related to the distribution distance. After the distribution center gives a certain rebate reward to the distribution point, the retail point will distribute it to the third-party logistics center, and the distribution center will conduct inspection and classification. Its tariff function is as follows:

$$W_0 = B_{ij} c_{0ij}. \tag{1}$$

From recycling center to transport node [22]; in the investigation, three different situations can be classified according to the severity of the product quality defect: severity of product quality (category I); the severity of product quality (category II); the severity of product quality (category III). If the product quality problem severity value is (0, S2), then the product belongs to category III. If the product's quality problem severity is (S2, S1), then the product belongs to category II. Medicines in the primary and secondary categories are put on the mandatory recall list. Therefore, for different problematic drugs, the transportation measures taken are different, so the required unit distance transportation costs are also different. Because the recycling machine collection area can detect the defects of medicines, the numbers of medicines with different defect grades at each collection point are as follows:

$$Q_{i1} = \int_{S_1}^{1} \sum_j c_{ij} f(S_{1i}) \mathrm{d}S_{1i}, \tag{2}$$

$$Q_{i2} = \int_{S_2}^{S_1} \sum_j c_{ij} f(S_{1i}) \mathrm{d}S_{1i}, \tag{3}$$

$$Q_{i3} = \int_{0}^{S_2} \sum_j c_{ij} f(S_{1i}) \mathrm{d}S_{1i}. \tag{4}$$

The single-cycle transportation cost function at this stage is as follows:

$$W_1 = \sum_{i,m} x_{im} p_k d_{1im} d_{1im} \left( \int_{S_1}^{1} p_1 f(S_{1i}) \mathrm{d}S_{1i} \right) + \int_{S_2}^{S_1} p_2 f(S_{1i}) \mathrm{d}S_{1i} + \int_{0}^{S_2} p_3 f(S_{1i}) \mathrm{d}S_{1i}. \tag{5}$$

The conditions that need to be met are as follows:

$$\sum_m \int_{S_1}^{1} x_{im} f(S_{1i}) \mathrm{d}S_{1i} \le Q_{i1}, \tag{6}$$

$$\sum_m \int_{S_2}^{S_1} x_{im} f(S_{1i}) \mathrm{d}S_{1i} \le Q_{i2}, \tag{7}$$

$$\sum_m \int_{0}^{S_2} x_{im} f(S_{1i}) \mathrm{d}S_{1i} \le Q_{i3}, \tag{8}$$

$$\sum_m x_{im} a_{1im} j_{1im} = T_m^1 \le c_m. \tag{9}$$

Transport between transport nodes [23]: considering the influence of the defect degree of the medicine on the transportation cost, it is necessary to calculate the current storage capacity of the defective medicine at each node, as shown in the following equation:

$$T_m^1 = \sum_i x_{im} a_{1im} j_{1im}. \tag{10}$$

The transportation volume matrix between each transportation node is $X_{mm}$, and its single-cycle transportation cost function is as follows:

$$W_2 = \sum_{i,j} x_{ij} d_{2ij} a_{2ij} j_{2ij} \left( \int_{S_1}^{1} p_1 f(S_{2i}) \mathrm{d}S_{2i} + \int_{S_2}^{S_1} p_2 f(S_{2i}) \mathrm{d}S_{2i} + \int_{0}^{S_2} p_3 f(S_{2i}) \mathrm{d}S_{2i} \right). \tag{11}$$

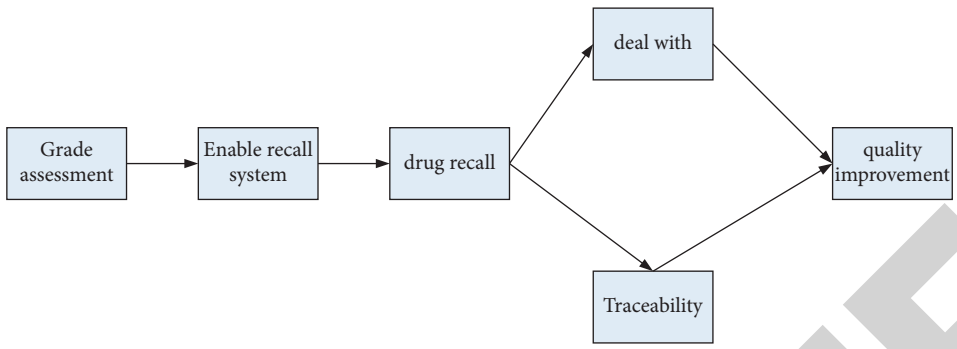


Figure 4: Drug recall process.

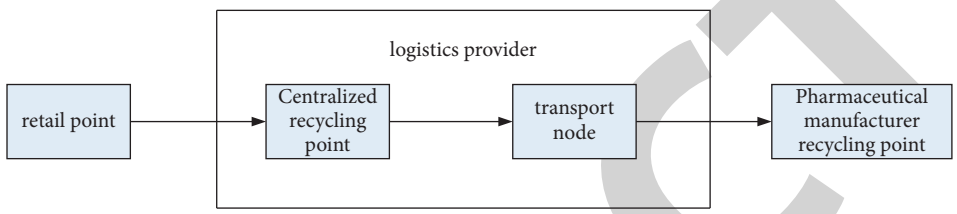


Figure 5: Reverse logistics network model under a random drug defect level.

The conditions that need to be met are shown in the following equations:

$$\sum_{j} x_{ij} d_{2ij} a_{2ij} j_{2ij} \leq T_i^1, \tag{12}$$

$$\sum_{i} x_{ij} d_{2ij} a_{2ij} j_{2ij} - \sum_{i} x_{ji} d_{2ji} a_{2ji} j_{2ji} + T_j^1 \leq c_j. \tag{13}$$

After the second stage, the current storage capacity of various types of defective drugs at each node is calculated, as shown in the following equation:

$$T_m^2 = \sum_{i} x_{im} d_{2im} a_{2ij} j_{2ij} - \sum_{i} x_{mi} d_{2mi} a_{2mi} j_{2mi}. \tag{14}$$

From hipping node to drug manufacturer recycling processing node: similar to the third stage, the transportation cost function of this stage is as follows:

$$W_3 = \sum_{m,t} x_{mt} d_{3mt} a_{3mt} j_{3mt} \left( \int_{S_1}^{1} p_1 f(S_{3i}) \mathrm{d}S_{3i} + \int_{S_2}^{S_1} p_2 f(S_{3i}) \mathrm{d}S_{3i} + \int_{0}^{S_2} p_3 f(S_{3i}) \mathrm{d}S_{3i} \right). \tag{15}$$

The conditions that are met are shown in the following equations:

$$\sum_{t} x_{mt} d_{3mt} a_{3mt} j_{3mt} \leq T_m^2, \tag{16}$$

$$\sum_{m} x_{mt} d_{3mt} a_{3mt} j_{3mt} \leq ce_t. \tag{17}$$

After the end of the previous stage, the storage capacity of various types of defective drugs at each node is calculated, as shown in the following equation:

$$T_m^3 = T_{mk}^2 - \sum_{t} x_{mt} d_{3mt} a_{3mt} j_{3mt}. \tag{18}$$

Modeling the total transportation cost: the transportation cost of the i-th cycle is the sum of the transportation costs of each stage, as shown in the following equation:

$$W_i = W_0 + W_1 + W_2 + W_3. \tag{19}$$

The main function of the logistics system is to minimize cost. This mode can ensure that medicines in each logistics node in the network can only be delivered or directly delivered to the recycling station of the pharmaceutical company. Thus, it is ensured that the recycling station of the pharmaceutical supplier becomes the final receiving point, so as to ensure that all the medicines in the secondary cycle can reach the collection point.

The number of loops $n = n_1 + n_2 + \ldots n_q$, where q is the number of times to adjust the parameters of a single loop. The total transportation cost function is as follows:

$$W_{\text{total}} = \sum_{i}^{q} n_i W_i. \tag{20}$$

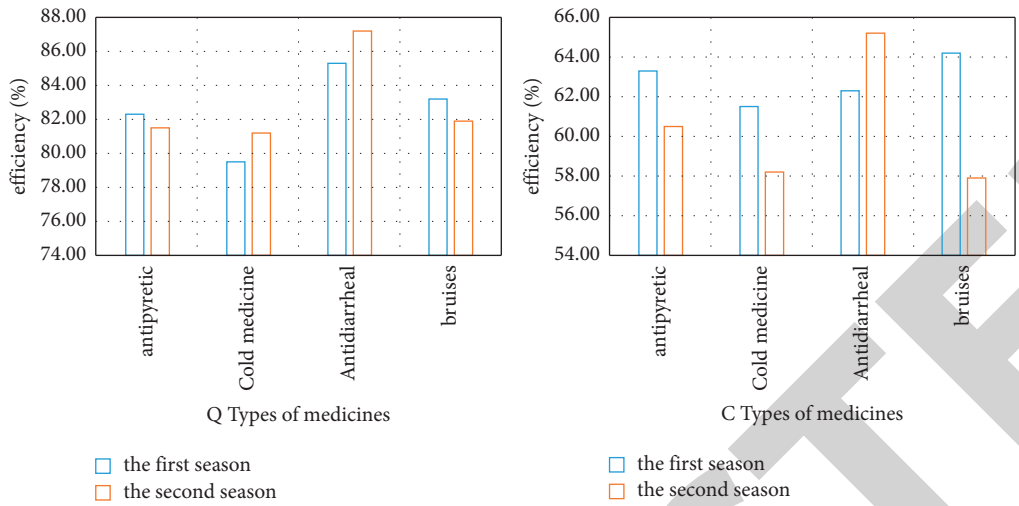


Figure 6: Comparison of recycling efficiency.

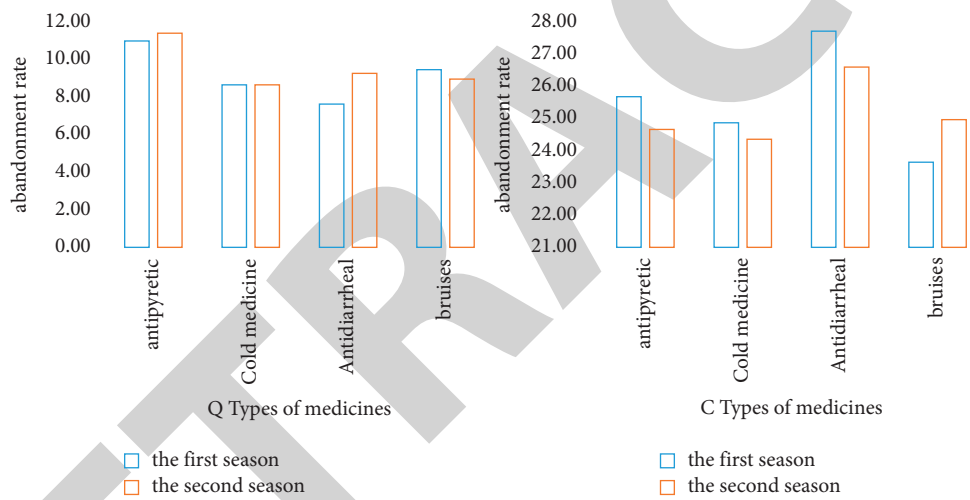


Figure 7: Comparison of scrap rates.

Solving this equation by a final calculation yields the desired value.

## 4. Comparison of Blockchain-Based Green Reverse Logistics

In this paper, a data query is carried out on the amount of drug recovery in several regions. In order to verify the accuracy of the data, the recovery of some pharmaceutical companies in daily medicine was investigated. Through questionnaires, the recovery time and cost of recovery, as well as the number of local drug sites, could be learned. Through mathematical verification, it was found that the survey data was in line with the online data. Through the analysis of the data from the drug website, the reverse logistics of drug recycling not based on blockchain (represented by reverse logistics at the current stage in the following text) and the reverse logistics based on blockchain (represented by C and Q in Figure 6) were analyzed in four aspects: enterprise recycling efficiency, abandonment rate, utilization rate, and enterprise income.

The recycling efficiency of enterprises is mainly related to the transmission between nodes. At this stage, there are deficiencies in reverse logistics in drug recovery, and there is no uniformity, resulting in relatively low recovery efficiency. The recycling efficiency of enterprises based on blockchain will be relatively better. The blockchain can achieve regular node information transmission in each link so as to achieve relatively high recycling efficiency. In the two quarters, the comparison of recovery efficiency between the two is shown in Figure 6.

From the comparison of Figure 6, it can be found that the recovery efficiency of drugs at this stage was only about 61.3%, while the recovery efficiency based on blockchain has reached 81.4%. Compared with the current stage, the recovery efficiency has increased by 20.1%, which shows that blockchain-based drug recovery is more effective.

The abandonment rate refers to the ratio of drugs that fail to meet the recycling requirements of all recycled drugs.

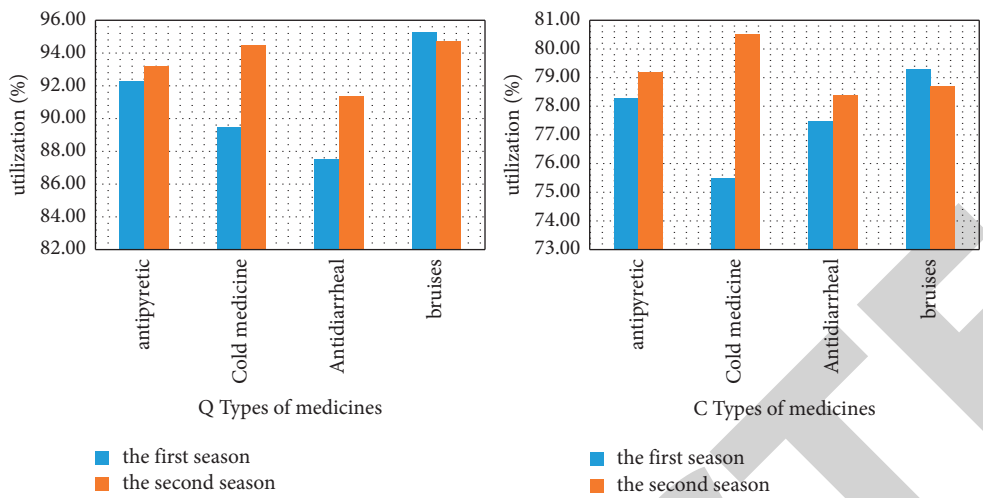


Figure 8: Comparison of utilization.

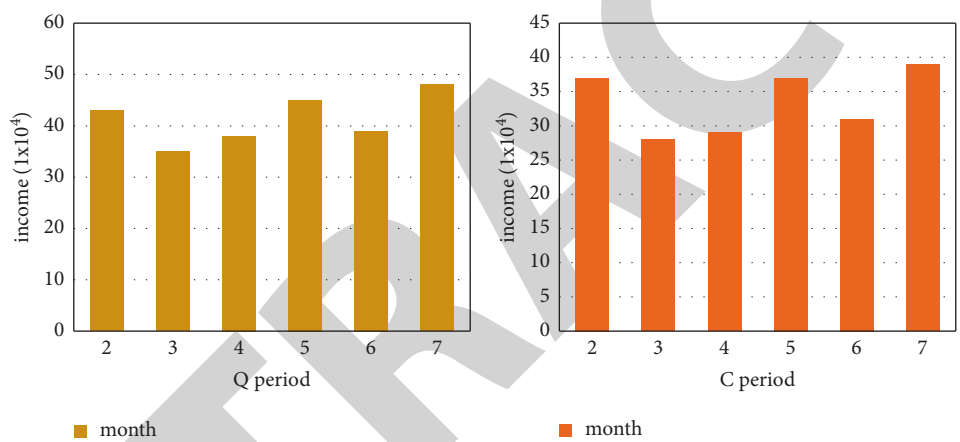


Figure 9: Comparison of corporate earnings.

This index can also be used to judge the sustainable development of enterprises. Utilization is the ratio of the amount people use to the total output of all drugs after they are sold. They are all important indicators for judging whether a company is pursuing sustainable development or not. The comparison between the current reverse logistics and blockchain-based reverse logistics in terms of waste rate and utilization rate is shown in Figures 7 and 8.

Through two sets of data, it could be found that the current abandonment rate of reverse logistics was between 22% and 28%, and the utilization rate was between 75% and 79%. The abandonment rate based on blockchain was between 7% and 11%, and the utilization rate was between 87% and 95%. The reduction in the waste rate and the improvement of the utilization rate showed that reverse recycling based on the blockchain is conducive to sustainable development, which can reduce the waste of medicines and reduce the damage to the environment.

The main purpose of pharmaceutical companies is to make profits, and cost control is an important part of that. It is related to the survival of the enterprise. Through the recycling of drugs, the cost of producing new drugs can be reduced. For the enterprise, it also saves materials and is conducive to its sustainable development. A comparison chart of the two in terms of corporate earnings is shown in Figure 9.

Through the comparison of Figure 9, it was found that the income based on blockchain was higher than that of reverse logistics at the current stage. Through the comparison of the overall income of the two quarters, it was found that the increase in interest was about 19.5%.

## 5. Conclusions

The focus of this paper is to propose the system architecture, working mechanism, and development characteristics of blockchain technology. It solves the problems of clarity of reverse logistics at the current stage, as well as the instability of the system, the complexity of operations, the complexity of goal realization, the repetition of operations, and the repetition of task completion. Taking advantage of the technical characteristics of blockchain and the cross-connection between it and the clarity of reverse logistics, a reverse logistics information system model developed from

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*Retraction*

# Retracted: Ecological Adaptability and Application of Traditional Historical Buildings under the Background of Environmental Protection

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] M. Yi, W. Wu, H. Su, and H. Chen, "Ecological Adaptability and Application of Traditional Historical Buildings under the Background of Environmental Protection," *Journal of Environmental and Public Health*, vol. 2022, Article ID 5107325, 13 pages, 2022.

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*Research Article*

# Ecological Adaptability and Application of Traditional Historical Buildings under the Background of Environmental Protection

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Traditional historical buildings carry the culture and spirit of China for thousands of years and have a unique charm that modern buildings do not have. However, traditional historical buildings have gradually declined over time, and their restoration not only takes time and materials but also causes certain harm to the environment. Therefore, this paper has aimed to explore how traditional historical buildings can develop in a sustainable and ecologically adaptive image in modern times. For traditional historical buildings, this paper has taken traditional cave dwellings in northern Shaanxi as an example to analyze their ecological adaptability, and based on the analysis results, traditional cave dwellings have been transformed. Specifically, this paper has taken the comfort of residential houses as the evaluation standard and has selected the thermal stability of the building and the energy consumption of heat supply as indicators to compare and analyze the traditional cave dwellings and the renovated cave dwellings. The experimental results of this paper have found that the traditional historical buildings are the crystallization of the wisdom of the ancients for thousands of years. However, due to the limitation of technology, the lighting and thermal stability of traditional cave dwellings are not high. After scientific design, the lighting and thermal stability of the transformed cave are 100% and 30% higher than those of the traditional cave, respectively, and the heating energy consumption is reduced by 50%.



## 1. Introduction

Traditional historical buildings have irreplaceable and non-renewable value, and the wisdom, aesthetics, and creativity reflected in the construction process can inspire and further innovate the future village construction. Its ecological adaptability is also one of the key factors in the formation of traditional historical buildings and their continuous updating and adaptation to environmental changes. Traditional historical buildings have undergone more than a hundred years of evolution. The builders of each are based on the local environmental conditions, relying on their own understanding of space in a specific regional context, to create a unique order belonging to the local village, and gradually adapt to the environment and the integration of the environment to stimulate the potential of the environment itself. It is a typical case of ecological adaptive construction and has an extremely high research value. However, with the development of the economy, many villages have been blindly constructed, ignoring the regional characteristics. Lack of effective use of the local natural environment, the gradual patterning of village construction has caused damage to the environment and lost its unique form due to adaptation to the environment. It is hoped that through the research of this paper, the status quo of ecological adaptability of traditional historical buildings can be further understood and the advantages of ecological adaptability in the construction of traditional historical buildings can be compared. By comparing the advantages of ecological adaptability in the construction of traditional historical buildings, it provides a theoretical basis for the ecological adaptability construction of future villages in this area and solves the problems arising from village construction during the implementation of the rural revitalization strategy.

The formation of traditional historical buildings often takes decades or even centuries of accumulation, which

contains the essence of traditional Chinese culture. There are many studies on the ecological adaptability of ancient villages. Xie has studied the ecological adaptation of Hani village landscape. He has mainly studied the reasons for the formation of rural landscape as a material carrier, the process of rural landscape adapting to nature and the built environment, and its inherent ecological significance from the perspective of ecological adaptability [1]. Shiyun Tang et al. has conducted on-the-spot analysis of traditional famous residences in many places in Guangxi, and has established different models for evaluation of the adaptability of traditional buildings [2]. Ramesh et al. has studied traditional dwellings on the Eastern Ghats of Andhra Pradesh, India, and it has assessed the ecological suitability of traditional dwellings [3]. The residences of Hani villagers are divided into 4 types: rammed earth house (earth palm house), mushroom house, tile house, and stilted house (dry barn house). Huang S. and Huang H. have analyzed the environmental adaptability of these buildings [4]. Heidrich et al. have put forward higher standards for the environmental adaptability of buildings and they have adopted stricter parameters to evaluate the environmental adaptability. Their research has contributed to the development of powerful tools for assessing building adaptability, which has enhanced the decision-making process for building design and the development of a more sustainable built environment [5]. However, their research goal is to maximize the preservation of ancient buildings and the environmental requirements are not very important.

Environmental protection is a necessary step for the sustainable development of human beings and the environmental protection of buildings is an important part of it. There are many scholars who have done research on green building and sustainable building. CSP Lopez has conducted an extensive, detailed, and accurate collection of case studies on the application of solar photovoltaic and thermal systems in historic buildings to assess the sustainability of historic buildings [6]. Greta et al. have developed a decision support system to plan and manage energy retrofit activities for cultural heritage. Cost and energy use were assessed, as well as the compatibility of interventions and their impact on indoor environmental quality [7]. Soyemi conducted research on the funds of the British Heritage Lottery Fund for the historical built environment, and he has proposed a new method of historical building conservation through the historical building conservation situation that has been funded [8]. Deggim et al. reconstructed the entire building, museum exhibits and six historical stages of construction based on the capture of 3D data [9]. Anisa and Lissimia aimed to describe the impact of the historic buildings in the Menara Kudus area on the sustainability of the surrounding area. They have analyzed field data using three dimensions of sustainability in the economic, social, and environmental domains [10]. However, most of their research objects are modern industrial buildings, and few scholars conduct research on the environmental protection and sustainability of historical and ancient buildings.

In this paper, the environmental adaptability and sustainable development of historical buildings have been studied. Without destroying the original environmental adaptability, the shortcomings of traditional historical buildings are improved by using modern technology, and finally, the sustainable development of traditional historical buildings is realized. It not only retains the cultural heritage of traditional historical buildings and the advantages of environmental protection but also improves the technical defects of traditional historical buildings. It has provided some help for the subsequent restoration and development of historical and ancient buildings.

## 2. Environmental Protection and Traditional Historical Buildings

*2.1. Ecological Adaptability of Historical Buildings.* Ancient villages refer to villages with a long history, most of which have existed for hundreds of years. At the beginning of the construction of the village, the population was often sparse, and after several years of reproduction, a huge family was gradually formed. Working people build their own homes on this land with their hard work and wisdom. The division of labor in ancient villages is clear, production and living are self-sufficient, and there is a strong sense of dependence on the ecological environment. Traditional historical buildings and their earthen buildings are examples of a high degree of integration with the environment. The traditional dwellings in the village are adapted to the climate and terrain and use the characteristics of local materials such as raw soil with strong heat storage capacity to maintain a relatively constant indoor temperature and ensure indoor comfort. It is a real low-carbon and environmentally friendly energy-saving building. The traditional historical buildings in various places are shown in Figure 1. After the reform and opening up, with the gradual emergence of public architectural works by international designers in various places, all kinds of buildings in China have followed the trend and converged. Buildings blindly focus on the appearance and volume, ignoring energy-saving needs and regional characteristics, resulting in the convergence of buildings in different places and the same urban appearance. China has rich cultural heritage and regional characteristics. This phenomenon of architectural style convergence has a destructive effect on the maintenance and development of Chinese architectural models. It not only causes waste of resources but also leads to the lack of traditional Chinese architectural culture. In the twentieth century, faced with the shortage of international resources and energy, the living environment is deteriorating. Contemporary architects realize the inferiority of abandoning regional characteristics and blindly following the trend, and turn their attention back to traditional dwellings that combine nature, environmental protection and energy saving, and adapt to local conditions. The traditional Chinese dwelling model, formed after hundreds of thousands of years of changes, is the result of the combined effect of the local ecological environment and regional culture [11].

In biology, ecological adaptation refers to "the ability of organisms to adapt to the ecological environment in which they live." As the external environment changes, the

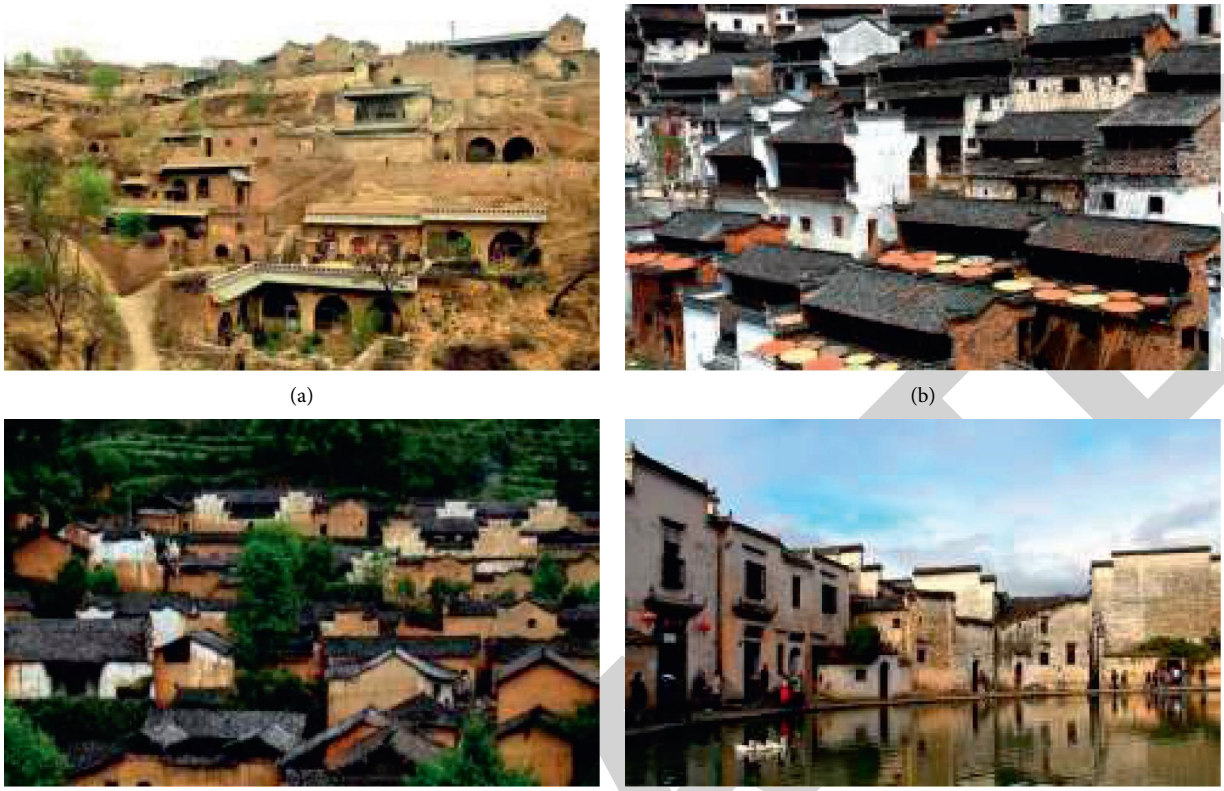


Figure 1: Traditional buildings with different styles.

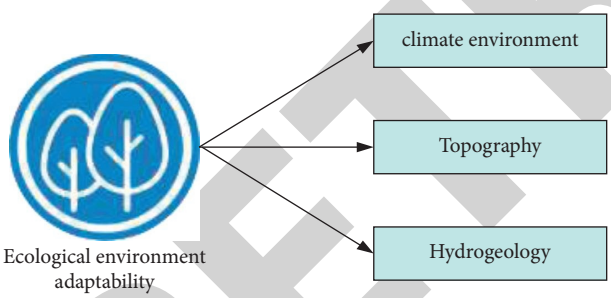


Figure 2: Ecological environment adaptability.

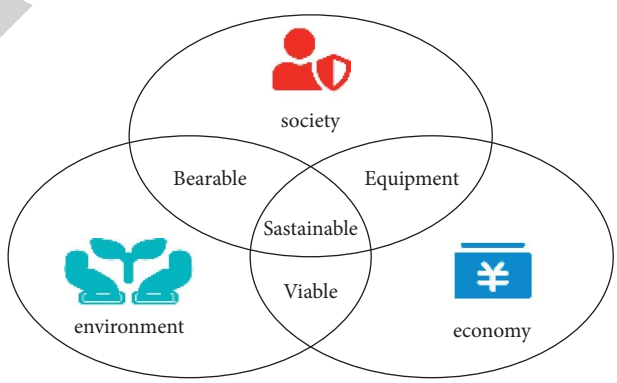


Figure 3: Sustainability.

creatures in nature will also change accordingly. This paper mainly studies the adaptability of traditional dwellings to the ecological environment. Specifically, it refers to the adaptive characteristics of the entire village and its courtyard dwellings to the ecological environment such as climate environment, topography, hydrogeology, etc. [12], as shown in Figure 2. Since adaptability to the natural environment is the first challenge that human settlements need to face in the early stage of formation, traditional historical buildings are typical in terms of ecological adaptability. The research on the construction of traditional historical buildings is also of great significance.

*2.2. Sustainable Development of Buildings.* Due to serious air pollution, environmental degradation, soil erosion, and other phenomena in recent years, people have begun to reflect on their own behavior. The theory of sustainable development arises from the contradiction between the overexploitation of resources and the limitation of resources, and it is the result of the development of human society. In 1987, the United Nations Commission on the World and the Environment formally proposed the concept of sustainable development, as shown in Figure 3, and defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their needs" [13]. The birth of this concept has aroused the attention of governments and public opinion in various countries, and actively advocated the public to implement it in actual production activities. The concept of sustainability

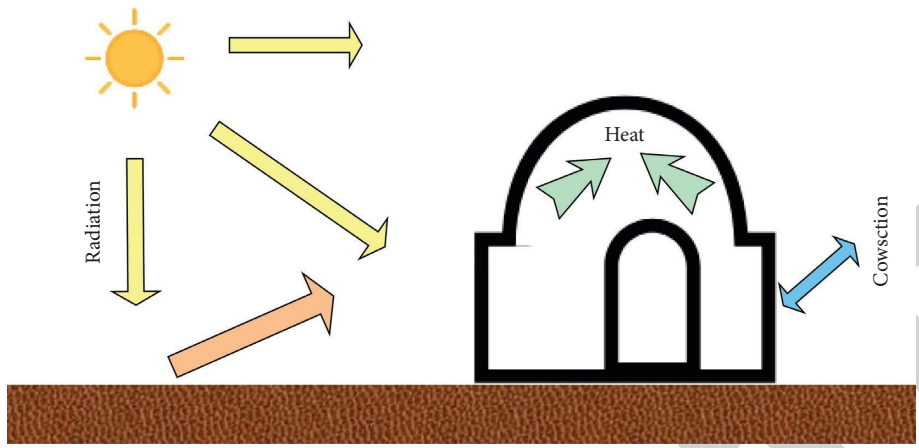


Figure 4: Building indoor and outdoor environmental interference.

was first proposed by ecologists, who advocated a balance between the ecological environment and the degree of human exploitation of nature, and hoped to use environmental resources in a controlled manner. The United Nations Conference on Environment and Development in 1992 adopted a series of documents such as the Framework Convention on Climate Change and the Global Agenda 21, which clearly demanded that the environment should not be neglected while developing. "Sustainable development" is a wake-up call for countries and people all over the world and the trend is gradually infiltrating all fields.

In China, the construction industry is an important industrial pillar of the national economy. At present, China is in a period of vigorous urban construction, and the investment and energy consumption of buildings are also increasing year by year. In the planning and design of buildings, the model of consuming a lot of energy in exchange for immediate economic benefits should be abandoned, the ecological environment should be protected as much as possible, the emission of pollutants should be reduced, and a sustainable "ecological house" should be constructed according to local conditions [14, 15]. Today, China is unable to meet the high-load resource demand. Many cities have adopted staggered power consumption and fixed-point power rationing to alleviate the problems caused by resource shortages.

*2.3. Thermal Stability of Buildings.* Architecture first existed as a shelter to ensure human safety. With the emergence of settlements, the maturity of construction techniques and the expansion of building scale, safety requirements have become the lowest-level requirements of buildings. No matter how mature the construction technique is and how the theory of architecture develops, the safety and independence of the interior space from the influence of nature are always the most basic needs of architecture. Since it is hoped to create a suitable building space, correspondingly, it is hoped to maintain a stable indoor thermal environment under the changes of external factors, so that it can meet the requirements of use and the thermal comfort of the human body. In general, the principle of interference that affects indoor temperature is shown in Figure 4.

Solar radiation is weakened in the atmosphere when sunlight passes through the earth's atmosphere, the radiant heat of each spectral component is weakened to different degrees, but all satisfy the law of differential weakening. For light of wavelength $\lambda$, the law is expressed as follows:

$$\mathrm{dI}_\lambda = I_\lambda \alpha_\lambda d_x. \tag{1}$$

where $\alpha_\lambda$ is the radiative attenuation coefficient of light per unit thickness of the atmosphere.

After changing the formula, the thermal radiation flow and the distance from the sun to the ground are, respectively, integrated, and the integral weakening law of the single-frequency light in the spectrum is obtained [16].

$$f_{I_{0\lambda}}^{I_{t\lambda}} \frac{1}{I_\lambda} \mathrm{dI}_\lambda = -f_0^l \alpha_\lambda d_x. \tag{2}$$

Or it is written as follows:

$$I_{t\lambda} = I_{0\lambda} \exp\left(-\overline{\alpha}_\lambda l\right). \tag{3}$$

In the formula, $\overline{\alpha}_\lambda$ is the integral value of $\alpha_\lambda$ within the integral limit.

For the entire wavelength range,

$$I_m = f_0^\infty I_{m\lambda} d_\lambda = f_0^\infty I_{0\lambda} p_{m\lambda}^m d_\lambda. \tag{4}$$

Among them are the following equations:

$$m = \frac{l}{h}, \tag{5}$$

$$p_{m\lambda}^m = \exp\left(-\overline{\alpha}_\lambda l\right). \tag{6}$$

According to the mean value theorem of integrals, there must be $p_m^m$ that makes

$$I = p_m^m f_0^\infty I_{0\lambda} d_\lambda = I_0 p_m^m. \tag{7}$$

The formula is the commonly used attenuation law of the full spectrum.

The solar radiation received by a surface is divided into two parts, direct radiation and scattered radiation. The direct radiation and scattered radiation of the sun irradiate the ground and are reflected and then are reflected by the clouds, going back and forth many times, and the scattered radiation is greatly enhanced. Considering these three points, the total radiant intensity on any surface is obtained by deduction [17]:

$$I_{ma}^{T} = I_m \cos\theta + D_{mE}^{a}. \tag{8}$$

In the formula, $\theta$ is the incident angle of sunlight on the surface and $D_{mE}^{a}$ is the total scattering intensity of the total scattered radiation from the sky and the ground on any surface.

The temperature radiation intensity of the black body surface is calculated by the following formula:

$$E = C_0\left(\frac{T_a}{100}\right)^4. \tag{9}$$

The net radiative heat intensity (specific heat flow) released by the ground due to long-wave radiation is as follows:

$$q_{re} = C_0\left(\frac{T_a}{100}\right)^4 - B_r C_0\left(\frac{T_a}{100}\right)^4 = (1 - B_r)C_0\left(\frac{T_a}{100}\right)^4. \tag{10}$$

The annual and daily changes of air temperature are cyclical, because the solar radiation that causes this change in air temperature is cyclical. The temperature can be harmonically analyzed according to the change period according to the observation data of the meteorological station. It expresses the temperature as a Fourier series:

$$t_e = \bar{t} + \sum_{k-1}^{\infty} \Theta_k \cos_k \omega(\tau - \tau_k). \tag{11}$$

In order to describe the thermal stability of the building, the abovementioned factors affecting the thermal stability of the building are combined, and the concept of outdoor comprehensive temperature is introduced. The comprehensive outdoor temperature is equivalent to an equivalent temperature, which takes into account the influence of outdoor air temperature and solar radiation, as well as the radiant heat effect of the interface between the envelope and the ground [18]. The outdoor comprehensive temperature is represented by $t_{sa}$, and its calculation formula is as follows:

$$t_{sa} = t_e + \frac{p_s I}{a_e} - t_{1r}. \tag{12}$$

When thermal insulation calculations are performed, the maximum value of the integrated temperature, the diurnal average, and its diurnal fluctuation amplitude must first be determined. The maximum comprehensive temperature is calculated as follows:

$$t_{sa,\max} = \bar{t}_{sa} + At_{sa}. \tag{13}$$

The average comprehensive temperature is calculated as follows:

$$\bar{t}_{sa} = \bar{t}_e + \frac{p_s \bar{I}}{a_e} - t_{1r}. \tag{14}$$

The amplitude of the day-night fluctuation of the integrated temperature is as follows:

$$At_{sa} = \left(A_{t_e} + A_{t_s}\right)\beta. \tag{15}$$

The heat storage coefficient of the material refers to the ratio of the heat flow amplitude $A_q$ on the surface directly receiving the thermal harmonic action to the temperature vibration radiation $A_\theta$ of this surface when the surface of one side of the envelope is subjected to thermal harmonics. The heat storage coefficient is represented by "$S$," which is related to the material itself, and the unit is $W/(m^2 \cdot K)$.

$$S = \frac{A_q}{A_\theta} = \sqrt{\frac{2\pi\lambda c p}{z}}. \tag{16}$$

When the fluctuation period is 24 hours, then

$$S_{24} = 0.51\sqrt{\lambda c p}. \tag{17}$$

When the envelope structure is composed of composite multilayer materials, the thermal inertia index needs to sum up the thermal inertia index of each layer material, the method is as follows:

$$\sum D = R_1 S_1 + R_2 S_2 + \cdots + R_n S_n = D_1 + \cdots + D_n. \tag{18}$$

## 3. Ecological Adaptability of Traditional Buildings

Some ancient villages still retain the original ecological production workshops, which are rare and well-preserved ancient villages in the world, and the study of ancient villages is representative to a certain extent. This paper takes the adaptability factors of Shaanxi cave dwellings and the ecological environment as the point of convergence and reflects the importance of traditional dwelling protection by studying the influence and role of climate environment, topography, hydrogeology, and other aspects on traditional dwellings in Hougou [19]. This article can not only enhance the public's attention to traditional dwellings but also contribute to the dissemination of the essence of Chinese traditional culture, and then extract useful experiences that can be learned from the construction of contemporary villages and towns. The traditional cave dwellings studied in this paper are shown in Figure 5.

*3.1. Adaptability of Building Materials.* The thermal environment comfort in the building is not only related to the layout and construction of the house but also largely depends on the thermal performance of the building materials. Traditional dwellings on the Loess Plateau mostly use readily available natural materials such as soil, stone, wood, brick, and grass. The roof of the building is covered with blue tiles, which have strong heat storage properties and are conducive to thermal insulation. In the back ditch, adobe is often used

(a) (b) (c)

Figure 5: The real picture of traditional cave architecture. (a) Cave house. (b) Cave room. (c) Cave house door.

(a) (b) (c)

Figure 6: Buildings with different materials. (a) Soil. (b) Stone. (c) Wood.

as a maintenance wall. The 60 cm adobe wall and 30 cm outer bricks are commonly known as "gold-clad silver." The entire space is wrapped with heavy materials to effectively reduce heat loss. Adobe, tile, and brick are thermally inert, conduct heat slowly, and take a long time for heat to pass through the material. When the sun shines on the roof and wall during the day, they absorb excess heat and store it in the material. When the temperature drops at night, the material transfers heat to the interior, thus playing the role of thermal insulation [20].

"Building materials reflect the nature of the materials used." Stone, soil, and bricks are all readily available materials in ancient villages, so the common forms of cave dwellings include stone kilns, earthen kilns, and brick kilns. Hougou raw earth building adopts hoop kiln technique, clever use of loess resources, and easy-to-obtain materials to create a different architectural atmosphere. These materials are nonpolluting to the environment and can degrade naturally even if they are discarded after several years. In short, the use of local materials is conducive to energy conservation and environmental protection, and has a high degree of adaptability to the ecological environment. Buildings with different materials are shown in Figure 6.

*3.2. Adaptability to Life.* The underground drainage system of the ancient village is famous, which is amazing. In an ancient society where information was blocked and resources were limited, it was not easy for working people to build a complete drainage system. In terms of organizing drainage, the open ditch is combined with the dark channel. It starts from the highest point of the northern hillside of the village, passes through the village, and passes through the courtyard, forming two systems of Huanglong and Heilong, and finally flows through the drainage outlets in the southeast and southwest of the village into the Longmen River. The normal life of human beings is inseparable from the drainage system. Water is a resource that villagers rely on for their survival, especially for the Loess Plateau, which is arid, less rainy and has loose soil. Organized drainage is conducive to efficient use of water resources and avoidance of waste. However, it is not uncommon to see the phenomenon of cross-flow of sewage in some villages today, which is not seen in ancient villages. The Hougou, which has a history comparable to a modern drainage system, has a history of hundreds of years and it embodies the diligence and wisdom of the ancient villagers [21].

The relative height difference of the ancient village is 66 meters. The terrain fluctuates greatly, and the buildings are built on the cliff. This kind of terrain can easily cause soil erosion. If there is no reasonable drainage system, geological disasters such as landslides are prone to occur. The ancestors of the ancient village may have realized these conditions and built the drainage system of the ancient village. The main principle is as follows: rainwater flows down from the top of the highest level through the underpass and into the next level. After a certain distance, it flows into the lower-level waterway through the channel, until it flows into the lowest level and finally joins the Longmen River in front of the village. There is a drainage outlet at the southwest corner of the lowest depression in each courtyard, through which the drainage in the courtyard flows into the channel under the village road, and bluestone slabs or stones are laid on it. The canals connect every household, but people are not visible. This practice is like a sewer in a city. The drainage system of the ancient village stretches for kilometers, the tributaries and the main stream are scattered, and the canal trunks are connected to each other and eventually merge into the river. It not only helps to keep the village clean and tidy but also saves resources and avoids soil erosion.

*3.3. Adaptability of Ventilation Methods.* The ancients asked for the site to be "backed by the mountains and facing the water," precisely considering the importance of "Tibetan wind." There is a saying in ancient villages that "the wind will disperse," so the wind is considered to be an important aspect of choosing a house. In fact, from a scientific point of view, wind is also a great threat to human health, so the idea of wind prevention is essential. When the cold wind strikes, the courtyard is the shield of the house and a windproof unit. The northwest wind prevails in the ancient village in winter. When building residential houses, try to avoid the buildings facing the northwest direction, and do not open doors and windows facing the northwest direction.

The back wall of the buildings in the ancient village compound is generally higher than the front eaves, and no windows are opened to the outside, so as to effectively resist the wind and sand. In order to avoid the biting northwest monsoon in winter, the gate of the house is generally located in the southeast corner or south of the courtyard. This layout is also conducive to the southeast monsoon blowing into the courtyard in summer, dispelling heat and dissipating heat and keeping the air fresh. Considering the existing layout of Hougou courtyard, when the northwest monsoon is raging in winter, people can hardly feel the wind in the courtyard, but they can hear the sound of howling wind outside the courtyard [22].

In addition to natural ventilation by heat pressure and wind pressure in a single building, most cave dwellings also use the self-circulation system formed by the flue, chimney, and cooking stove of the kang to enhance the ventilation effect. In this system, the stove mouth is at a relatively low position and belongs to the high pressure area and the chimney is at a relatively high position and belongs to the low pressure area. The flowing air will discharge the indoor foul air out of the cave through the chimney, keeping the indoor air fresh. In summer, the chimney is in the negative pressure area, and the power of natural ventilation is mainly the effect of wind pressure. In winter, the temperature of the stove mouth is high. At this time, natural ventilation mainly relies on the effect of heat pressure. The temperature difference between indoor and outdoor in summer and winter is large and the air pressure difference is obvious. The ventilation effect is better than that in spring and autumn.

## 4. Reconstruction and Application of Traditional Historical Buildings

*4.1. Green Renovation of Ancient Village Cave Dwellings.* Site selection and material selection is done according to local conditions.

Energy saving and environmental protection: here, the cave dwellings are built on the hillside. Through the stepped layout following the slope, the harmonious treatment of "integrating" into the environment is closely combined with nature. In addition, the caves built by using natural gullies will not damage the ecology or occupy fertile land, but also help to maintain water and soil resources and coordinate with the ecological environment. According to relevant information, "the cave dwelling is 20% more energy efficient than modern high-rise buildings."

A livable environment with "warm in winter and cool in summer."

Warm in winter and cool in summer, comfortable and practical. Traditional kiln dwellings are closed and regular, with concise planes, simple shapes, and relatively small shape coefficients, thereby reducing the impact of outdoor air temperature on the indoor thermal environment. The caves with thick loess and masonry as the enclosure structure are fireproof, noise-proof, and have good thermal insulation performance. Under the influence of large outdoor temperature fluctuations, the indoor temperature remains relatively stable.

The way of constructing "the unity of man and nature."

Most of the traditional cave dwellings face south and are built on the hillside or the foot of the mountain. Most of the north faces are backed by mountains. According to the principle of mechanics, the construction is completed with a special arch structure, and the noise is low. The stove used for cooking in the cave is connected to the kang, and the smoke and waste heat generated by cooking are converted into radiant heat when passing through the flue, which transfers heat to the kang, and also meets the heating needs while cooking.

During the research period, in ancient villages, detailed tests and questionnaires were conducted on the old cave dwellings of Zhangjia Old Courtyard and the physical environment quality of residential areas.

The survey is divided into two parts: objective and subjective: the current situation of cave dwellings and the residents' intuitive feelings about cave dwellings. Among them, the main contents of the test and investigation include: indoor and outdoor thermal environment, light environment, acoustic environment, various harmful gases and dust in the air, thermal properties of cave building materials, outdoor climate and meteorological parameters, etc.

Indoor thermal environment: "warm in winter and cool in summer," that is, the temperature is relatively stable throughout the year, as shown in Figure 7.

Acoustic environment: the sound field is uneven and there is sound focusing.

Light environment: the lighting coefficient is extremely uneven; air quality: poor ventilation and poor quality.

In order to create a more comfortable indoor thermal environment, the author conducted a field investigation and research on the Zhangjia Laoyuan, a representative Yuan Dynasty building in the ancient village. While fully affirming its construction technology, the aspects that affect the comfort of the occupants are reasonably transformed.

Cave dwellings usually use "one light and two dark," several cave dwellings are connected in series with each other, and there are door openings inside.

The thick and heavy envelope of traditional cave dwellings is maintained. Due to the strong heat storage performance of loess and other materials, the interior is warm in winter and cool in summer, creating a comfortable and pleasant living environment.

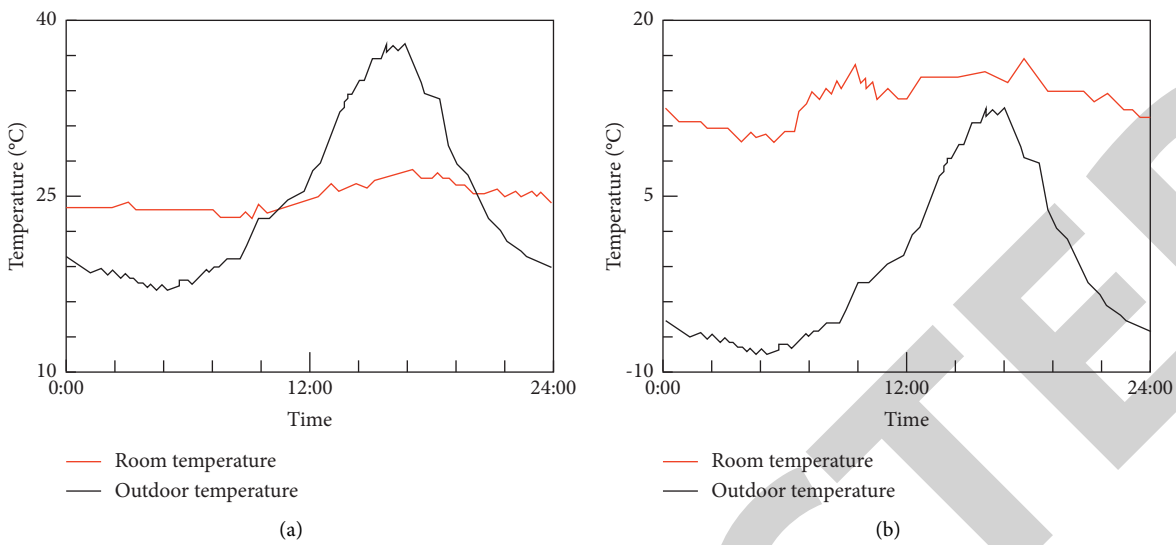


Figure 7: Indoor thermal environment of the cave. (a) Indoor and outdoor temperature comparison in summer. (b) Indoor and outdoor temperature comparison in winter.

Table 1: Differences between traditional buildings and new residential buildings.

| | | Wall thickness (cm) | Window to wall ratio | Body shape factor | Heat consumption index (W/m$^3$) | Coal consumption for heating (t) |
|---|---|---|---|---|---|---|
| *Traditional building* | Cave | 100 | 0.12 | 0.35 | 18 | 1 |
| | Brick and wood structure dwellings | 50 | 0.18 | 0.50 | 20 | 1.2 |
| Newly built dwellings | | 40 | 0.37 | 0.55 | 22 | 2 |

Improvements are made by opening windows on the north side and setting up lighting and ventilation shafts. Using the principle of light reflection, setting mirror materials at appropriate positions in the shaft can effectively improve the lighting rate.

*4.2. Application Strategies of Ecological Technology in New Residential Buildings in Contemporary Towns.* In this paper, the cave dwellings, brick-wood structure dwellings with similar area and volume in the old courtyard of the old village of Zhangjia, and the newly built dwellings built by the descendants of the Zhang family outside the village are taken as the research objects, and their physical properties are analyzed through the calculation of heat consumption index and coal consumption:

It can be seen from Table 1 that the heat consumption index of newly built dwellings is significantly higher than that of traditional dwellings in cave dwellings and brick-wood structure dwellings, and the coal consumption is also much higher than that of traditional dwellings.

In addition, the thermal insulation and thermal insulation ability of the envelope structure is reflected in the barrier effect of the envelope structure on heat. The heat transfer resistance of the envelope structure is its blocking effect on heat, and its single material calculation formula is $R = d/\lambda$, as shown in Table 2:

Table 2: Calculation of thermal resistance of the wall.

| | Rammed clay | Grassed clay | Brick |
|---|---|---|---|
| $\lambda[W/(m \cdot K)]$ | 1.32 | 0.78 | 0.82 |
| $d$ (m) | 0.88 | 0.43 | 0.38 |
| $R$ | 0.67 | 0.55 | 0.46 |

After monitoring, without using any artificial equipment, the indoor temperature of traditional residential buildings in winter is 1.5–3°C higher than that of new residential buildings. The results show that in terms of indoor comfort, traditional dwellings are superior to newly built dwellings. New dwellings should inherit the advantages of energy saving of traditional dwellings, combine modern technology and materials, and build local buildings that are energy-saving and environmentally friendly. New residential buildings in villages and towns require the lowest possible energy consumption, and more attention should be paid to the ventilation and lighting of buildings, the recycling of energy and the selection of construction materials. In winter, it relies on its own materials to store heat and keep warm, and in summer, it is cooled by natural ventilation, and then integrates new technologies such as solar energy and geothermal energy to reduce living costs. Such houses must be talked about by villagers.

After several studies and determinations of the physical environment of the cave dwellings in the main house of the Zhangjia Old Courtyard, the author summarizes its suitability characteristics and the indicators that need to be renovated to affect the indoor comfort.

*4.3. Thermal Stability and Energy Consumption.* The reason why buildings generate energy consumption and follow its source is that people have different thermal needs in different environments. Buildings are based on a certain geographical environment. The building isolates the internal space from the external environment, but at the same time, the thermal environment of the internal space of the building is constantly affected by the external environment and internal conditions. The external environment is constantly changing, and the internal environment is affected by the common influence of various equipment and human body heat production. The indoor thermal environment is therefore constantly changing, while the human thermal demand is relatively constant. Due to these changes, the actual indoor thermal environment is different from the thermal environment expected by people to achieve comfort needs. In order to eliminate this difference, various ventilation, cooling, heating, dehumidification, and other equipment are used inside the building to adjust. For example, using central heating equipment to increase indoor air temperature in winter, reducing indoor air temperature through air conditioning equipment in summer, and dehumidifying equipment in places with high humidity are all means to eliminate differences.

The thermal comfort of the human body is related to six factors, and the factors related to the building itself are radiation temperature, air temperature, wind speed, and humidity. Through the device, the air temperature, wind speed, and humidity can be adjusted, but the radiation temperature cannot be controlled. To control the radiation temperature, the expected envelope temperature can only be controlled by designing the envelope structure, so as to achieve the purpose of controlling the radiation temperature. In desert areas, the moisture content is very low, and at the same time it is basically constant, the wind speed is not large, the sunshine is strong, the air temperature fluctuates greatly within 24 hours, and the comprehensive temperature of the building surface changes drastically under the combined effect. At this time, it is very important to select a suitable enclosure structure to resist the influence of the fluctuation of the comprehensive temperature on the indoor thermal environment, which is very important to maintain a stable indoor thermal environment.

How well the building is designed and how the building envelope is constructed is not only reflected in the numerical value but also needs to consider whether the human body feels comfortable in the building. Here, the neutral temperature calculated by the thermal comfort model in the dry-hot, dry-cold area is used to compare the operating temperature to evaluate whether the person feels comfortable in the room. The thermal comfort model represents the change of the comfortable temperature felt by the human body with the outdoor air temperature under certain climatic conditions. The thermal comfort model used in this paper is derived from the results of other members of the research group. The thermal comfort model of dry-hot and dry-cold regions can be expressed in the range of −10°C to 40°C.

$$y = 0.019x^2 - 0.288x + 18.25. \tag{19}$$

*where* $x$ is the outside air temperature and $y$ is the neutral temperature.

The distribution of neutral temperature and operating temperature at each moment in summer and winter is shown in Figure 8.

It can be seen from Figure 8(a) that the operating temperature of the cavern will be higher than the neutral temperature from 13:00 to 23:00 at night, especially from 16:00 to 18:00, the difference is close to 2°C. However, it can still ensure that the thermal comfort needs of the human body can be met for most of the 24-hour period.

From Figure 8(b), it can be seen that the neutral temperature changes significantly with the outdoor air temperature, and the neutral temperature is the highest around 9 am in the morning. The neutral temperature is the lowest around 4:00 pm, which is also in line with the fact that the radiation intensity is not large in the morning when the sun just rises, and various functions of the human body are gradually adjusted from sleep. It is hoped that the higher indoor temperature is consistent with the common sense that the demand for indoor temperature begins to decrease in the afternoon with the enhancement of solar radiation and the deployment of human body functions to achieve the maximum effect.

In general, in winter, when openable components such as doors and windows are closed, the indoor operating temperature is quite constant, and the extremely low temperature outside has little effect on the indoor temperature. Especially under the heavy structure of the dwellings (caves), the influence of the extreme outdoor temperature within 24 hours can be ignored. Due to the good thermal stability of the envelope structure, the inner surface of the envelope structure is not greatly affected by the fluctuation of the outside temperature. Therefore, when adjusting the indoor thermal environment in winter, the indoor air temperature has become the only factor to be considered. At the same time, this factor is also easy to control through equipment or traditional stoves. It should also be noted that in the case of large amounts of solar radiation in the afternoon in winter, it is very beneficial to introduce solar radiation into the room reasonably to increase the indoor operating temperature, improve the comfort of people in the room, and save energy.

In summer, with natural ventilation, the operating temperature in the afternoon will be greater than the neutral temperature. At this time, closing the doors and windows to stop natural ventilation, preventing outdoor high-temperature air from entering the room, can effectively reduce the indoor operating temperature. At the same time, attention should also be paid to the surrounding environment of the building and the design of the shading

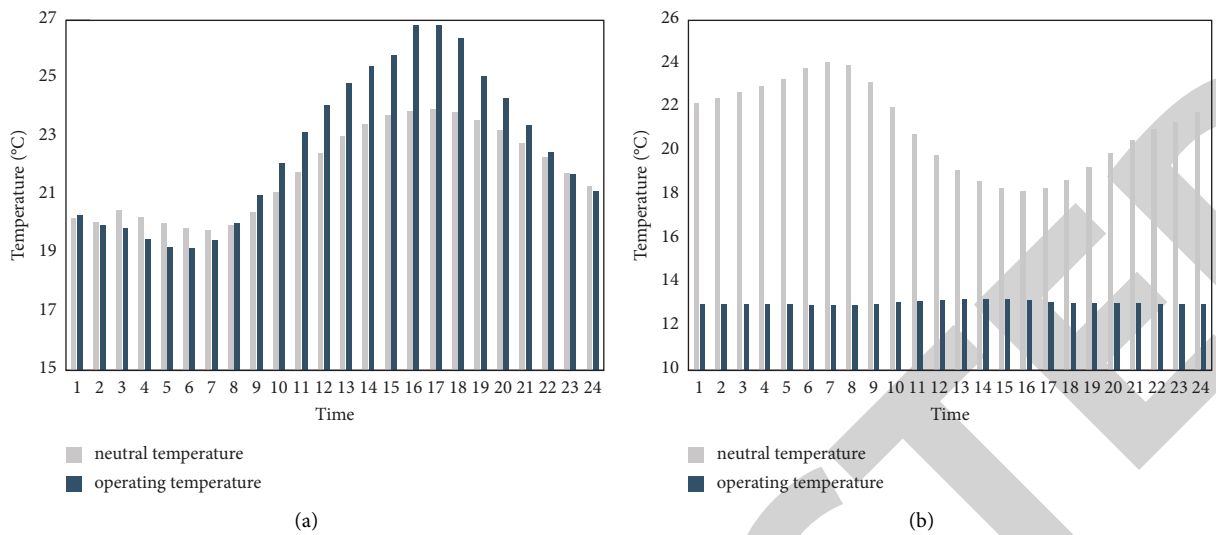


Figure 8: Comparison of neutral temperature and operating temperature. (a) Summer neutral temperature and operating temperature distribution. (b) Winter neutral temperature and operating temperature distribution.

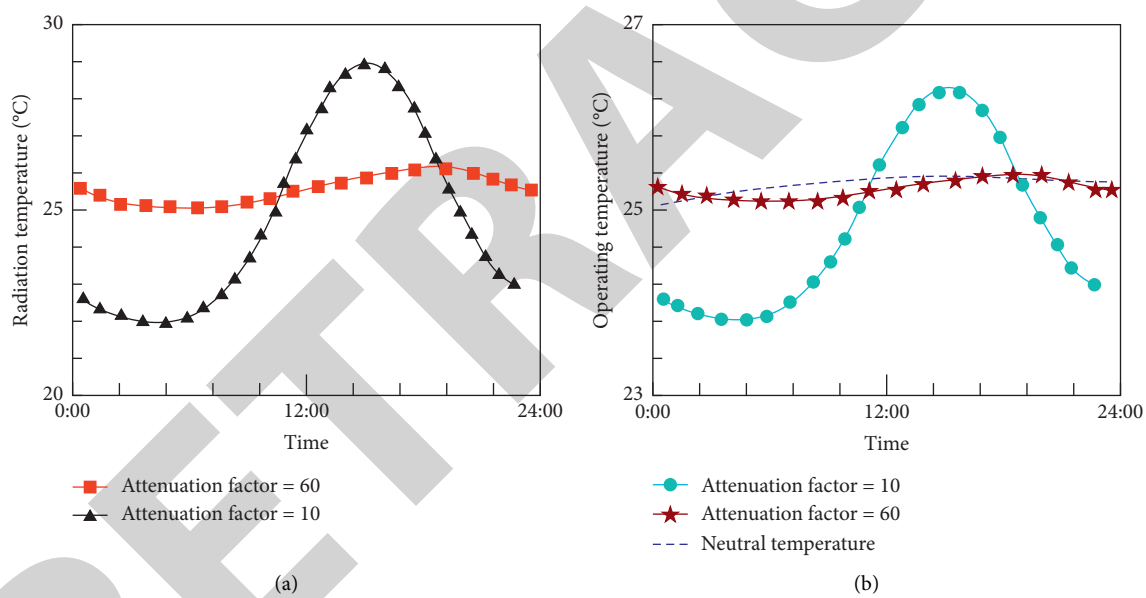


Figure 9: Effects of different attenuation factors on operating temperature and radiation temperature. (a) Radiation temperature comparison at different attenuation times. (b) Operating temperature comparison at different attenuation times.

components of the building itself. The former can reduce the amount of radiation directly received outdoors, thereby reducing the temperature of the air entering the room, while the latter can reduce a large amount of direct solar radiation entering the room and heat the air temperature in the room. It is precisely because of the good thermal stability of the envelope structure that the inner wall is less affected by fluctuations in outdoor temperature, making the control of indoor air temperature and wind speed the main consideration for improving the indoor thermal environment in summer.

In the calculation of this paper, the room heat transfer situation is idealized, and it is considered that the indoor air temperature in winter is constant and the structure is uniform, while the gaps, infiltration and thermal bridges existing in the actual building will affect the final indoor operating temperature results. The outdoor weather data used for the calculation are monthly averages, that is, the effects of extreme low temperatures are not considered. It is conceivable that when the temperature at night is extremely low, especially in weak parts such as windows, there is a cold radiation effect at night. In the absence of the thermal storage call cold radiation effect of the envelope, the radiant temperature of a room with a lightweight envelope can be significantly reduced. This means that a higher indoor temperature needs to be provided to increase the indoor operating temperature, and at the same time bring higher energy consumption. In addition, it can also be seen that in

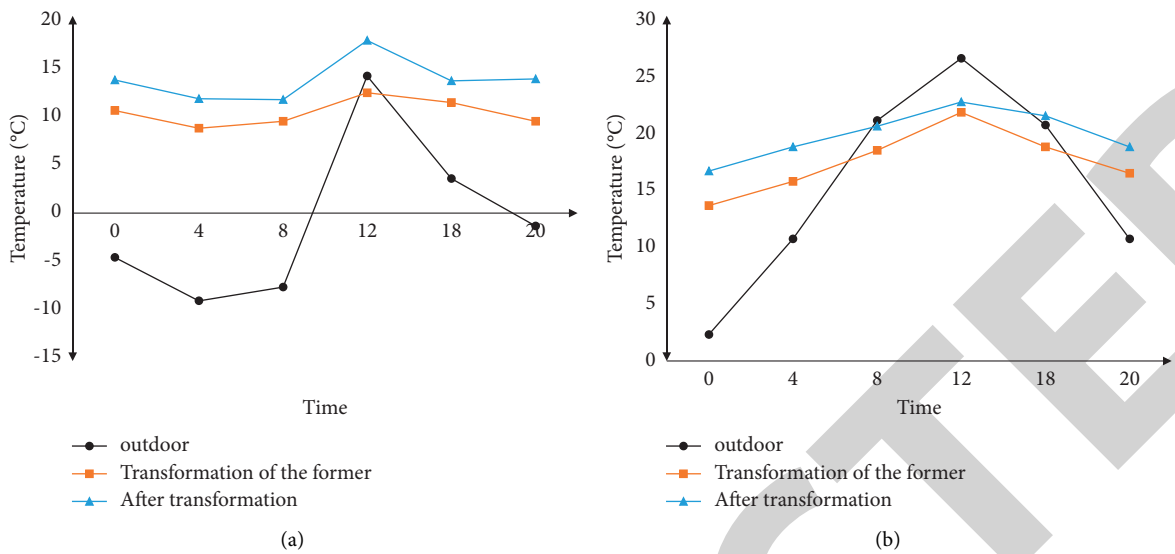


Figure 10: Comparison of indoor temperature before and after renovation. (a) Comparison of indoor temperature in winter before and after renovation. (b) Comparison of indoor temperature in summer before and after renovation.

winter, the rational use of solar radiation is of great significance for room heating and reducing heating energy consumption.

For buildings with no natural ventilation and constant indoor air temperature, the effect of radiant temperature is more obvious. Figures 9(a) and 9(b) show the same thermal resistance, the attenuation factor of 60, the constant temperature room constituted by the envelope with the delay time of 5 hours and the attenuation factor of 10, respectively. A schematic diagram of the radiation temperature and operating temperature changes of the envelope with a delay time of 1 hour under the influence of the outdoor temperature harmonics is shown. Figures 9(a) and 9(b) show the same thermal resistance, the attenuation factor of 60, the constant temperature room constituted by the envelope with the delay time of 5 hours and the attenuation factor of 10, schematic diagram of the radiation temperature and operating temperature changes of the envelope with a delay time of 1 hour under the influence of the outdoor temperature harmonics, respectively. The outdoor meteorological parameters are still taken according to the local summer conditions. It can be seen that due to the selection of enclosure structures with different heat storage coefficients and structural forms, the attenuation factor differs by 6 times and the delay time differs by 5 times, resulting in a room with good thermal stability. The radiation temperature and operating temperature are very stable. In a room with poor thermal stability, although the air temperature is constant, the operating temperature still changes drastically under the influence of the radiation temperature change. That is to say, although the indoor air temperature is controlled within a constant range by means of equipment adjustment, if an inappropriate enclosure structure is adopted, the temperature felt by the human body will still change drastically. When the neutral temperature is distributed according to Figure 9(b), a larger cooling energy consumption is required to make a room with a small attenuation factor meet the comfort requirement. Due to the poor thermal stability, the radiation temperature of the room with a small attenuation factor changes drastically within 24 hours, resulting in the still drastic change of the operating temperature, which is very unfavorable in terms of energy saving and human physiological health.

Table 3: Daylighting coefficients before and after renovation.

| Distance from the window (m) | Transformation of the former (%) | After transformation (%) |
|---|---|---|
| 0 | 17.3 | 31.5 |
| 3 | 3.6 | 10.6 |
| 6 | 1.4 | 1.9 |
| 9 | 0.4 | 0.4 |

*4.4. Transformation Effect.* In order to compare the advantages and disadvantages of the indoor environment quality of the kiln dwelling buildings before and after the renovation, a comprehensive simulation of the indoor thermal environment was carried out. Through comparison, an accurate evaluation can be made on the renovated cave dwelling buildings, which is of great significance to whether the new cave dwelling buildings can become a sustainable living model in the Loess Plateau. The thermal environment includes indoor and outdoor ambient temperature, daylighting coefficient, acoustic environment and acousto-optic environment, as shown in Figure 10, Tables 3– 5, respectively.

The abovementioned results show that the green-renovated cave dwelling not only inherits and retains its traditional advantages but also significantly improves the indoor comfort. The results show that the indoor physical environment quality of the renovated kiln house is better than that of the traditional kiln house. The new type of cave dwelling not only provides a good living model for the

Table 4: Cave acoustic environment.

| | Transformation of the former | After transformation |
|---|---|---|
| Background noise (dB) | 27.3~30.2 | 27.3~29.4 |
| Noise when no one speaks (dB) | 24.3~31.8 | 33.3~39.5 |
| Noise when someone is talking (dB) | 24.1~54.5 | 43.2~53.1 |

Table 5: Cave light environment.

| | Outdoor (lx) | Indoor (lx) |
|---|---|---|
| Suitable light intensity | — | 1000 |
| Transformation of the former | 40500 | 400 |
| After transformation | 40500 | 1100 |

ancient villages on the Loess Plateau but also has substantial significance for the inheritance and extension of the local cultural context, and creatively improves the architectural living environment in the area.

Cave dwellings are products that conform to the natural ecology and social economy, and are the crystallization of the experience and wisdom of the working people. The green thinking contained in them makes them a typical example of energy saving and land saving. In contemporary architectural design, it is necessary to learn from the experience of ecological architecture embodied in traditional dwellings, and to develop it according to the characteristics of the times. Especially in the design process of residential buildings in local towns, it is necessary to be good at using ecological language to make residential buildings more livable.

## 5. Conclusions

With the rapid development of the global economy and the accelerating process of urbanization, countless high-rise buildings across the country have been erected, resulting in more and more traditional dwellings disappearing from people's sight. While blindly pursuing immediate interests and comforts, the environment has also given human beings a blow. Climate deterioration, resource depletion, soil erosion and other problems that have appeared in recent years are all caused by human overdevelopment in violation of the laws of nature. Traditional ancient villages and their dwellings are living models that are compatible with the ecological environment and are the result of sustainable development. Studying the ecological strategies for their construction has a good reference value for contemporary village construction and architectural design. The disadvantage of this paper is that the relevant calculations and software simulation operations are carried out under ideal conditions and the results are inevitably slightly biased. The authors used meteorological data from the nearest area, but can guarantee that the final result will not be affected. Therefore, in the follow-up research, more historical and traditional buildings and more ancient villages will be studied.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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*Retraction*

# Retracted: Green Innovation and Enterprise Sustainable Development Performance Based on the SBM-DEA Model

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] N. Han, F. Li, J. Long, J. Liu, and Q. Li, "Green Innovation and Enterprise Sustainable Development Performance Based on the SBM-DEA Model," *Journal of Environmental and Public Health*, vol. 2022, Article ID 3127899, 10 pages, 2022.

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*Research Article*

# Green Innovation and Enterprise Sustainable Development Performance Based on the SBM-DEA Model

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Since the introduction of a low-carbon economy, corporate performance is no longer limited to the evaluation of internal economic benefits but has become the performance of corporate sustainable development, adding environmental and social factors. Now, the whole world is paying attention to low consumption and low emission. As the main economic pillar of society, the enterprise undertakes the biggest low-carbon task. In order to develop the economy in the longer term and meet the needs of society, enterprises must combine green innovation to evaluate the performance of sustainable development. However, because the previous model's analysis of performance will produce distortion effects, the data error is also relatively large. Therefore, in order to solve these problems and make performance analysis more realistic, this paper deeply discusses the issue of green innovation and enterprise sustainable development performance. Using the method of the SBM-DEA model, it analyzes the performance comparison of enterprises without and with the expected output and conducts a comparison experiment. The result shows that in 2017, the efficiency of company A without unexpected output was 0.6943. The efficiency with undesired output is 0.6643. In 2018, the efficiency of the enterprise without undesired output is 1, and the efficiency with undesired output is 1. After applying the model, it is obvious that the efficiency of computing performance has been greatly improved. Therefore, in order to better study the sustainable development performance of enterprises, the SBM-DEA model should be focused on.



## 1. Introduction

China's economy continues to achieve new high-speed growth, but the price of this growth is the destruction of the natural environment and the consumption of natural energy. In the process of economic development, human beings have produced too many sources of pollution, and these pollutants have squeezed the bearing capacity of the Earth's environment. It leads to extreme ecological imbalance and global warming; some harmful substances affect the health of many people; and natural resources are gradually depleted. This is undoubtedly another warning from the Earth to mankind, there is only one Earth, and these injuries are of a global nature. Through relevant surveys, it can be found that the pollutants emitted by enterprises are the largest. Therefore, enterprises should undertake this social responsibility, formulate green innovation strategies, and attach importance to the implementation of the concept of sustainable development. By deepening the concept of green development, innovating technological models, and improving corporate performance, a positive corporate social image should be created. At present, many scholars have studied the topic of green innovation and enterprise sustainable development performance, but there are relatively few studies using the SBM-DEA model. The SBM-DEA model is an efficiency evaluation method. It can solve the slack problem of input and output and reduce the impact of undesired output on efficiency measurement. If the model is applied to the analysis of green innovation and enterprise sustainable development performance, it is believed that it can get good results.

The implementation of enterprise green innovation strategy is to make enterprises pay more attention to green management, reduce waste of resources, and enhance the thinking of caring for the environment. Many scholars have also done research on green

innovation and corporate sustainability performance. Guan [1] studied the innovation management performance evaluation model of papermaking enterprises based on organizational shared thinking and constructed a management structure model [1]. However, he did not explain much about the concept of organizational mind sharing in the text. Randeree and Ahmend [2] studied the case of Masdar City's urban sustainable development strategy and used it to verify the social sustainable development effect of eco-city [2]. The analytical description they develop in the text lacks a conclusion. Zhang and Lin [3] used quantitative analysis methods to study the high-quality development of the urban economy from multiple aspects and found that innovative green strategies are very suitable [3]. However, they did not make a comparison of urban and rural incomes in the article. He and Shi [4] discussed the impact of environmental regulation on the performance of exploratory innovation, developmental innovation, and green innovation of enterprises [4]. The model they choose in the text is not very suitable.

After analyzing the research results of other scholars, Singh et al. [5] studied the relationship between green innovation strategy and corporate performance and found a positive correlation [5]. But the experiments they conducted in the paper did not take into account the existence of possible influencing factors. Yiyun [6] used the spatial measurement method to test the green innovation ability and performance of enterprises, and the result showed that the competitive relationship can help enterprises develop better [6]. But none of the data he used in the text is up-to-date. Zhang [7] studied the innovation and green development of many enterprises and found that the development of a green economy can effectively improve the performance of enterprises [7]. But he did not describe the before and after comparison of enterprise performance in the article.

The SBM-DEA model has a very wide range of applications, and it has many advantages. It has very good advantages in simplifying the algorithm and reducing errors. The innovation of this paper is to use a novel method, the SBM-DEA model, to study green innovation and enterprise sustainable development performance. In the research process, relevant data and analysis are used in a convenient way to provide support for future green innovation and enterprise sustainable development performance analysis.

## 2. Method of Green Innovation and Enterprise Sustainable Development Performance

*2.1. Green Innovation.* Green innovation is to make full use of human and financial resources and knowledge under the premise of protecting the amount of energy and the natural environment to achieve economic, environmental, and social gains. The process of achieving this is green innovation [8]. Green innovation also includes a lot of content, as shown in Figure 1.

From the information in Figure 1, the difference between green innovation and the innovation advocated before is still very obvious [9]. Green innovation needs to consider the issue of protecting the environment. Its purpose is not only to improve the economic level of enterprises but also to ensure ecological balance and coordinate the conflict between the environment and economic development to ensure the sustainability of enterprise development. Green innovation is not just about technological innovation, not just to meet the needs of the market; the government will also provide corresponding policies to promote its changes. Therefore, green technology, market demand, and government policy are its three aspects, and these three aspects also promote its progress. We can find that green technology has the greatest effect on it. At present, the country is vigorously carrying out the implementation and research and development of green technology, combining green technology with the Internet to improve the labor force. It reduces high energy consumption, reduces pollutant emissions, and effectively improves the natural environment. In fact, the main purpose of designing green innovation activities is to protect ecological resources, study the transformation of different substances, and let new energy technologies replace high energy consumption methods. This makes economic development green and harmonious. Through its construction of a green and economical society, the ecological balance has been maintained. Therefore, in general, green innovation is to make economic development and ecological balance on the same front, check and balance each other, and advance together, thereby promoting the generation of new technologies and reducing energy consumption and pollutant emissions.

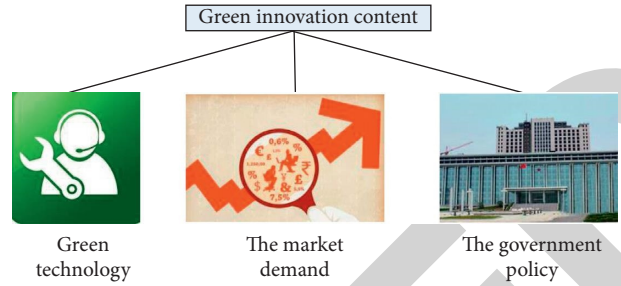


Figure 1: Contents of green innovation.

The concept of green innovation is given above. Below, we summarize the indicators of green innovation [10], as shown in Figure 2.

Information can be obtained from Figure 2, which has a total of six indicators [11]. The first indicator is the innovation object, mainly about products, services, and production methods. Product innovation is to make the product more green concept and make it circulate in the market, which brings people a better sense of experience. The innovation of services is to integrate the current low-carbon requirements, so as to eliminate waste and increase the burden on the Earth. In the process of service, users can also experience the wind of green saving. The innovation of production methods is the most important part because, according to our investigation, most of the production methods in the country currently bring many pollutants.

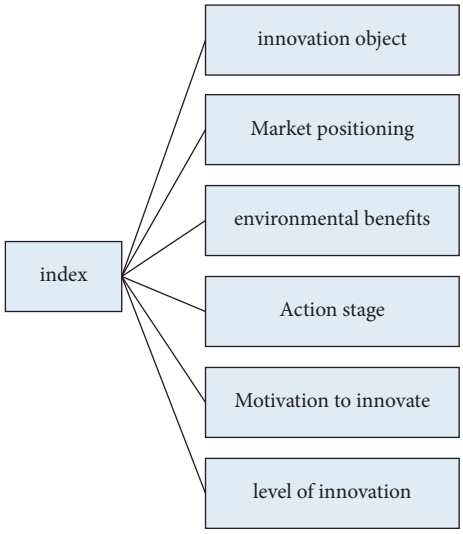


Figure 2: Green innovation indicators.

This has a great impact on the ecological environment. There is only one Earth, and environmental pollution is of a global nature. Therefore, it is necessary to change production methods and optimize innovation methods so that it can implement the concept of green and low-carbon. The second indicator is market positioning, which mainly refers to the need to meet the needs of customers and the competitive environment of the market. Due to the introduction of low-carbon policies, people's awareness of environmental protection has been strengthened. The needs of customers are also gradually linked to green and low-carbon, so the current market positioning is also to be green, low-carbon, and environmentally friendly. The competitive environment of the market should also be positive, and the concept of green innovation should be implemented. The third indicator is environmental benefits, and the environment is the most important indicator here. The introduction of green innovation is to improve the ecological environment and reduce the harm caused to the environment when developing the economy, hoping that the economy can move forward in harmony with the environment. The fourth indicator is the effect stage. What it means is to include the present and the future, to apply this green principle all the time. The fifth indicator is innovation motivation. There is a motivation to do everything, and innovation also has a motivation. It is mainly to minimize the damage to the environment. The sixth indicator is the level of innovation, and the level of innovation is also different, and different standards can be completed from different levels of enterprises, departments, and individuals [12].

*2.2. Sustainable Development.* Sustainable development is a long-term economic growth model [13]. Its ideal state is to meet the needs of current people without affecting the continued development of future generations. It is actually the thought that people get after realizing the seriousness and then reflecting on the ecological destruction [14]. It is a concept that is being promoted all over the world now. It has several basic principles, which can be seen in Figure 3.

Information can be obtained from Figure 3, which has a total of six basic principles [15]. The first principle is the principle of fairness, which mainly means fairness when everything chooses a chance. Creatures in the Earth's ecological cycle predate human beings' possible existence. Our uncontrolled and excessive consumption of the Earth's resources has caused irreparable damage to the space environment in which they live [16, 17]. It is not fair to them. There is also the fairness of predecessors and future generations, and the Earth's resources are not inexhaustible. It is quantitative. If predecessors consume resources excessively, future generations will not get any resources and will clean up the mess left by predecessors. This is not fair to posterity [18]. The second principle is the principle of sustainability, which is the most important part of the six principles. What it means is to emphasize the continuous use of resources and to maintain normal productivity even if the ecology is disturbed by the outside world. To rationally develop and utilize natural resources, the population size should be controlled as much as possible, and the relationship between the economy and the natural environment should be coordinated. The third principle is the principle of harmony, which is an explanation of sustainable development. It means to pay attention to the peaceful coexistence between man and nature [19]. It is hoped that human beings can abide by the laws of nature and treat the natural environment sincerely so that people and nature can interact and make progress together. The fourth principle is demand. It advocates meeting the needs of all people, not selling people's needs as commodities, and creating a vision of a better life. The fifth principle is the principle of efficiency. It means that efficiency is not measured in terms of productivity but in terms of people's actual satisfaction. The sixth principle is stepwise [20]. It mainly says that because of the progress of society, people's requirements will be higher, so future development will change from a low level to a high level.

It also has several connotations, as shown in Figure 4:

Information can be obtained from Figure 4, and its connotation has four points [21]. The first point is to highlight new development themes. It does not blindly pursue economic growth; it considers various factors, such as society, culture, technology, environment, and so on. It pays attention to the rights that people have in common, and countries at any stage have the same right to development. No one can take away this right. The second point is the sustainability of development, and the starting point for this is the ecological environment. It advocates that when human beings develop society and economy, they should consider reducing their impact on the environment. We cannot just focus on production without restraint, without considering the issue of protecting the environment. Once the natural environment can no longer bear it, human beings will suffer a backlash. The third connotation is the fairness of human-human relations. It means that even if the current generation cannot plant trees and let others enjoy the shade, they should not use up resources prematurely so that future generations

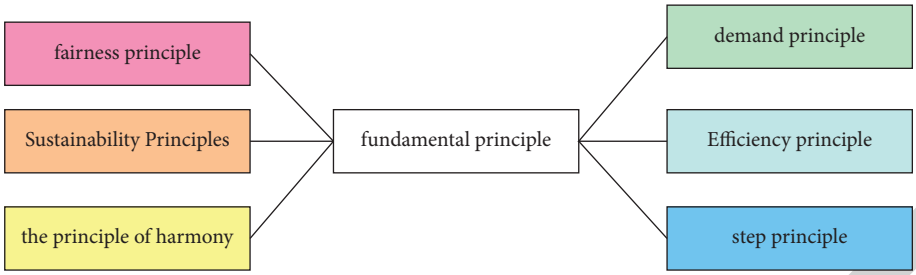


Figure 3: Basic principles.

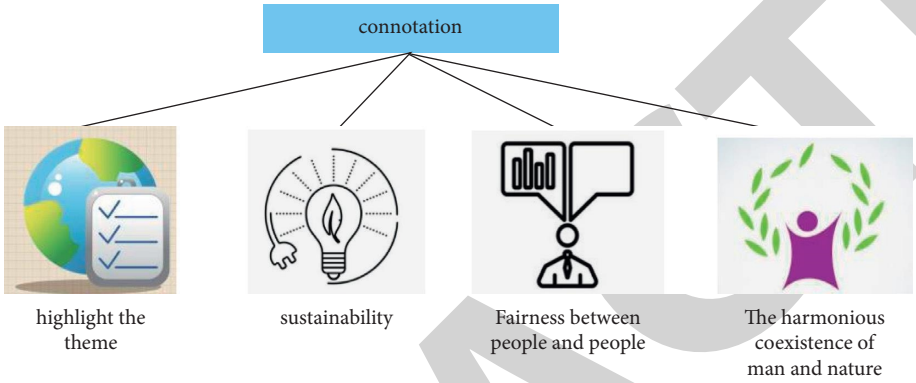


Figure 4: Connotation of sustainable development.

have no resources to use. Opportunities between people should be equal. Whether it is predecessors or future generations, everyone should get the same resources. The development of the previous generation should not harm the interests of the next generation. Therefore, we must pay attention to sustainable development so that resources can be used effectively and long-term development. The fourth point is the harmonious coexistence of man and nature [22]. People need to know that there is only one Earth. If the ecological balance of the Earth is destroyed by human beings, then only the extinction of human beings will be greeted. Therefore, human beings must establish a new green concept, learn to respect nature, protect nature, and achieve the realm of peaceful coexistence between man and nature. People do not just ask for nature; we can also give back to nature, invent more new energy technologies, replace high energy consumption, and help build the ecological balance of nature.

*2.3. Corporate Performance.* Enterprise performance is the internal consideration and evaluation of the enterprise, which is expressed by relying on the financial indicators in the audit. The corporate social performance is a more comprehensive assessment, indicating the relationship between the organization and various stakeholders [23]. The basic framework of enterprise performance evaluation is shown in Figure 5.

From Figure 5, we can get the information that the sustainable development enterprise performance evaluation system is a "triple performance" evaluation model. It consists of three parts, namely economic performance, environmental performance, and social performance [24]. These three parts can be regarded as the three legs in its evaluation system, which stably support the evaluation system, and the relationship between these three legs is also very clear. In fact, the content of the enterprise performance evaluation system of sustainable development is the concept of sustainable development, stakeholders, and corporate social responsibility. These three subjects represent the evaluation indicators well. Because the main body of stakeholders has become more and more, the interests requested by everyone have also become different. The scope of performance evaluation is no longer limited to corporate economics but also adds corporate social responsibility and responsibility for protecting the environment. These three dimensions represent the sustainable development of enterprises [25].

The enterprise performance map can be seen in Figure 6 for details.

From Figure 6, we can know the information because green innovation and corporate responsibility are very closely related, and the behavior of enterprises not only affects the enterprise itself but also affects the whole society. Social performance is the external social responsibility image of an enterprise [26]. Enterprises should not only focus on making profits but should undertake social responsibilities. While it creates social wealth, it should also undertake corporate social responsibility. At the same time, the social performance also includes the economic contribution of the enterprise to society, and the enterprise also has the goal of creating value for society. Enterprises can drive the increase

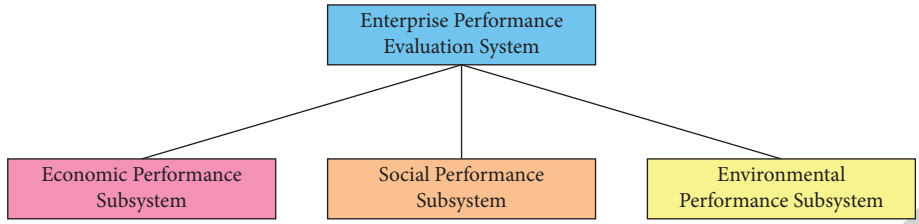


Figure 5: Basic framework.

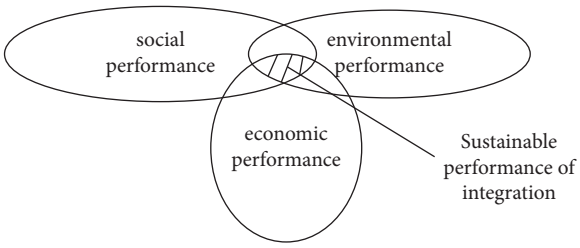


Figure 6: Enterprise performance graph.

in employment rate and contribute tax revenue, which are all part of their social responsibility. Economic performance refers to the internal profitability of an enterprise, and the primary purpose of any enterprise is to strive for profits. If the goal of an enterprise is not to make profits, then the enterprise can only go into decline in the end. Its evaluation standard is mainly determined according to resource allocation and resource utilization, but it is very difficult to take into account both situations when evaluating. Therefore, the general evaluation will be carried out after different standards are formulated. The environmental benefit is an evaluation index extended according to the sustainable development of enterprises. In order to meet the needs of the current low-carbon society, environmental performance is added to the performance evaluation of enterprises. It mainly considers environmental performance. This assesses the company's environmental policy for the environment, the environmental goals achieved, and the environmental targets set. These environmental outcomes were measured [27].

*2.4. SBM-DEA Model.* This model is actually an efficiency evaluation method. Generally used in microeconomy, it can enrich theory and technology and can also reduce subjective factors and experimental errors and simplify algorithms [28]. However, because the traditional model has the problem of slack, the results will be unrealistic. In order to solve this problem, the SBM-DEA model was proposed.

$\delta$ is a non-negative number; then the decision-making unit can be expressed as follows:

$$\begin{aligned} C_P &= \delta C + D^-, \\ U_P &= \delta U + D^+, \end{aligned} \tag{1}$$

where $D^-$ is the input index and $D^+$ is the output index; then the efficiency model of the slack index system can be expressed as follows:

$$\begin{aligned} YR_P &= \mathrm{MIN}\frac{1 - 1/N\sum_{O-1}^{N} D_O^-/C_{OP}}{1 + 1/D\sum_{O-1}^{D} D_O^+/U_{OP}}, \\ \sum_{K=1}^{M} \gamma_K C_U + D_K^- &= C_{OP}, \\ \sum_{K=1}^{M} \gamma_K U_{OP} + D_K^- &= U_{OP}, \\ \sum_{K=1}^{M} \gamma_K &= 1.s. \end{aligned} \tag{2}$$

The linear programming is changed to get

$$\begin{aligned} YR_P &= \mathrm{MIN}Y\sum_{K=1}^{M}\frac{D_O^-}{C_{OP}}, \\ \sum_{K=1}^{M} \gamma_K C_U + D_K^- &= YC_{OP}, \\ \sum_{K=1}^{M} \gamma_K U_{OP} + D_O^+ &= YU_{OP}, \\ Y + \frac{1}{D}\sum_{K=1}^{M}\frac{D_T^+}{U_{TO}} &= 1, \\ \sum_{L=1}^{N} \beta_L &= 1. \end{aligned} \tag{3}$$

Output can be divided into desired output and undesired output. Then the sustainable innovation efficiency model can be constructed as follows:

$$\begin{aligned} P &= \mathrm{MIN}\frac{1 - 1/D\sum_{K=1}^{M} D_T^+/U_{TO}}{1 + 1/D_1 + D_2\left(\sum_{K=1}^{M} D_O^H/C_{OP}^H + \sum_{K=1}^{M} D_O^N/U_{TP}^N\right)}, \\ Y &+ \frac{1}{D_1 + D_2}\left(\sum_{K=1}^{M}\frac{D_O^H}{C_{OP}^H} + \sum_{K=1}^{M}\frac{D_O^N}{U_{TP}^N}\right) = 1. \end{aligned} \tag{4}$$

The CCR model is a more traditional model in DEA. If there are $M$ units and $C_{OP}$ represents the $0^{\text{th}}$ input index, it can get

$$YR_P = \mathrm{MAX}\left(\frac{\sum_{T=1}^{D} I_T U_{TP}}{\sum_{O=1}^{N} B_O C_{OP}}\right). \quad (5)$$

Transforming this formula, the following formula can be obtained:

$$YR_P = \mathrm{MAX} \sum_{T=1}^{D} \beta_T U_{TP}. \quad (6)$$

When $YR_P$ is equal to 1, even transforming this formula, we can get

$$\mathrm{MIN}\vartheta_P^{CCR} - \delta\left(\sum_{T=1}^{D} D_O^{+} + \sum_{T=1}^{N} D_O^{-}\right). \quad (7)$$

## 3. Experiment and Green Innovation and Enterprise Sustainable Development Performance

*3.1. Determination of Indicator Weights.* The three indicators of corporate performance are listed above. Next, we will conduct a questionnaire survey to investigate the leaders and staff of an enterprise and ask them to evaluate the importance of indicators. Because they are very clear about the situation of the enterprise, their evaluation will be very realistic. The obtained results are shown in Table 1.

Information can be drawn from Table 1; the economic performance is divided into five parts. The profitability weight is 0.307. The weight of asset operating capability is 0.238. The weight for developing ability is 0.162. The weight of management capability is 0.063. The weight of innovation ability is 0.06. These are the results obtained by investigating the personnel of the enterprise. From the data in the table, we can know that the most important factor in economic performance is profitability because the primary goal of the enterprise is to make profits. Unprofitable businesses end up going out of business. The second is the asset operation capability because the enterprise needs asset coordination to operate. Then everyone thinks the least important is the ability to innovate. This is also in line with the current situation of most enterprises.

The weights of economic indicators are listed above, and the weights of social indicators are listed below, as shown in Table 2.

From the information in Table 2, the social performance indicators mainly have four parts. The weight of labor employment is 0.83. The weight of social influence is 0.127. The product liability weight is 0.556. The weight of human resources is 0.238. It can be seen that labor employment is the most important component of social performance because it bears the employment rate of most people. The second is product responsibility; the product designed by the company is to serve people. Therefore, if there is any problem with the product, the enterprise should be responsible for it. The least important is social impact, which may be compared to the fact that the people of the company feel that social impact is not enough part of social performance.

Then there are the weights of environmental performance indicators, as shown in Table 3.

From the information in Table 3, the EPI has three components. The weight of resource utilization is 0.62. It is the highest among the three parts, indicating that the strikes believe that resource utilization is the most important component of environmental performance. The requirement of a low-carbon society is to reduce the use of resources. The weight of emissions is 0.285, which is also considered important. Because the large amount of emissions produced by enterprises in the production process has caused adverse effects on the environment, emissions also occupy a place in environmental performance. The weight of environmental governance is 0.097. Because the first two parts are done, this part is not so important. Therefore, the company believes that the importance of environmental governance is relatively low.

*3.2. Experiments Based on the SBM-DEA Model.* In order to verify the reliability of the model in this paper, we collected the input-output data of a certain enterprise, as shown in Figure 7.

The information can be obtained from Figure 7. From 2017 to 2020, the fixed asset index of the company has always belonged to an upward trend, increasing year by year. The company's total profit is not very stable. This can be affected in many ways. But, overall, there is still an upward trend. The fixed asset value of the company in 2017 was 2,614,917.9; in 2018, it was 2,805,940.93; in 2019, it was 3,000,537.36; and in 2020, it was 3,765,123.2. The growth rate is still very fast, and it is expected to grow in the future, which shows that the fixed asset value of the company is very stable. The total profit of the company in 2017 was 81,835.5; in 2018, it was 244,419.8; in 2019, it was 159,091.83; and in 2020, it was 218,245.62. During this period, the total profit showed a loss, which shows that the production and operation of the enterprise were affected by other factors, but the overall profit curve still showed an upward trend.

In order to prove the excellent performance of the model, one enterprise may be less as a case, and we analyze the data of three enterprises. The enterprise performance efficiency excluding undesired outputs and the environmental efficiency of undesired outputs are compared. The result is shown in Figure 8.

From Figure 8, we can get the information that the performance efficiency of company A is the best. In the past 4 years, this enterprise has been at the forefront of efficient production, indicating that the input and output of this enterprise are very effective. Even in the case of sustainable development and green innovation, its efficiency is still at a high level. All aspects of the enterprise are developing in a balanced manner. In 2017, the efficiency of company A without unexpected output was 0.6943. The efficiency with undesired output is 0.6643. In 2018, the efficiency of the enterprise without undesired output is 1, and the efficiency with undesired output is 1. In 2019, the efficiency of the

Table 1: Economic indicators.

| Index | Profitability | Asset operation | Development ability | Management ability | Creativity | Weights |
|---|---|---|---|---|---|---|
| Profitability | 2 | 1/3 | 3 | 6 | 6 | 0.307 |
| Financing | 3 | 2 | 2 | 5 | 3 | 0.238 |
| Development | 1/5 | 2 | 2 | 4 | 4 | 0.162 |
| Management | 1/3 | 1/5 | 1/4 | 5 | 5 | 0.063 |
| Innovation | 1/3 | 1/5 | 1/4 | 1/3 | 1 | 0.060 |

Table 2: Social indicators.

| Indicators | Labor and employment | Social influence | Product liability | The human resources | The weight |
|---|---|---|---|---|---|
| Indicators | 2 | 1/3 | 1/5 | 1/4 | 0.83 |
| Social influence | 3 | 2 | 1/5 | 1/5 | 0.127 |
| Product liability | 6 | 5 | 2 | 5 | 0.556 |
| The human resources | 4 | 4 | 1/5 | 2 | 0.238 |

Table 3: Environmental indicators.

| Indicators | Resource utilization | Emissions | Environmental governance | The weight |
|---|---|---|---|---|
| Resource utilization | 2 | 4 | 5 | 0.62 |
| Emissions | 1/4 | 2 | 5 | 0.285 |
| Environmental governance | 1/5 | 1/5 | 2 | 0.097 |

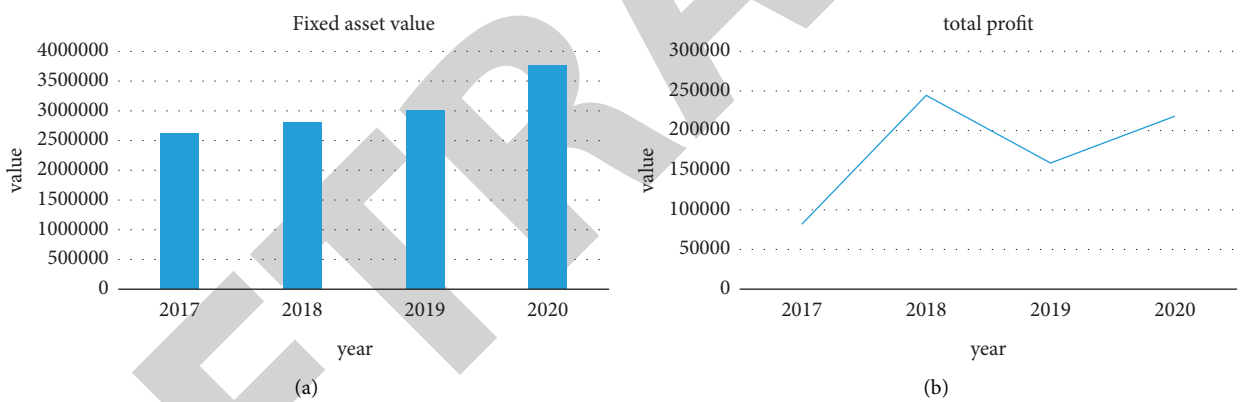


Figure 7: Input-output data: (a) value of fixed assets and (b) total profit.

company without undesired output is 1, and the efficiency with undesired output is 1. In 2020, the efficiency of the company without undesired output is 1, and the efficiency with undesired output is 1. This shows that the company's performance in sustainable development is very good under green innovation. This also proves the applicability of the model in this paper from the side, using the efficiency of expected output and undesired output to compare, making the results more clear and specific.

Next, we make statistics on the Malmquist indices of the three companies without expected output, as shown in Figure 9.

From Figure 9, it can be seen that the Malmquist index of the latter two firms is greater than 1. In recent years, there have been great improvements in management and technology, and enterprises are also developing in a direction that is conducive to enterprise progress. A company's Malmquist index is between 0.9 and 1, which means that it has not developed comprehensively in terms of technical efficiency or technological progress. Its technical efficiency index is greater than 1, while the technological progress index is less than 1. Since the degree of impact of technological progress is greater than that of changes in technical efficiency, its Malmquist exponent is less than 1. That is to say, although the enterprise may have made some progress in enterprise management in a few years. But the extent of its lack of technical aspects hinders the production development of the entire enterprise. If all indexes of the enterprise are less than 1, the enterprise needs to adjust the strategic management structure to help the enterprise develop better. Without considering the undesired output, only company *B* is on the frontier, the performance efficiency of company A is relatively high, greater than 0.8, and the efficiency value of company *B* with relatively low efficiency is less than 0.4.

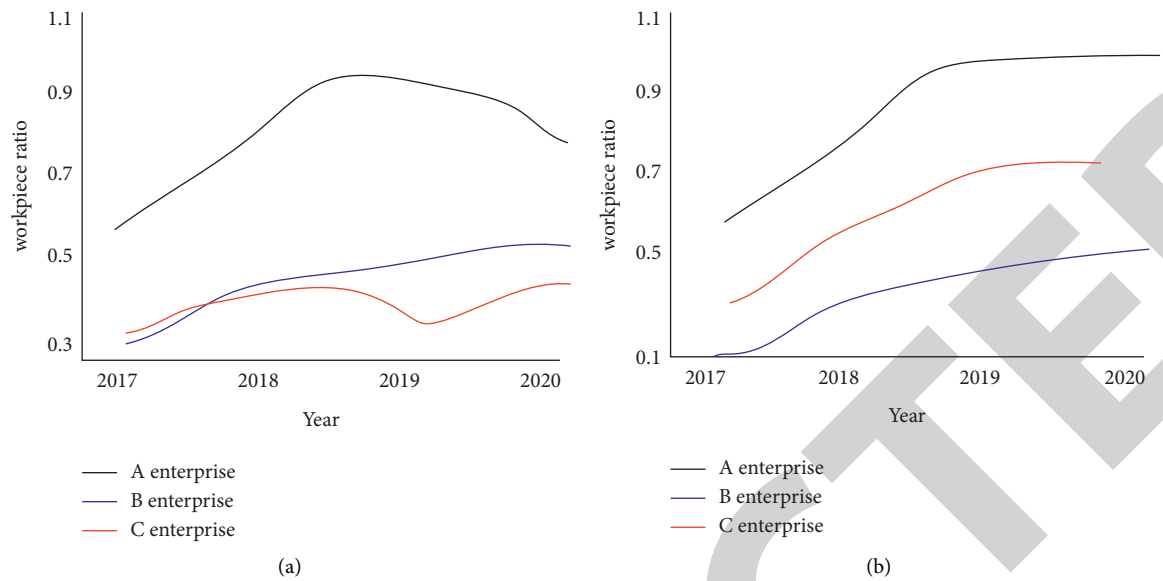


Figure 8: Comparison of enterprise performance efficiency: (a) does not contain undesired outputs and (b) contains undesired outputs.

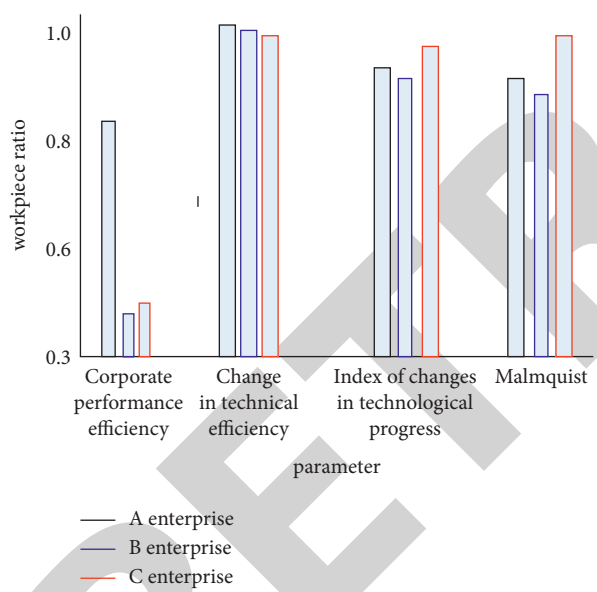


Figure 9: Statistics of Malmquist indicators of various enterprises without expected output.

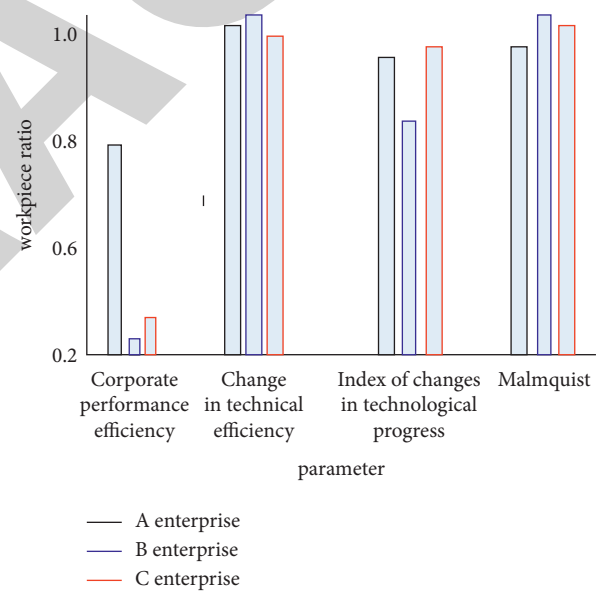


Figure 10: Malmquist index statistics for companies with unexpected outputs.

Through the model listed in this paper, these data and information are well obtained, which shows that the model in this paper is very suitable for the analysis of enterprise sustainable development performance.

Below, we also conduct statistics on the Malmquist index of each company with the expected output, and the results are shown in Figure 10.

From Figure 10, it can be seen that the Malmquist index of firms A and B is greater than 1, and only the technical efficiency of the three firms is greater than 1. This shows that the management and technology of these two enterprises have been greatly improved in recent years, and the level of performance efficiency has a trend of developing in a good direction. The Malmquist index of enterprise A is between 0.9 and 1, which means that the development of production efficiency of this enterprise is uneven. The reasons are all a matter of technological innovation and change. In terms of efficiency, compared with the data without undesired output, the efficiency value of enterprises with undesired output has decreased to varying degrees. The average efficiency of the three companies is only 0.47, and the efficiency values of companies B and C are far lower than the average efficiency value. This shows that after taking into account the undesired output, the negative effect of this indicator has resulted in different degrees of impairment in comprehensive

technology. This also means that firm efficiency evaluations that do not take into account the impact of undesired outputs are unrealistic. It further proves that the model in this paper can avoid the result distortion caused by the limitation of angle and radial direction of the traditional DEA model. It reflects the real enterprise performance efficiency and provides scientific and reliable data support for performance auditing.

## 4. Conclusion

This paper studies and analyzes the performance of green innovation and enterprise sustainable development through the SBM-DEA model and concludes that nonapplication of the model is of great help to the study of enterprise performance. It is more accurate and more realistic than the general model, making the output data more scientific and accurate. Therefore, further research on the implementation effect of this model can be considered. Due to the limited length of the article, it cannot cover all aspects, and there are not many examples used in the research. This is also the limitation of this paper. In the future, the author looks forward to using more real data to conduct in-depth research, so as to explore more methods for researching green innovation and corporate sustainable development performance. At the same time, we also firmly believe that there will be more and more researches on this topic in the future, and the sustainable development performance of enterprises will be better and better.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgments

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*Retraction*

# Retracted: A Study on the Strategy of Sustainable Governance of NIMBY Movements: Focusing on Civil Environmental Rights

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] C. Cao, "A Study on the Strategy of Sustainable Governance of NIMBY Movements: Focusing on Civil Environmental Rights," *Journal of Environmental and Public Health*, vol. 2022, Article ID 2514373, 6 pages, 2022.

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*Research Article*

# A Study on the Strategy of Sustainable Governance of NIMBY Movements: Focusing on Civil Environmental Rights

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It is a common problem faced by countries in the process of industrialization and urbanization that citizens oppose the construction of negative externality facilities near their residence. Environmental right is one of the basic rights enjoyed by citizens and also an important part of human rights, allowing citizens to participate in their own environmental use decisions and defend their own environmental rights and interests against infringement. This paper focuses on the basic environmental rights of citizens, essentially defines the NIMBY movement as a movement for justice in which citizens advocate for equal environmental rights and interests, and analyzes the movement's rationale or the fundamental environmental rights of citizens. Disregard for citizens' substantive and procedural environmental rights and interests is linked to NIMBY movements. At the same time, compared with the traditional campaign-styled governance paradigm, the sustainable development governance emphasizes joint negotiation and multiple interactions, which can better maximize the environmental benefits of the whole governance cycle. Therefore, this paper discussed the governance path of NIMBY from two dimensions: determining the boundaries of citizens' substantive environmental rights and interests for enhancing their sense of identity and protecting citizens' procedural environmental rights and interests by laying more emphasis on the sustainable governance of NIMBY movements.



## 1. Introduction

Currently, NIMBY incidents occur from time to time, while the solution is often limited by the pressure of maintaining stability and the dilemma characterized by protest, compromise, and construction suspension. The limitations are attributed to the failure to adopt a strategy of sustainable governance. A NIMBY movement may be perceived as socially destabilizing and met with rude suppression or a compromise when suppression fails, leading to a bizarre circle of "distribution by the degree of instability." In turn, such a situation radicalizes a NIMBY movement. Since the NIMBY itself is a product of unequal distribution of citizens' environmental rights and interests, it is particularly important to explore NIMBY movements by focusing on citizens' basic environmental rights, analyze the nature and causes of NIMBY movements, and discuss the path of sustainable governance in a bid to solve the NIMBY dilemma. Meanwhile, sustainable development governance refers to the rule of law process in which the government, the market, enterprises, social organizations, and the public jointly manage public affairs and assume public responsibilities through joint consultation and other interactive ways based on their common rights, so as to continuously maximize public interests and maintain social justice [1]. The nature of the NIMBY movement determines that it needs to be governed by sharing rights and jointly negotiating in order to maximize the governance efficiency.

## 2. Civil Environmental Rights: A Focus on Exploring NIMBY Movements

*2.1. NIMBY and Civil Environmental Rights.* Not in My Backyard (NIMBY), a term first proposed by O'Hare in his paper, refers to the opposition of citizens to public facilities being built in their neighborhood. NIMBY movement means that citizens fear some construction projects (toxic waste disposal sites or landfills, incineration sites, etc.) which

may have negative impacts on the quality of the surrounding environment, asset value, or physical and mental health, which in turn breeds aversion and antagonistic behavior [2]. Since the waste incineration power generation project in Liulitun, Haidian District, Beijing, was protested by residents in 2006, the conflicts caused by the construction of waste treatment facilities have occurred from time to time, resulting in great impact. For example, due to the government's late publicity of the information on the waste incineration power generation project before the project approval in Yuhang District of Hangzhou, the surrounding public lacked understanding of the project construction information, which led to the emergence of a large-scale neighborhood avoidance movement. For another example, due to the failure to publicize the kitchen waste resource treatment station project in Xi'erqi, Haidian District, Beijing, residents believed that the site selection of the project was unreasonable, because there were many residential quarters, kindergartens, primary and secondary schools, hospitals, and other public institutions around the project, which lead to large-scale petitions [3]. By the degree of citizens' resistance, NIMBY movements can be roughly divided into the pre-NIMBY period when citizens lack knowledge of toxic pollutants, the early NIMBY period when discrete sporadic resistance is done, and the post-Love Canal period when aggregated resistance occurs. The research on NIMBY movements can also be correspondingly classified into the nascent, developmental, and mature periods. Scholars in all periods have also presented various views on the nature of NIMBY [4].

In the nascent and developmental periods, most scholars viewed NIMBY as an unjustified emotional behavior, arguing that NIMBY movement originated from citizens' protection of their personal self-interest and was an extreme act of citizens' stubborn opposition to the construction of public facilities that they believed may adversely affect their living. For instance, Frey et al. contended that NIMBY is "beneficial for citizens but harmful to individuals" [5]. However, the viewpoint only emphasized citizens' tolerance obligation but did not take into account their environmental rights, ignoring citizens' desire and pursuit of a better environment. The deviation from understanding the nature of NIMBY directly triggered strong opposition of citizens in a community, instead culminating an extreme NIMBY movement. After the mature period, scholars reflected on the deviation of defining NIMBY In the past and redefined NIMBY from various angles. Before the environmental justice theory, scholars analyzed NIMBY in terms of social governance, economics, and psychology. Regarding social governance, when preventing and controlling social incidents, NIMBY is considered as an overreaction of citizens to influence government decisions out of their own interests, while maintaining social stability is a targeted countermeasure, ignoring the legitimate demands of citizens [6]. From the perspective of economics, the main consideration is about interest. The NIMBY phenomenon is attributed to the conflict between public interests and citizens' environmental interests, which eventually leads to the paradox of public interests and individual interests. [7] From a psychological perspective, the main focus is on the process from the formation of the NIMBY mentality to the NIMBY behavior influenced by the mentality. The behavior is simply attributed to the citizens' overreaction, which disregards the negative externalities of NIMBY facilities and presents a biased understanding of the nature of NIMBY [8].

In contrast to the psychological, economic, and social governance perspectives that stigmatize NIMBY movements, such movements are perceived from the perspective of civil environmental rights to recognize citizens' environmental rights to live and develop in a beautiful comfortable environment and confront the just distribution of citizens' tolerance obligations and environmental rights. The essence of NIMBY is defined as a just movement in which citizens stand for equal environmental rights.

*2.2. Source of Rationality of NIMBY Movements: Civil Environmental Rights.* The concept of environmental rights originated in the West in the 1960s, roughly fifty years ago [9]. More than 30 years earlier, Ken.saro-Wiwa declared that "the environment (right) is the primary right of human beings" [10].

As of 2010, 142 of 198 UN member states had recognized environmental rights directly or indirectly in their constitutions, with civil and environmental laws in Germany, Russia, and Switzerland, among others, containing specific provisions for environmental rights [11]. In terms of its attributes, the right to environment is a nonproperty right related to personality, and its exercise is personality-oriented and nonproperty. In other words, the exercise of environmental rights is only based on personality needs (such as people's needs for peaceful enjoyment of health, comfort). It neither pursues the acquisition or appreciation of wealth nor consumes or costs environmental elements [12].

The basic environmental rights of citizens means that citizens enjoy the rights to live and develop in a healthy, comfortable, and beautiful environment. The rights are mainly manifested in substantive and procedural environmental rights and interests. The former includes the rights to life and health, clean air, water, light, ventilation, and peace, and the latter includes the rights to know about the government's environmental decisions and actions and make corresponding suggestions. Since citizens have the right to enjoy a good eco-environment, citizens' NIMBY movement cannot be simply categorized as an irrational act of affecting the public interest at the expense of their private interests. For the purpose of defending their legitimate rights and interests, citizens' resistance and protection measures are evidently justified when the healthy, comfortable, and beautiful environment they enjoy is affected and destroyed. Hence such a NIMBY movement is just. Of course, the basic civil environmental rights have boundaries, beyond which they fall within the category of citizens' tolerance obligations. A NIMBY movement perceptibly has its boundaries that depend on the legal boundary between civil environmental rights and tolerance obligations. Various environmental laws and regulations contain provisions regarding the scope of civil environmental rights and the degree of

tolerance obligations. A NIMBY movement beyond the legal boundary may abuse basic environmental rights and violate tolerance obligations, developing into extreme environmentalism and extreme individualism and then into an obstacle to social development and public interests.

*2.3. Analysis of the Causes of NIMBY Movement.* Although the facilities that trigger a NIMBY movement are the necessities of citizens' production and life, their unique nature would inevitably lead to a NIMBY movement if citizens' legitimate environmental rights and interests are not taken into account in the site selection and construction. From the perspective of citizens' environmental rights, NIMBY movement can be attributed to the disregard to citizens' substantive and procedural environmental rights and interests.

*2.3.1. Disregard for Substantive Environmental Rights and Interests of Citizens.* The current primary and direct cause of NIMBY movements lies in the disregard for citizens' rights to clean air, water, light, ventilation, peace, and other substantive environmental rights and interests in making a decision to establish NIMBY facilities. Therefore, it is difficult for citizens to develop a corresponding sense of identity while their rights and interests are violated [13]. The scope of relevant environmental laws and regulations in China is not clearly defined regarding citizens' substantive environmental rights and interests. Although citizens are legally granted corresponding substantive environmental rights and interests, which are mostly declaratory in nature, in practice, it is difficult to identify the boundary between citizens' substantive environmental rights and interests and tolerance obligations. NIMBY facilities involve a significant derogation of civil environmental rights and interests. In this case, the government's decisions are based on ambiguous norms, directly leading to the lack of citizens' sense of identity. It is difficult for the government to meet citizens' desire for justice. The difficulty results in a de facto recognition that justice has been denied. Also, some governments are still dealing with the NIMBY problem simply as a group incident through stabilization measures. It is difficult to truly recognize the legitimate environmental rights and interests of citizens and solve the problem based on the recognition. In the case of Wuhan Yangluo waste-to-energy project, for example, the government responded to citizens' concerns about the proximity of the site to universities and communities and the impact of the odor from the dump on their living by means of an environmental impact assessment (EIA) report, ignoring the citizens' demand for clean air. This led to a large mass incident, which was followed by a simple brutal halt. According to the government, the project would not commence if the public did not agree. Such a stabilization approach has not only led to an unhealthy atmosphere of "distribution by the degree of instability," but also greatly affected the credibility of the government.

*2.3.2. Disregard for Citizens' Procedural Environmental Rights and Interests.* Currently, China's decision-making mechanism for NIMBY facilities is mostly a model featuring "decision-making, declaration, and defense." The top-down model behind the scenes derives more of its advice from expert assessments. Citizens are excluded from the consultation agenda, which ignores citizens' procedural environmental rights and interests, such as the rights to know about information and make suggestions, and impedes their demands for legitimate interests.

On the one hand, the current decision-making model of NIMBY facilities is more biased towards the risk value obtained by experts and scholars using statistical models. The government demonstrates the feasibility of NIMBY projects from the technical perspective, finally informing citizens of the optimal scheme obtained accordingly. According to the approach, citizens can only passively participate in and receive decisions on building NIMBY facilities, with their right to know about decisions not fully exercised. Compared with experts, laymen tend to overestimate risks, in particular when what they receive is ambiguous expertise [14]. This does not mean, however, that citizens deny the role of professional knowledge and skills in perceiving risks. What citizens oppose more is the monopoly authority of experts over risk information [15]. The current model of decision-making ignores citizens' subjective perception of risks, emphasizing the objective risk as the basis for decisions on NIMBY projects. It is difficult to convince citizens to abandon their risk perceptions based on their experiences. In the absence of communication, this situation reinforces citizens' mistrust of experts' conclusions and contributes to their resentment against the risk information monopolized by experts and scholars. Conclusions that are originally science-based become, in the eyes of the citizens, an expert's embellishment of a NIMBY project, triggering rebelliousness among citizens and intensifying a conflict between citizens and the government. Citizens' opinions and suggestions on the current decision-making model for NIMBY facilities are made late. The chain of engagement is short, with decisions made public prior to approval of site and planning and at the EIA stage. The passive and solicited nature of the engagement approach is prominent, resulting in that citizens engage in NIMBY movements due to derogated trust interests and reducing credibility of the government.

On the other hand, the existing information disclosure channels for the planning and operation of NIMBY projects are few and the public information is sketchy, resulting in that the public do not obtain project information in a timely manner or even are informed of the relevant information in a casual and passive situation. However, the preliminary work of project has been done in an orderly manner. The lack of information disclosure and transparency has become a strategic arrangement to hinder or circumvent public engagement or to propose a project site. In essence, this practice is building up conflicts for NIMBY protests. At the EIA stage, where public participation is legally required, the public in the vicinity of a NIMBY project is circumvented in selecting participants. The only channel for releasing the EIA report with citizens less informed is chosen to make the simplified version public within the shortest legal period. The practices have exacerbated public resistance to NIMBY facilities.

*2.3.3. Analysis of the Sustainable Governance Path of NIMBY Movement.* Sustainable governance is a new paradigm of governance that differs from movement-based governance. If campaign-styled governance represents an old management paradigm, sustainable governance is a new public management paradigm. The campaign-styled governance has pan-politicization thoughts, attempting to achieve change through the promotion of authority. It advocates external and imposed changes, emphasizes the rule of others, attaches importance to consistency and obedience, stresses monism and denies diversity, advocates centralization rather than sharing of power, and swings between ideal and reality [16], while sustainable governance is just the opposite, which emphasizes sharing power and responsibility and realizes sustainable public governance with the cooperation of citizen participation, social autonomy, and government governance. It emphasizes that the rule of law attaches importance to consultation in order to resolve the opposition and conflict between the government, citizens, and other stakeholders. Its focus is placed on multiagent, multi-interaction and active change; that is, governance subjects improve their governance ability through continuous learning based on the vision and purpose of improving governance performance [17]. Compared with campaign-styled governance, sustainable governance pays more attention to the environmental rights and interests of residents' entities and procedures, pays more attention to the value of democracy and rule of law, emphasizes the rule by law and public participation, and can better reflect the core interests and demands of multiple subjects. Therefore, the sustainable governance of NIMBY movements can fully respect and recognize civil environmental rights and explore effective governance of NIMBY movements within the framework of civil environmental rights.

*2.4. Determining the Boundaries of Citizens' Substantive Environmental Rights and Interests and Enhancing Their Sense of Identity.* It is difficult for citizens to develop a sense of identity for their derogated rights and interests, making it hard to recognize justice. To solve this problem, we must first define the meaning of citizens' substantive environmental rights and interests, further refine laws and regulations, determine the boundary between citizens' rights to clean air, water, light, ventilation, and peace, and clarify the boundary of citizens' tolerance obligations. On this basis, first, the government, when making decisions on NIMBY facilities, should prudently consider whether the derogation of citizens' environmental rights and interests exceeds the boundary of tolerance obligations. The government should take technical measures or reduce the scale of projects that exceed the boundary, so that the environmental burden can fall within the boundary. Second, when the government is faced with a NIMBY movement, it needs to abandon the past governance model of "maintaining the stability." It should communicate with citizens, listen to their demands, and review the boundary of citizens' environmental rights and tolerance obligations in accordance with relevant laws and regulations. The government should respond to citizens' reasonable demands and, conversely, provide them with timely explanations. Finally, while recognizing the rationality of a NIMBY movement, the government should educate citizens about their identity. In education, it should focus on not only raising citizens' awareness of their rights, but also enhancing their awareness of responsibilities and duties. The government should build an identity education system in which rights are consistent with responsibilities, in order to teach citizens that responsibilities and duties are not the antithesis of individual rights and freedoms. The conscious performance of duties and responsibilities stems from the identification with the public value of society and the consistency of rights and obligations. This motivates citizens to spontaneously assume environmental tolerance obligations and responsibilities and fundamentally promotes a change in citizenship thinking.

*2.5. Focusing on the Sustainable Governance of NIMBY Movement and Safeguarding Citizens' Procedural Environmental Rights and Interests.* The paradigm of sustainable governance calls for shared rights and joint consultation, emphasizing the rule of law and pluralistic interaction. In order to realize the sustainable governance of NIMBY movement, it is necessary to take corresponding governance instruments in the process of NIMBY decision-making at different points.

*2.5.1. Before NIMBY Decision-Making.* Before making a decision on a NIMBY facility, first of all, the government should strengthen communication with citizens in the NIMBY area, encourage the consultation between NIMBY enterprises and citizens, and change the model featuring decision-making, declaration, and defense to one characterized by engagement, consultation, and consensus. The latter model involves the government, enterprises, and citizens in the whole process. In response to the problems of late citizen engagement, low sense of existence, and lack of ways to express demands regarding the site of NIMBY facilities, the citizen engagement chain can be lengthened to introduce the engagement and interaction of pluralistic subjects, so that multiple parties can reach a consensus on risks and benefits compensation of NIMBY facilities [18]. The consensus is reached through consultation before the decision and announcement. Then, the government and NIMBY enterprises should disclose the planning information of NIMBY projects through multiple channels to safeguard citizens' rights to know about information. Finally, in the EIA, environmental quality assessment, and social stability risk assessment, assessment subjects need to pay attention to explaining professional information to lay persons and convert terms into the expressions understood by citizens, so as to eliminate differences in citizens' risk perceptions.

*2.5.2. In the Construction of NIMBY Facilities.* In building NIMBY facilities, both the government and the enterprises need to attach importance to disclosing construction

information and maintain communication channels with citizens at the project site. NIMBY facility enterprises should timely publicize various matters concerning citizens' environmental rights and interests via various means, such as community bulletins and enterprise websites. They should communicate with citizens to resolve any inconsistencies in the plan negotiated prior to actual construction, as well as any additional derogations of citizens' environmental rights and interests due to construction and other reasons. Local governments can also work with enterprises and local citizens or village committees to set up leadership groups to deal with relevant problems promptly. The leadership group does a good job of serving as a bridge between the public, enterprises, and the government and communicates with the public to ensure that their environmental demands can be resolved.

*2.5.3. After the Completion of NIMBY Facilities.* The completion of NIMBY facilities does not mean the end of NIMBY governance. There is still an ongoing need for regulatory revisits to NIMBY projects that have been up and running. The four types of facilities proposed by China's Ministry of Ecology and Environment cover urban sewage treatment, domestic waste treatment, treatment of hazardous refuse and waste electronic products, and environmental monitoring. They should be strictly accessible to citizens on a regular basis. NIMBY facilities should be equipped with pollutant monitoring devices by the law so as to monitor the discharge information in real time. The automatic monitoring system should be networked with the environmental department to facilitate its law enforcement and supervision, while the discharge information should be made public on time to citizens in the community where a site is located. In conclusion, the completion of NIMBY facilities is only the starting point of the governance. When the facilities are in operation, it is essential to lay more emphasis on supervising the pollutant discharge of NIMBY enterprises, increase the information disclosure of completed and operating projects, and establish a good mutual trust with neighboring citizens to avoid NIMBY incidents [19].

## 3. Conclusions

As Martin Wolsink said, the stigmatization of the word "NIMBY" will hinder the analysis of the environmental interests of opponents in the NIMBY movement [19]. The word "NIMBY" is a tool to describe the reality, rather than a means of stigmatization. Simply taking the NIMBY movement as an event that destroys social stability is not only suspected of stigmatizing residents' legitimate rights protection actions, but also has the problem of endorsing the construction of illegal projects, which is not conducive to the governance of the NIMBY movement but will stimulate more and more serious social contradictions and conflicts [20]. Therefore, taking citizens' basic environmental rights as the discussion center, this paper clarifies the essence of the NIMBY movement, discusses the legitimacy of the NIMBY movement, and analyzes the causes of the NIMBY movement on the basis of correcting the names of residents who take legitimate NIMBY actions. At the same time, the governance effect of the NIMBY movement directly depends on the effectiveness of institutional arrangements and policy design formed with the joint participation of public governance subjects. Therefore, exploring the governance path of the NIMBY movement from the perspective of sustainable governance is the key to addressing the NIMBY problem and the starting point to solve the NIMBY problem.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this article.

## Authors' Contributions

Chen Cao was born in Wuhan, Hubei. P. R. China, in 1998. He received the bachelor's degree from Jianghan University, P. R. China. Now, he studies in College of Law, Xiangtan University. His research interests include environmental protection law, procedural law, and social governance.

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*Retraction*

# Retracted: Psychological Changes of Social Media on Charitable Cultural Behavior Based on Big Data Technology

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] X. Chen, "Psychological Changes of Social Media on Charitable Cultural Behavior Based on Big Data Technology," *Journal of Environmental and Public Health*, vol. 2022, Article ID 5871669, 12 pages, 2022.

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*Research Article*

# Psychological Changes of Social Media on Charitable Cultural Behavior Based on Big Data Technology

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With the advent of the era of big data, the world is facing the challenge of unprecedented information blowout growth, and Internet information processing technology has also ushered in rapid development. At the same time, charity culture has always been a part that the state and society attach great importance to. It is a form of social wealth redistribution and a supplement to the social security system. Based on this social background and reality, this paper analyzes and explores the psychological changes of charitable cultural behavior by social media based on big data technology. This paper introduces latent semantic analysis and constructs the theoretical framework of social media. This paper introduces the related concepts of heart rate variability and mental state, collects the factor factors and constructs the model, and studies the PLS load and cross load. This paper makes a statistical analysis of the data of charitable donations in China from 2017 to 2021 and tests the validity of the questionnaire from the psychological level. The experimental results show that the correlation between the subscales of the questionnaire and the total scale is between 0.470 and 0.820, and the correlation between the dimensions is between 0.183 and 0.590. The correlation between the dimensions and the total score of the scale is higher than that between the dimensions, which shows that there are both connections and differences between the dimensions of the two scales, which are relatively independent, and the scale has a certain structural validity.



## 1. Introduction

In the development process of psychological research, the psychological state has changed from the psychological basic theory to the psychological dimension theory, which is the complex and changeable psychological dimension theory of people's psychology. In order to accurately represent and evaluate people's mental state, it is necessary to establish an effective mental state model. According to the different judgment methods, the judgment of psychological state is mainly divided into two categories: judgment of non-physiological signals and judgment of physiological signals. The mental state judgment based on nonphysiological signals is mainly judged by facial expressions and speech. Based on the above background, the main research content of this paper is to screen samples from the level of social media. It explores the analysis of psychological state changes on the topic of charitable cultural behavior. The innovations of this paper are as follows: (1) the CBOW model and the Skip-Gram model are reconstructed. In the projection layer, the two word vectors in the input layer are accumulated and summed, which greatly simplifies the algorithm. (2) The internal correlation coefficient analysis of latent variables was carried out, which made the discriminant validity more obvious. (3) The donations received by various types of entities in 2021 are selected as the second sample data, which is obviously convincing and time-sensitive.

## 2. Related Work

Social media is an emerging social tool that is widely used around the world. Rothkrantz proposed a matching algorithm in teaching mode for creating peer groups to perform group work. In distance learning, students are remote in time and place. Social media can provide a virtual meeting place. But his research does not divide social media into

mobile and host [1]. Christian surveyed the results of a survey of 1,034 citizens of 30 European countries between February and June 2015. It aims to explore citizens' attitudes towards the use of social media for private purposes and emergencies [2]. Allcott Gentzkow discussed the economics of fake news and provided new data on fake news consumption ahead of the election. A new online survey was conducted based on web browsing data, fact-checking website archives [3]. Enikolopov et al. conducted research to consider whether new media would promote accountability as a social and political topic in nondemocratic countries, where traditional media are often suppressed [4].

Subsequently, foreign academic and practical circles continued to discuss and study it. Management, economics, law, ethics, and many other schools of thought study corporate philanthropy from their respective fields. Charitable cultural behavior is a supplement to the social security system. Jeffery et al. argued that reduced access to farmland in the background and food insecurity in urban areas has expanded the need for emergency food aid. His research assessed the relationship between charitable food assistance clients' federal nutrition program use, local resources, and fresh produce consumption [5]. Research by Sneddon found that personal values influence charitable giving decisions. He aimed to emphasize that research on donor values can provide a more nuanced understanding of their motivations for choosing philanthropy. It also has the potential to inform the research and practice of fundraising. But he did not sort out the relationship between personal values and charitable giving [6]. Yang Y examined the intergenerational effects of individual charitable giving in China based on China's unique social structure, traditional culture, and philanthropic history. He identified the mutual influence of children's charitable giving and parental charitable giving through downward and upward intergenerational transmission. It is demonstrated that the effect of upward propagation is greater than that of downward propagation [7].

## 3. Changes in Mental State

*3.1. Latent Semantics in Big Data.* The earliest citation of the term "big data" can be traced back to apache Org's open-source project Nutch. At that time, big data was used to describe a large number of data sets that needed batch processing or analysis to update the network search index. Latent Semantic Analysis performs statistical analysis of large amounts of text to extract the semantics of terms in the text. This semantic information is essentially the sum of contextual information in the text. Representing text and terms with semantic structure eliminates the correlation between terms and simplifies text vector representation [8]. With the development of various social networking sites and other emerging service industries, the type and scale of data in human society are growing rapidly, which marks that we have entered the era of big data.

LSA uses a term-text matrix to describe the relationship between text and terms. The term-text matrix is a sparse matrix where each row represents a term, and each column represents a text:

$$X = \begin{bmatrix} \text{weight}_{1,1} & \dots & \text{weight}_{1,n} \\ \dots & \dots & \dots \\ \text{weight}_{m,1} & \dots & \text{weight}_{m,n} \end{bmatrix}. \quad (1)$$

Among them, the elements on the diagonal of matrix $\Sigma$ are singular values. Left singular vectors form a matrix, and right singular vectors form a matrix:

$$X = U \times \Sigma \times V^T. \quad (2)$$

The correlation matrix of terms and texts can be expressed as follows:

$$XX^T = \left(U\Sigma V^T\right)\left(U\Sigma V^T\right)^T = \left(U\Sigma V^T\right)\left(V^{T^T}\Sigma^T U^T\right) = U\Sigma\Sigma U^T,$$
$$X^T X = \left(U\Sigma V^T\right)^T\left(U\Sigma V^T\right) = \left(V^{T^T}\Sigma^T U^T\right)\left(U\Sigma V^T\right) = V\Sigma^T\Sigma V^T. \quad (3)$$

The correspondence between text, latent variables, and terms in the PLSA model is shown in Figure 1.

The joint probability formula [9] is defined for the modeling process:

$$p = \left(t_i, w_j\right) = p\left(t_i\right)p\left(w_j|t_i\right), \quad (4)$$

$$p\left(w_j|t_i\right) = \sum_{k=1}^{K} p\left(w_j|z_k\right)p\left(z_k|t_i\right). \quad (5)$$

Using the Bayesian formula, formula (5) is transformed into the following formula:

$$p\left(t_i, w_j\right) = \sum_{k=1}^{K} p\left(z_k\right)p\left(t_i|z_k\right)p\left(w_j|z_k\right). \quad (6)$$

The likelihood function is found as follows:

$$L = \sum_{i=1}^{M}\sum_{j=1}^{N} n\left(t_i, w_i\right)\log p\left(d_i, w_i\right). \quad (7)$$

The iterative process of the EM algorithm mainly includes $E$ steps and $M$ steps [10]:

(1) Step E: calculate the posterior probability of the latent variable by estimating the currently known parameters by the following formula:

$$p\left(z_k|t_i, w_j\right) = \frac{p\left(z_k\right)p\left(z_k|t_i\right)p\left(w_j|z_k\right)}{\sum_{l=1}^{k} p\left(z_l\right)p\left(z_k|t_i\right)p\left(w_j|z_l\right)}. \quad (8)$$

(2) M step: the posterior probability calculated by the $E$ step updates the probability distribution:

$$p\left(w_j|z_k\right) = \frac{\sum_{i=1}^{m} n\left(t_i \cdot w_j\right)p\left(z_k|t_i, w_j\right)}{\sum_{i=1}^{M}\sum_{l=1}^{N} n\left(t_i, w_l\right)p\left(z_l\right)p\left(z_k|t_i, w_l\right)}, \quad (9)$$

$$p\left(t_i|z_k\right) = \frac{\sum_{i=1}^{N} n\left(t_i \cdot w_j\right)p\left(z_k|t_i, w_j\right)}{\sum_{i=1}^{M}\sum_{j=1}^{N} n\left(t_i, w_l\right)p\left(z_l\right)p\left(z_k|t_i, w_l\right)}, \quad (10)$$

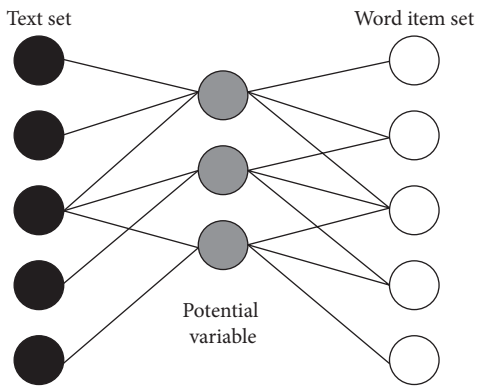


Figure 1: Correspondence between text, latent variables, and terms.

$$p(z_k) = \frac{\sum_{l=1}^{M}\sum_{j=1}^{N} n(t_i \cdot w_j) p(z_k|t_i, w_j)}{\sum_{l=1}^{M}\sum_{J=1}^{N} n(t_i, w_l)}. \quad (11)$$

E-step and M-step are continuously calculated interactively until the likelihood function reaches a maximum value.

First, get the joint generation probability of the entire document set:

$$p(w, z|\alpha, \beta) = p(w|z, \beta). \quad (12)$$

Through analysis, it can get

$$p(w|z, \beta) = \prod_{k=1}^{K}\prod_{k=1} p(w_i = t|z_i = k). \quad (13)$$

Through analysis, it can get

$$p = (z|\theta) = \prod_{m=1}^{M}\prod_{k=1}^{K} (z = k|m). \quad (14)$$

The joint probability distribution is obtained by (12)–(14):

$$p(w, z|\alpha, \beta) = \prod_{k=1}^{K}\prod_{z_i=k} p(w_i = t|z_i = k) \times \prod_{m=1}^{M}\prod_{k=1}^{K} (z = k|m). \quad (15)$$

Two probability distributions are introduced [11]:
Distribution A:

$$p(\text{nexttable}) = \text{occupied occupied } r_j|\text{previous } m-1, \gamma = \frac{n_j}{\gamma + m - 1}, \quad (16)$$

$$p(\text{nexttable}) = \text{occupied table}|\text{previous } m-1, \gamma = \frac{\gamma}{\gamma + m - 1}. \quad (17)$$

Machine learning algorithms cannot directly recognize text in natural language. Therefore, it is first necessary to convert the natural language into a form that the algorithm can recognize. Word vector is the product of mathematical processing of natural language [12].

$$\text{Vectors}(WC) = \left\{ v' = \begin{bmatrix}1\\0\\0\\0\\0\end{bmatrix}, v^{\text{like}} = \begin{bmatrix}0\\1\\0\\0\\0\end{bmatrix}, v^{\text{Twitter}} = \begin{bmatrix}0\\0\\1\\0\\0\end{bmatrix}, v^{\text{learning}} = \begin{bmatrix}0\\0\\0\\0\\1\end{bmatrix} \right\}. \quad (18)$$

*3.2. CBOW Model and Skip-Gram Model.* The main function of CBOW is to predict words based on known words in the current context. The CBOW model mainly includes three layers: input layer, projection layer, and output layer. Suppose that there is a training sample Context$(w)$, where $w$ represents a word, and Context$(w)$ represents the first $c$ and last $c$ words of word $w$ [13], as shown in Figure 2.

In the projection layer, the 2 word vectors in the input layer are accumulated and summed. The formula is as follows:

$$X_w = \sum_{i=1}^{2c} v(\text{Context}(w)i). \quad (19)$$

The Skip-Gram model predicts its context from a given word. Its model mainly includes three layers: input layer, projection layer, and output layer. Among them, the input layer is the word vector of words [14]. The maximum value of formula (20) is obtained by the projection layer:

$$\frac{1}{T}\sum_{t=1}^{T}\sum_{-c \le j \le c} \log p(W_{t+j}|W_t). \quad (20)$$

*3.3. Theoretical Framework.* With the development and application of computer technology in social life, the growth rate of information is gradually accelerating, and the total amount of information is also rapidly increasing, which has led to changes in its form—quantitative change leads to qualitative change and has accumulated to a level sufficient to trigger change. The characteristics of big data can be summarized by four "Vs," namely volume, variety, velocity, and value. Consent mobilization on social media can be summarized into three stages: cognitive construction, affective mobilization, and action mobilization. Through "speech content" and "emotional performance," cognitive construction and emotional mobilization can be achieved in the audience, thereby constructing "meaning" and "identity." This way, participants can act on their behalf and mobilize for action. However, consent mobilization on social media takes place in a virtual online world where both mobilizers and participants are hidden and decentralized. The power of this "discussion" and "consciousness" is mobilized differently and uncertainly in each "person." The prediction of big data is based on the correlation analysis of massive data. The era of big data provides us with a new way of thinking. It is no longer keen on exploring the causal relationship between things, but to explore possible related

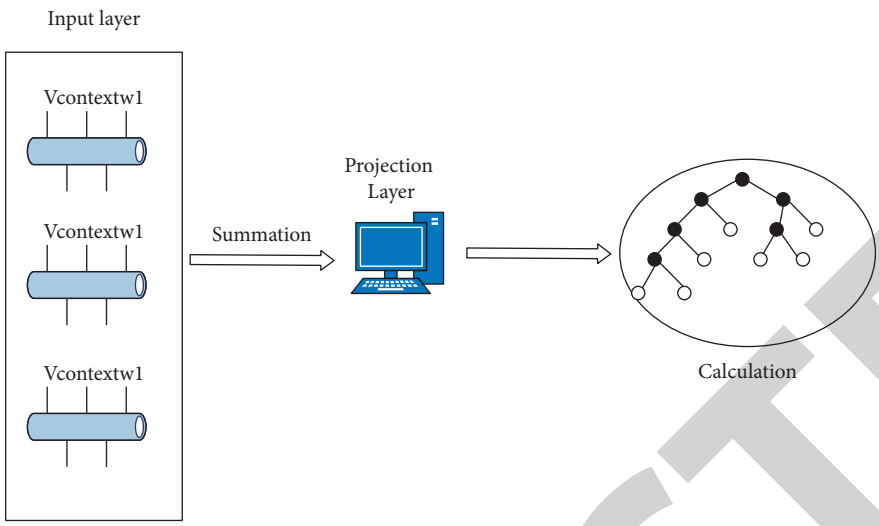


Figure 2: Schematic diagram of the CBOW model.

things through correlation, replacing the traditional error prone methods based on assumptions.

Research on the impact of consensus mobilization has primarily focused on the impact of mobilization information on individuals. It refers to the concept of "communicative effect" in communication, which refers to the changes in psychology, attitude, and behavior caused by persuasive communicative behavior. In communication, the effect of communication is divided into three levels: external information acts on people's perception and memory systems, causing people's knowledge growth and changes in cognitive structure, which belong to the influence of cognitive level. Effects on people's perceptions and value systems, as well as changes in emotions or feelings, are psychological and attitudinal effects. These changes are manifested in what people say and do; that is, they become the result of actions. In the communication effect, from cognition to attitude to action, it is a process of accumulation, deepening, and expansion of effect [15]. The communication effect of the former level also affects the communication effect of the latter level. The entire research model is shown in Figure 3.

The application of social media has attracted widespread attention at home and abroad, but in the practice of applying it to archival work, foreign archival circles precede China, and countries such as the United States and France have applied more social media in archival work.

*3.4. Definition of Social Media Word of Mouth.* The social responsibility concept of "putting the economic interests of enterprises first" no longer has a dominant position. People began to reexamine the social responsibility of enterprises, and it has become a common understanding that enterprises should bear other responsibilities than economic responsibility. Some academics define social media as "potential, actual, and former consumers' positive or negative perceptions of a product or company." Some researchers also define it as "a virtual world where people can communicate their comments about a product or service by typing." Social behaviors take many forms on the Internet, mainly including ratings, likes or dislikes, comments, recommendations, experience exchanges, and promotions. And through empirical research, it is proved that the socialized enterprise structure can be divided into three dimensions: recommendation and promotion, rating and comment, and forum and community. On this basis, the normative use of social media is created and empirically demonstrated that recommendation and promotion are important components. Figure 4 shows the social media word-of-mouth research model [16].

Social media was originally designed for socializing, not for consumers to shop. Therefore, the specific functional design is different from that of shopping websites, resulting in changes in the way consumers participate in word-of-mouth. The author believes that this change needs to be considered [17]. In terms of research areas, domestic research is mainly concentrated in the more developed regions in the southeast, and there is less research on enterprises in the northwest.

*3.5. Heart Rate Variability.* HRV refers to the difference in the interval between sustained heartbeats. The difference in heart rate interval is determined by the push from the sinoatrial node. The impulses from the sinoatrial node are determined by the activity of the sympathetic and parasympathetic nervous systems. Therefore, HRV is an indicator reflecting the activity and balance process of the autonomic nervous system. It can qualitatively and quantitatively evaluate autonomic function. Due to its advantages of rapidity, convenience, noninvasiveness, accuracy, and objectiveness, it has been widely used in clinical practice. It detects heart rate variability in patients with anxiety and depression. The study found that patients with anxiety and depression had reduced heart rate variability, indicating reduced autonomic nervous system function. Users who received negative news alerts on social media and other platforms were more likely to experience negative emotions such as anxiety and depression.

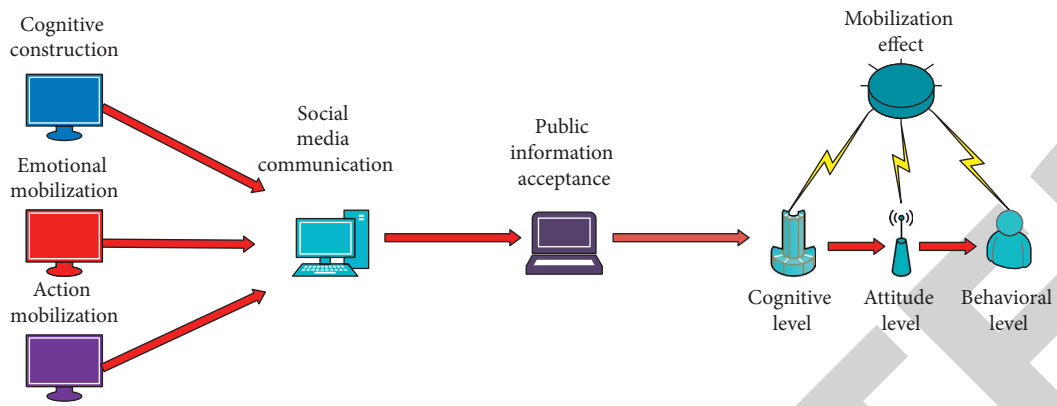


Figure 3: Research pattern diagram.

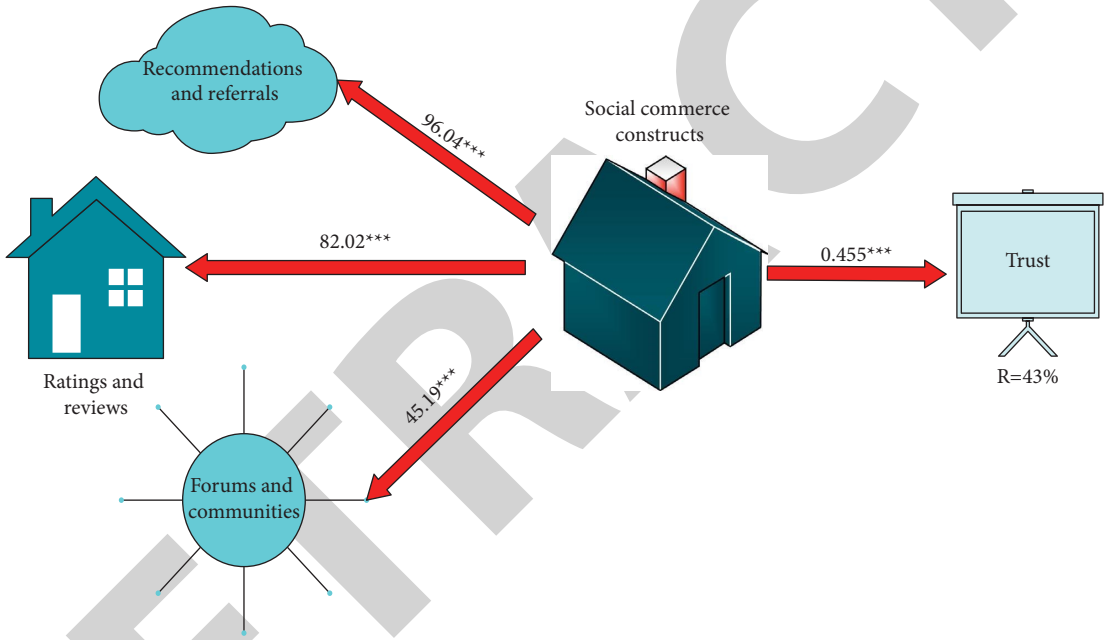


Figure 4: Social media word-of-mouth research model.

Although they have lower levels than those with anxiety and depression, their heart rate variability can also be altered by psychological factors that can even lead to disturbances in the autonomic nervous system. At the same time, people have self-awareness and subjective evaluations of all aspects of themselves. Whether these knowledge and assessments are accurate and objective directly affects relevant thinking and behavior. Similarly, people also have subjective understanding and evaluation of their own psychological state. If the recognition and evaluation are scientific, accurate, and objective, these will have a good impact on philanthropic cultural behavior and social ethos. Conversely, if there is a deviation, there will be a negative impact on philanthropic cultural behavior and social style [18]. Negative words can reverse the emotional tendency of sentences and then change the emotional tendency of sentences.

*3.6. Negative Effects of Mental Subhealth State.* "Mental subhealth" is an important type of subhealth. It is an intermediate state between mentally healthy and mentally unhealthy. These states all meet the psychiatric diagnostic criteria such as CCMD-III, ICO-10, and DSM-IV. But it has a great impact on people's life and work [19]. Through the self-rating scale, for example, if the self-perceived mental state persists for more than 2 weeks, the SCL-90 score is greater than 160, or the scores of each factor are greater than 2, the subjects are excluded from suspected psychosis or other mental diseases, that is, in a state of "mental subhealth" [20]. However, these studies tend to study natural symptoms, the most representative of which is the study of "chronic fatigue syndrome" in Western countries. The research on the classification of "ill-health" is still in its infancy.

*3.7. Mental State Model.* Benefits are not only economic benefits, but also political benefits. Through enterprise charity activities, entrepreneurs share the pressure of the government on some functions, so that the government has a good impression on the enterprise, and the enterprise owner can obtain a certain political identity, so as to create a good political environment for the enterprise.

At present, two-dimensional mental state classification models have been widely used. The first is to set the mental state in a polar coordinate system. The second is to label mental states based on enthusiasm and liking. Mental states are thus integrated into a two-dimensional Cartesian coordinate system. In the model, excitement and fatigue correspond to each other. This is equivalent to the dimension of love described in another model. And happiness and pain correspond to each other, which is equal to the dimension of love in the model. The policies and regulations related to corporate philanthropy can be divided into two categories: one is the normative and guiding policies for enterprises, and the other is the encouraging policies. Captivating spaces allow us to quantify changes and differences in people's psychological states. However, for further research on mental states, the two-dimensional mental state model cannot support deeper psychological research. Therefore, based on the two-dimensional mental model, it began to study three-dimensional and even multidimensional mental models, including Plutchik. Tension means that each mental state has a different tension. The same representative has different mental states under the same feeling. The stronger the two diametrically opposite polar states of mind, the stronger the dependence on their status. On the other hand, the weaker the state of mind, the lower its status, and the lower the state of mind. A state of bipolar manifestation is a diagonally similar form in a position next to the mental state. The occurrence, development, and results of human social events are the result of the interaction and joint action between the "socialized individual" and the objective external world.

*3.8. Definition and Calculation Characteristics of Big Data.* Although a large number of researchers have conducted extensive and in-depth research on the idea of arrogant data since it was put forward, there is no precise definition so far. Many research institutions and scholars have determined a huge amount of data according to their own understanding, but these are only qualitative descriptions. Wikipedia defines big data as a group of data that cannot be obtained, which is managed and processed at a specific time using traditional and widely used software technologies and tools. The definition given by others is as follows: big data refers to a kind of transaction in which the size of the data set exceeds the possibility of acquisition, storage, and the management and analysis of traditional database tools.

The key characteristics of big data put forward new requirements and challenges for data processing and data mining. The data object processed by traditional data processing technology is structured data, which only represents a small part of the real data, and more than four-fifths of the data are semistructured or unstructured data, such as text or video. Traditional data processing techniques are powerless. Considering the above problems, in order to process big data efficiently, it is necessary to summarize different processing requirements and calculation characteristics according to different application characteristics.

## 4. Mental State Change Experiment

*4.1. Experiment Content.* This study selects "charity" in Baidu Tieba as an example and uses the crawler tool Python to collect data. It crawls a total of 17,818 floors of netizens' messages from December 4th to December 10th and uses this as the total sample. Through the method of equidistant sampling, 300 netizens' messages were selected as samples for content analysis. In these 17,818 floors, there is a lot of post-blogging phenomenon. During sampling, if the same brush post information is selected, the next one will be automatically selected, and so on, as shown in Figure 5.

It can be seen that the search rates for the two terms, that is, charity activities for the disabled and charity activities for business personnel, are 17.3% and 16.6%, respectively. Charitable activities in these two areas are searched more frequently.

Table 1 is a cross-tabulation of the utterance types of the experimental subject platform.

A cross-sectional analysis shows that news information is the most published information by accredited organizations. This is also related to the fact that most of the publishing bodies are news organizations. Weibo big V publishes less knowledge and news information. Comments have the most information, with nearly half of them. Mobilization information accounted for more than one-third. The number of basic-level ordinary user comments and mobilization categories is equal.

It collects feature factors and builds models. Our model has a total of 6 reflective constructs and 21 items. The factor loading value of each item is examined, and all are greater than 0.7, so there is no need to process the item, and the final model will retain all the items as shown in Table 2.

As shown in the table, the combined reliability values for all constructs are greater than 0.7. Therefore, the credibility of the construct is considered to be high. In addition, the AVE values of all constructs were greater than 0.5, so the constructs were considered to have good convergent validity.

The intrinsic correlation coefficient of the latent variable shows the intrinsic correlation coefficient of the latent variables. The square root of AVE of a construct is greater than the correlation coefficient between this construct and other constructs, as shown in Table 3.

The correlation coefficients between constructs were all less than 0.7, and all were less than the square root of AVE. Therefore, it is considered to have good discriminant validity.

The PLS loads and cross loads are shown in Table 4.

It analyzes the communicative power of textual discourse. The forwarding and likes of each message are counted, so as to obtain the maximum, minimum, and

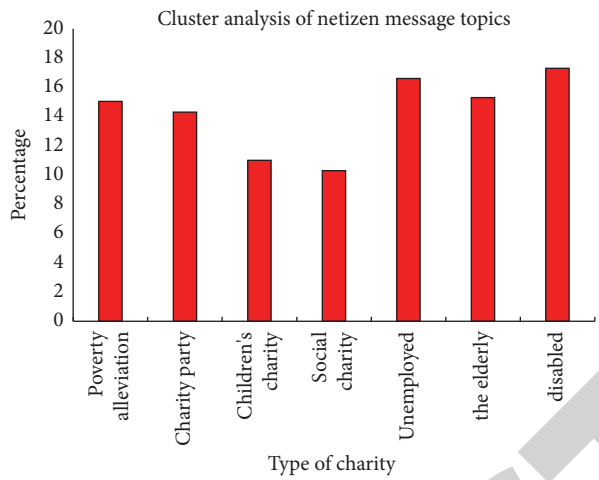


Figure 5: Cluster analysis of netizen message topics.

Table 1: Discourse type cross tabulation.

| | Knowledge class | News category | Comment class | Mobilization class | Total |
|---|---|---|---|---|---|
| Certification organization or institution | 3 | 37 | 22 | 5 | 67 |
| Certified individual | 13 | 14 | 90 | 56 | 173 |
| Ordinary grassroots users | 0 | 4 | 17 | 15 | 36 |

Table 2: AVE, CR, and CA values.

| | AVE | Cr | $\alpha$ |
|---|---|---|---|
| SP | 0.8352 | 0.953 | 0.9342 |
| MIC | 0.786 | 0.9168 | 0.8662 |
| EH | 0.796 | 0.9397 | 0.9141 |
| PC | 0.8095 | 0.9271 | 0.8857 |
| PR | 0.6917 | 0.8703 | 0.7828 |
| SW | 0.7772 | 0.9331 | 0.9044 |

Table 3: Intrinsic correlation coefficients of latent variables.

| | SP | Mic | Eh | PC | Pr | SW |
|---|---|---|---|---|---|---|
| SP | **0.9139** | | | | | |
| MIC | 0.659 | **0.8866** | | | | |
| EH | 0.6065 | 0.669 | **0.8921** | | | |
| PC | 0.0933 | 0.0283 | 0.0181 | **0.8997** | | |
| PR | −0.0351 | −0.0434 | 0.0007 | 0.4328 | **0.8316** | |
| SW | 0.4991 | 0.5557 | 0.5864 | −0.0949 | −0.1049 | **0.8816** |

average of the forwarding and likes in each type of discourse topic. In this way, the dissemination and influence of discourses on different topics are analyzed, as shown in Table 5.

It can be seen that the two discourse topics of "Charity Gala" and "Guarantee for the Disabled" are higher than the two discourse topics of "Charity" and "Analysis of Charity Forms" in terms of forwarding and likes. It shows that the discourse power and influence of these two aspects are more prominent.

*4.2. Development of Charity.* With the development of philanthropy in China, public awareness of public welfare has been continuously enhanced. People have independently

Table 4: PLS load and cross load.

| | SP | Mic | Eh | *PC* | Pr | SW |
|---|---|---|---|---|---|---|
| SP1 | 0.8876 | 0.5965 | 0.5704 | 0.1497 | −0.0498 | 0.4826 |
| SP2 | 0.8825 | 0.5988 | 0.5318 | 0.0178 | −0.061 | 0.472 |
| SP3 | 0.9241 | 0.5988 | 0.5644 | 0.0892 | −0.0072 | 0.4111 |
| SP4 | 0.9332 | 0.6125 | 0.5488 | 0.0832 | −0.0051 | 0.4501 |
| MIC1 | 0.915 | 0.8826 | 0.6265 | 0.0383 | −0.0577 | 0.5836 |
| MIC2 | 0.5886 | 0.9116 | 0.5958 | 0.031 | −0.0361 | 0.4414 |
| MIC3 | 0.608 | 0.8651 | **0.8239** | 0.0005 | −0.0142 | 0.4195 |
| EH1 | 0.5527 | 0.5587 | **0.9035** | 0.0172 | 0.0602 | 0.452 |
| EH2 | 0.4553 | 0.6013 | **0.9275** | 0.035 | 0.0093 | 0.511 |
| EH3 | 0.5799 | 0.6286 | **0.9103** | 0.0105 | −0.0111 | 0.5549 |
| EH4 | 0.5891 | 0.589 | 0.0235 | 0.0039 | −0.0433 | 0.565 |
| PC1 | 0.5326 | 0.0295 | −0.0116 | **0.9132** | 0.3834 | −0.0776 |
| PC2 | 0.0925 | 0.0374 | 0.062 | **0.951** | 0.3999 | −0.1088 |
| PC3 | 0.0904 | −0.0023 | 0.0093 | **0.8308** | 0.3995 | −0.055 |
| PR1 | 0.0641 | −0.0781 | 0.0232 | 0.4769 | **0.7698** | −0.0821 |
| PR2 | 0.0017 | 0.0112 | −0.0176 | 0.3481 | **0.8435** | −0.0555 |
| PR3 | −0.0054 | 0.0287 | 0.5383 | 0.2797 | **0.8781** | −0.1081 |
| SW1 | −0.065 | 0.4956 | 0.4943 | −0.1181 | −0.0989 | **0.8901** |
| SW2 | 0.4466 | 0.4549 | 0.4967 | −0.0966 | −0.0634 | **0.8901** |
| SW3 | 0.4366 | 0.5042 | 0.535 | −0.0183 | −0.0865 | **0.8733** |
| SW4 | 0.4571 | 0.5027 | 0.525 | −0.0977 | −0.1184 | **0.8727** |

Table 5: Transmission power analysis.

| Topic | Maximum | Minimum forwarding volume | Mean value | Maximum | Minimum likes | Mean value |
|---|---|---|---|---|---|---|
| Charity party | 209955 | 4 | 778.91 | 49353 | 4 | 2196.11 |
| Philanthropic undertaking | 16256 | 12 | 1502.81 | 74480 | 13 | 5918.81 |
| Analyzing the form of charity | 26752 | 4 | 871.16 | 66878 | 7 | 2059.6 |
| Disability protection | 50230 | 13 | 3122.97 | 94483 | 21 | 6192.97 |

participated in charity activities through various channels, showing great enthusiasm for donation. Figure 6 shows the amount of charitable donations in China from 2017 to 2021.

The data in the "2021 China Charitable Donation Report" shows that, in addition to a slight decrease in the total amount of charitable donations in 2018, the total amount of donations from 2017 to 2021 showed a steady upward trend as a whole. Especially in 2021, China's actual domestic and foreign donations (including cash and materials) will be 110.857 billion Yuan, accounting for 0.16% of the annual GDP, and the per capita donation will reach 8.169 billion yuan.

Figure 7 shows the donations received by various types of entities in 2021.

As can be seen from the figure, the foundation received donations of 44.557 billion Yuan, accounting for 40.19%. Charitable organizations received donations of 32.647 billion Yuan, accounting for 30%. Foundations and charitable organizations have become the two most important channels for donations, accounting for more than 70% of the total.

Figure 8 shows the proportion of corporate donations in 2019–2021.

It can be seen from the figure that corporate donations are still the most important source of social donations. This shows that enterprises have become an important force in promoting China's philanthropy.

*4.3. Questionnaire Validity Test.* Psychometrics believes that the correlation between each dimension and the total scale score exceeds the correlation between dimensions as a manifestation of construct validity. The mental health scale using social media attention to charity was sampled here. It examines the content validity of the questionnaire based on the correlation between each subscale and the total scale, as shown in Table 6.

The correlation between the questionnaire subdivisions and the overall scale ranged from 0.470 to 0.820. The correlation between dimensions is between 0.183 and 0.590. The correlation between each dimension and the total scale score is higher than the correlation between dimensions. This shows that the dimensions of the two scales are both related and different, and they are relatively independent and have certain construct validity.

It explores the proportion of male and female users of social media in a sample and conducts psychological research on philanthropy-based cultural behavior. The specific performance is to count the parameter matrices of all male and female users separately and make a graph comparison of 10 factors from A to J. The results are then compared, as shown in Figure 9.

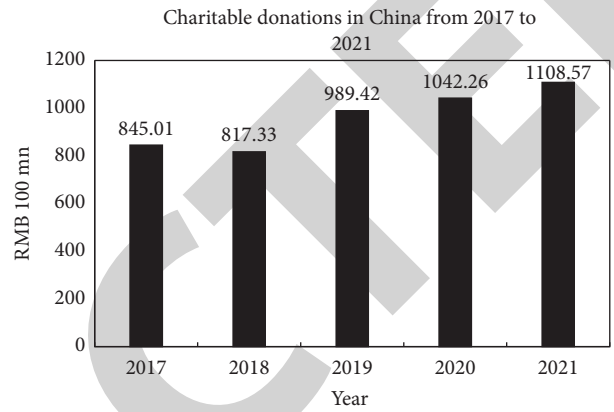


Figure 6: Charitable donations in China from 2017 to 2021.

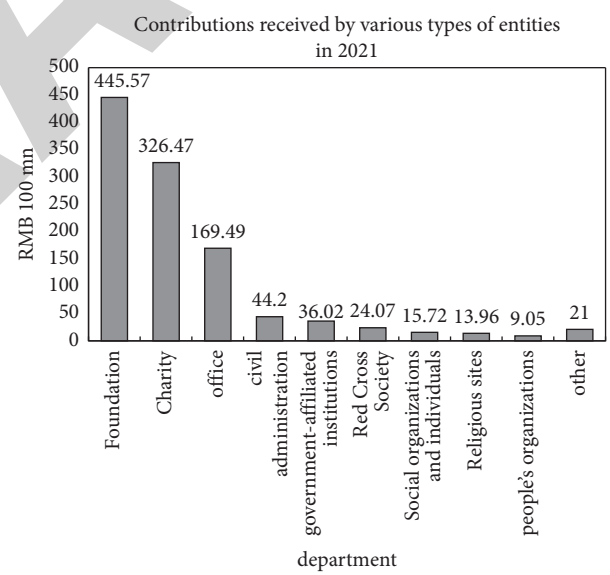


Figure 7: Donations received by various types of entities in 2021.

As can be seen from the figure, except for the factor A, the male data is much higher than that of females, and there is no significant difference in other items.

The more reference mental state changes can be discussed with the hierarchical affective model. The measurement of the basic emotional points of the PAD mood space is determined by psychological methods. Many researchers hope to reveal the location of basic emotions in the PAD space through research and experiments. By calculating the emotional distance between the unknown emotional point and each basic emotional point in the three-dimensional space of PAD mood, the basic emotion with the shortest

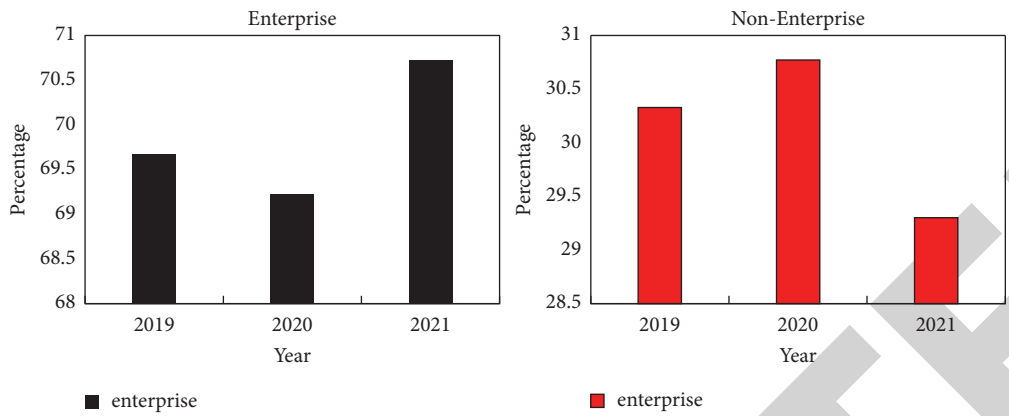


Figure 8: Proportion of corporate donations in 2019–2021.

Table 6: Correlation statistics of social media attention to charity mental health scale.

| | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 |
|---|---|---|---|---|---|---|---|---|---|---|
| F1 | 0.451** | | | | | | | | | |
| F2 | 0.566** | 0.451** | | | | | | | | |
| F3 | 0,397** | 0.494** | 0.438** | | | | | | | |
| F4 | 0.560** | 0.550** | 0.407** | 0.312** | | | | | | |
| F5 | 0.584** | 0.589** | 0.459** | 0.590** | 0.480** | | | | | |
| F6 | 0.488** | 0.354** | 0.419** | 0.257** | 0.451** | 0.291** | | | | |
| F7 | 0.188** | 0.361** | 0.353** | 0.325** | 0.266** | 0.383** | 0.183 | | | |
| F8 | 0.537** | 0.354** | 0.372** | 0.330** | 0.508** | 0.530** | 0.289** | 0.253* | | |
| F9 | 0.188 | 0.361** | 0.353** | 0.325** | 0.266** | 0.383** | 0.183 | 0.188 | 0.383** | |
| F10 | 0.820** | 0.742** | 0.705** | 0.702** | 0.697** | 0.810** | 0.558** | 0.470** | 0.651** | 0.383** |

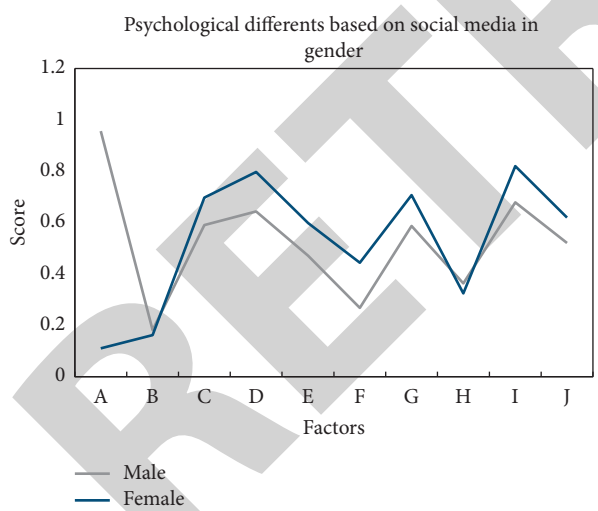


Figure 9: Comparison of gender differences in social media users based on charitable cultural behaviors.

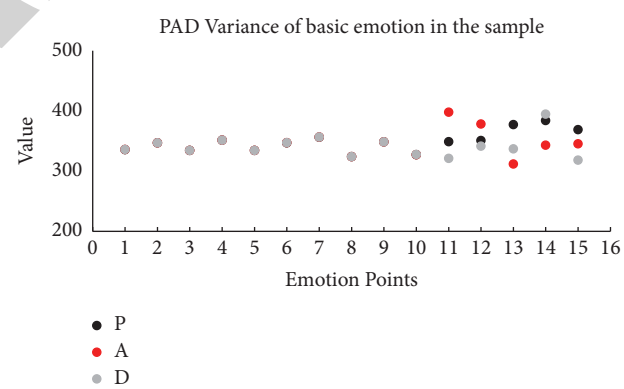


Figure 10: Basic sentiment PAD variance plot in the sample.

emotional distance is selected as the emotional state of the unknown emotional point. In this way, the distance value between the unknown emotional point and each basic emotional point is obtained, as shown in Figure 10.

It can be seen from Figure 10 that the three items of PAD almost overlap in the emotional points from 1 to 10, while in the latter 5 points, they show a scattered form. This shows that when the emotional data set is very large, the PAD vector value of each basic emotional point tends to be stable, and the coordinate distribution in the PAD mood space is also relatively stable.

## 5. Discussion

*5.1. Concept and Connotation of Charity Culture.* Domestic scholars have done a lot of research on the topic of "charity culture," and there are different opinions on its definition. In the research on the development of Chinese philanthropy, experts believe that philanthropy culture is knowledge and attitude. It is the feeling and evaluation of a

country's philanthropy formed in the historical development. It is an important part of national culture and social culture. Among the different kinds of charity activities held on TV, the charity party can usually raise a large amount of money in a short time, and the effect is remarkable.

To understand the cultural construction of charity gala, we must deeply understand how the cultural connotation is manifested through different symbols in such a grand "media ceremony" as charity gala. A positive and healthy philanthropy culture has a positive effect on promoting philanthropy in a country. Philanthropic culture is functionally rich, but at its core are altruistic values. Charity culture is an important part of Chinese traditional culture. For centuries, China has emphasized philanthropy and poverty alleviation. It believes that people should pay attention to their own life and development and have a kind heart. People should recognize the social value of devotion and fraternity, deal with the difficult and needy people in society, express kindness and love within their ability, and provide help within their ability. Under the influence of a culture of charity, it promotes the creation of a "helping" social environment and the improvement of interpersonal relationships. Building bridges of communication and communication between members of society can bring people closer to each other. It is easy to eliminate the rigid and unfamiliar interpersonal relationships and the estrangement between different social classes when social audiences treat each other tolerantly. This has played a role in overcoming the growing social estrangement and promoting the development of a harmonious society.

Charity and poverty alleviation have been traditional Chinese virtues since ancient times. The development of a philanthropic culture is inseparable from these traditional virtues. China's philanthropic culture has a long history and rich functions. Its development process can be roughly divided into three stages: the first is the ancient charity culture with "goodness" as the core, the second is the modern charity culture with the goal of "saving the country," and the third is the modern charity culture with "human nature" as the core.

"Ritual view" pays attention to the maintenance of information on society in time. It does not mean the act of sharing information, but the representation of sharing faith. Therefore, it emphasizes not control and power, but sharing and communication. This definition reflects "Commonness," "common," "sharing," and "communication."

### 5.2. Theoretical Basis

*5.2.1. Social Action Theory.* According to rationalism and degree of rationality, experts divide social behaviors into goal rationalization behaviors, value rationalization behaviors, emotional behaviors, and traditional behaviors. The expected rational action should demonstrate that the actor has a clear goal and understands the tools and means needed to achieve that goal. It is through expectations of external things and the behavior of others as conditions or means that they achieve their legitimate ends. The characteristic of rational value action is that it attaches great importance to the value of the action itself, regardless of the conditions required for taking the action and the consequences of the action. Essentially, the actor himself takes certain goals very seriously and is willing to hold on to their beliefs and uphold them. Emotional behaviors are behaviors that result from realistic emotions and emotional states. Emotions, on the other hand, relate to the social interactions the actor experiences and the subjective awareness of preexisting attitudes. Traditional movements are driven by habituation based on usual stimuli to repeat an established posture.

In the process of charitable donation, enterprises can form a subtle force to affect all aspects of the enterprise. Through charitable donations, enterprises have established the social image of public welfare enterprises, accumulated corporate reputation, created a good external environment for the operation and development of enterprises, and promoted the improvement of enterprise performance.

It can be said that companies must meet consumers' expectations for more responsibility and create a positive image for increasing market share, thereby maximizing their own interests. Philanthropy is only the way and means for enterprises to realize their own interests. Explanations of corporate philanthropy with rational values tend to lean toward individual beliefs about the value of business owners or managers, or the expansion of corporate culture. This is the behavior of enterprises based on ethical pursuits. Some business owners or business managers encourage businesses to do charitable acts out of gratitude, empathy, or other feelings, based on their previous interactions or current stimuli. Obviously, emotional behavior is volatile and unpredictable. Using traditional behavior to explain corporate charitable behavior, corporate charitable behavior can be regarded as related to the social content accepted by corporate managers or related to the company's consistent corporate culture.

*5.2.2. Social Exchange Theory.* From an economic point of view, corporate philanthropy is an act that indirectly promotes the maximization of interests. Interests here refer not only to economic interests, but also to political interests. Entrepreneurs share the pressure of the government in some functions through corporate philanthropy, so the government has a good impression of the enterprise. Business owners can obtain certain political recognition, thereby creating a favorable political environment for the business. Entrepreneur's political status allows companies to reduce the risk of acquisitions and ensure sustainable business development when they obtain certain basic resources controlled by the government. When this mutually beneficial relationship is established, businesses tend to become more involved in philanthropy. In addition, some scholars believe that corporate philanthropy is a defense mechanism for corporate crisis events and can accumulate moral capital for companies. When an accident happens to a business that negatively affects its image and reputation, charities can compensate or reduce the negative impact to a certain extent. Businesses are actively fulfilling their social

responsibilities to avoid rational regulation. Because in the market competition, some business activities are regulated by the government. This regulation will reduce the company's profits and even force the company to cut production and stop production. When companies actively fulfill their social responsibilities and engage in charitable activities, they can basically avoid this regulation and improve their competitiveness in the market.

## 6. Conclusions

In recent years, the explosive growth of data scale and the high complexity of data mode have prompted the current information society to enter the era of big data. In this era of rapid development, more and more people participate in charity. Charity culture is the driving force behind the development of philanthropy, and charitable culture also affects the development of philanthropy. Types of mental states are classified according to the level of mental activity. The level of positivity of mental activity is the internal cause of different mental states. It mainly refers to the degree of awakening and activity of the cerebral cortex, that is, the degree of awakening and activity of consciousness. Under such theoretical guidance and background significance, this paper selects "charity" in Baidu Tieba as an example. It collects data through the crawler tool Python, crawls a total of 17,818 floors of netizens' messages from December 4th to December 10th, and uses this as the total sample. Through the method of equidistant sampling, 300 netizens' messages were selected as samples for content analysis. It analyzes the amount of charitable donations in China from 2017 to 2021, as well as the donations received by various types of subjects in 2021, and draws a basic emotional PAD variance map in the sample. It analyzes the psychological state of other reasons for charitable cultural behavior and introduces the relevant content of social action theory and social exchange theory. It has well completed the subject of social media analysis and exploration of the psychological state changes of charitable cultural behaviors. In the follow-up research, more years of charitable donations should be selected as samples, and expanding the sample size can make the experimental results more authentic and reliable.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this article.

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*Retraction*

# Retracted: A Brief Data on Water Demand Assessment for Sustainable Potable Water Supply in Yergalem Tula Kebele, Ethiopia

**Journal of Environmental and Public Health**

Received 5 December 2023; Accepted 5 December 2023; Published 6 December 2023



This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] D. S. Vijayan, H. T. Tadesse, Y. Yokamo, R. Divahar, T. Bezabih Bashe, and J. Jebasingh Daniel, "A Brief Data on Water Demand Assessment for Sustainable Potable Water Supply in Yergalem Tula Kebele, Ethiopia," *Journal of Environmental and Public Health*, vol. 2022, Article ID 1606590, 8 pages, 2022.

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*Research Article*

# A Brief Data on Water Demand Assessment for Sustainable Potable Water Supply in Yergalem Tula Kebele, Ethiopia

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In spite of Ethiopia's abundant water resources, such as rainwater, groundwater, river, and lake, there has been an increase in the demand for potable water during the past decade. Since 1990, Ethiopia has only achieved 57 percent of the Millennium Development Goal target for access to safe drinking water. Inadequate access to clean potable water and sewerage services and lack of good hygiene practices have a negative impact on health and nutrition, such as diarrheal disease which is one of the leading causes of mortality among children under the age of five in Ethiopia. The objective of the present study is to assess the water demand in Yergalem Tula Kebele, which will be used in the sustainable potable water supply design for the city. The water demand analysis is based on a geometric method of population forecasting with an annual growth rate of 3%. The total water demand (domestic and nondomestic water demands) projection has also been made and the per capita water demand of 25 liters for a distance of 0.5 km from the water distribution point for rural piped water supply system is adopted, as per GTP-II minimum service level. The mode and level of services considered for community water supplies include public fountains and institutions (i.e., schools and health centers/posts) with stand water points.



## 1. Introduction

The Millennium Development Goals (also known as the MDGs) are a set of eight goals that have been established to improve the lives of the world's most impoverished people. Each of these goals has a quantitative target and an explicit timescale associated with it. At the United Nations Millennium Summit in 2000, the heads of state of 189 different countries signed the historic Millennium Declaration to achieve these goals and alleviate global poverty. Under this goal, globally, safe drinking water, sanitation, and hygiene (WASH) are basic aspects of the standard living of humans. This right is recognized in international legal instruments that address the provision of a safe and adequate supply of water for all domestic uses. The benefits of improved water supply and sanitation are many, including safe and adequate water supply to the community, basic health care in terms of disease prevention, economic activity promotion, and proper collection, and management of waste which leads to improved quality of life [1]. However, it was known that nearly 4 billion people have to go through a severe water scarcity for at least one month in a year and 1.8 billion people face water problems for a minimum of 6 months per year. This is due to population growth, urbanization, and climate change [2].

Ethiopia has a population of about 81 million and is the second most well-known country in Africa. The country has abundant water resources, known as 'the water tower of East Africa' [3, 4]. Due to the lack of technical, financial, and uneven distribution of these resources, Ethiopia faced

drought and aridity in its land frequently. According to central static data (2016), 97% of urban people have access to an improved source of drinking water, but only 57% of rural households are provided with safe potable water [5].

The Ethiopian government, in collaboration with the international donors, needed to reduce these water-related problems. Given the country's low starting point and the need to address the causes of poverty, a lot of money was spent, and policies were changed to help the country reach some of the Millennium Development Goals (MDGs) by 2015. In recent years, Ethiopia has made considerable progress in terms of improving low access coverage of safe water supply, sanitation, and hygiene (WASH). Despite the significant acceleration in coverage and a relatively favorable policy environment, additional effort is needed to achieve the goals of the sustainable development plan and One WaSH National Program (OWNP) [6]

This paper presents a detailed assessment of the water demand in 'Yirgalem-Tula Kebele' which is required for the design of a water supply system in the regions of 'Yirgalem-Tula Kebele' community, which is found in the Southern Region of Ethiopia Dale Woreda (Sidama Zone) and is one of the target areas selected for the development of access for potable water [7].

To design a water supply project, it is important to know how much water will be given to the community. This means figuring out how many people will be served, how much water each person uses, and what other factors might affect the consumption rate. The total water demand is calculated by considering the water requirement for public and domestic usage of water expected in the community. In this study, various water demands are being predicted for the city 'Yirgalem-Tula Kebele' of Ethiopia, which will be useful in the design of any water supply project for this area.

*1.1. Location and Accessibility.* Yirgalem-Tula Kebele is located in the southern part of Ethiopia, particularly in the Sidama Zone, Dale Woreda. The geographic location of the Yirgalem-Tula-Kebele is approximately between 6°45′ and 6°46′latitude north and 38°22′and 38°23′longitude east. Yirgalem-Tula Kebele is 40 km far from Hawassa (the regional capital) [8]. This road is part of the international road from Addis Ababa (Ethiopia)–Moyale (Kenya) as shown in Figures 1 and 2. The water source (deep borehole) is located 3 km off-road. This road is accessible only in the dry season. Yirgalem is located at a distance of 7 km from Abosto and 48 km from the regional capital Hawassa. For the supply of construction materials to the site, mainly pipes, and fittings, which are transited from Addis Ababa, this road path is suitable. Also, the road from Addis Ababa to Hawassa town is an all-weathered asphalt concrete road having a distance of 270 km.

*1.2. Administration.* The project area, "Yirgalem-Tula" Kebele, is found in one of the southern provinces of Ethiopia, known as the southern nation's nationalities and people of Ethiopia (SNNPR). The region is divided into different administrative zones; 'Sidama' is one of the zones

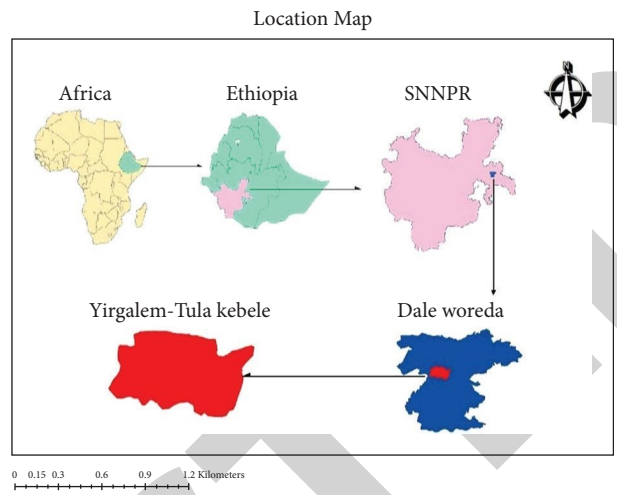


Figure 1: Yirgalem-Tula Keble" @ 6°45′ to 6°46′latitude north and 38°22′ to 38°23′longitude east.

found in the SNNPR. The zone is also subdivided into nineteen 'woredas' (distinct) and two town administrations. Each woreda is also divided into units of administration classification (known as, Kebele). Yirgalem-Tula Community is located in Sidama Zone Dale Woreda [9]. It is established traditionally and it was not master plan based.

*1.3. Existing Water Source.* Yirgalem-Tula Kebele community has not had enough potable water. There is one hand-dug well in the Kebele (Figure 3) and there are two taps that are not functional. Then a small number of people get potable water. However, some people of the community purchase potable water from the nearby town of Abosto. Also, the remaining part community is forced to use surface water (ponds and runoff) which has a high-quality problem. This community is vulnerable to water-related diseases. The community of Yirgalem-Tula mainly uses ponds and runoff for cattle and washing purposes in the rainy season, which is far from most of the users. Also, the majority of this water has poor hygiene and is contaminated with bacteria such as *Shigella*, *Salmonella*, and *Salmonella typhi* as has been shown below. Most sources are of poor quality and the community has a large population; as a result of constructing a water supply system from the proposed source, the borehole is suitable for the drinking needs of such a large community.

## 2. Population Forecasting

*2.1. Present Population.* The use of a reliable base population figure is very important for optimizing the project costs and sustaining the project's service year. Here the overestimation and underestimation of the population result in a higher investment cost and a lower service run period, respectively. Hence, it is very important to initially get realistic base population figures that do not come with the above-mentioned problems. Specific information about the population is taken from the Kebele administration office and confirmed from the census information.

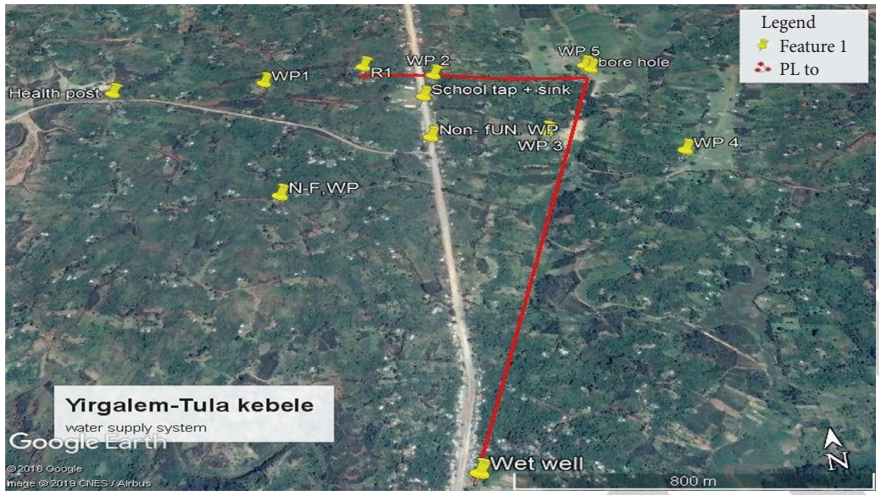


Figure 2: Yirgalem-Tula Keble" @ 6°45′ to 6°46′latitude north and 38°22′ to 38°23′longitude east.

Figure 3: Existing source of water in Yirgalem-Tula.

The Central Statistical Authority (CSA), Office of Population and Housing Census Commission, published the 2007 population and housing census of Ethiopia. This is where you can find population numbers. The CSA predicts how many people will live in towns and rural areas by region. Accordingly, the population of 'Yirgalem-Tula' Kebele is 5,566 (five thousand five hundred sixty-six) (See Table 1 below).

*2.2. Population Projection.* Because unpredictable events can change population trends, it has been known for a long time that the growth of the human population would follow an S-shaped curve. Most of the time, arithmetic progression, geometric progression, decreasing rate of growth, or graphical extension is used to estimate the population in the next 1–20 years. All three of the first steps are based on the "S" shaped growth curve. When making predictions about population, the trends of the past population will be examined to determine which of the three methods best fits the trend [4].

For rural Kebele, like Yirgalem-Tula, the population forecasting method selected is geometric progression with CSA growth rates, that is, 3%. The population forecasting will be done, established at the national level, for every 15-year interval. Table 1 projects the population forecasting from 2007 to 2039.

Population forecasting formula for the design period:

$$P1 = Po\ (1 + K)n, \tag{1}$$

where $P1$ is the population at the current period, $Po$ is the population in the previous period, $K$ is the growth rate = 3%, and $n$ is the period (years) = 15.

*2.3. Population Characteristics.* The majority of the population belongs to the Sidama ethnicity and speaks Sidamuafoo, which is a Cushitic language family. Based on the 2007 census, the estimated population is 212,947 and the projected rural population in five years (2012 EFY) is 238,298. Ninety-seven percent (97%) of the population constitutes the rural population. The composition of sex shows that males account for 1,06,894 and females account for 1,06,053 in the ratio of 3686 : 3657.

*2.4. Household Characteristics.* According to the report produced by the central statistics authority, the number of people per household in rural areas is estimated at 5.38. As a result, Yirgalem-Tula Kebele has increased from 1,143 households in 2007 to 1,475 households in 2019.

## 3. Water Demand Analysis

*3.1. Domestic Demand.* Domestic water is required for various uses in the house, primarily for drinking, cooking, washing, cleaning, and other related tasks, and the factors affecting domestic demand vary based on the mode of supply, socioeconomic conditions, and climate [3].

Table 1: Population projection (2007–2039).

| Description | Growth rate per year (%) | Year (projection period) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2007 | 2019 | 2024 | 2029 | 2034 | 2039 |
| Population projection | 3 | 5566 | 7936 | 9200 | 10665 | 12364 | 14333 |

Table 2: The daily domestic demands of different consumptions.

| | Stage 1 | Stage 2 |
|---|---|---|
| House connection (HC) | 50 l/c/day | 70 l/c/day |
| Yard connection, own (YCO) | 25 l/c/day | 30 l/c/day |
| Yard connection, shared (YCS) | 30 l/c/day | 40 l/c/day |
| Public tap supplies (PT) | 20 l/c/day | 25 l/c/day |

Source: Ministry of Water Resources, Ethiopia 2006.

*3.2. Types of Modes of Services.* Modes of services commonly prevalent in Ethiopia are classified into five categories, namely,

(i) Traditional source users (TSUs)
(ii) Public tap users (PTUs)
(iii) Neighborhood tap users (NTUs)
(iv) Yard tap users (YTUs)
(v) House tap users (HTUs)

The daily domestic demands of consumption are shown in Table 2 in which the values were extracted from the ministry of Water Resources in the year 2006.

*3.3. Per Capita Demand and Projection.* The number of people who use each service will change over time. Taking the above conditions into account, it is possible to estimate the current and future percentages of people served by each demand category. This projection showed how public taps could be given to the traditional source users.

*3.4. Adjusted Domestic Water Demand.* The above-average domestic demand should be further refixed by adjustment factors for climatic and socioeconomic conditions.

*3.5. Climatic Adjustment Factor.* The water consumption is less in the area where the average temperature is low and high where the temperature is very high. Yirgalem-Tula Kebele has a minimum mean annual temperature of 70°C and maximum mean annual temperature of 21°C. Accordingly, Yirgalem-Tula Kebele is included. Mean annual temperature is between 15 and 20. Hence the climatic factor of 1.0 is considered as shown in Table 3.

*3.6. The Socioeconomic Conditions Adjustment Factor.* Socioeconomic survey data shows some of the people in Yirgalem-Tula Kebele are driving their livelihood by undertaking small-scale trade, through local drinking centers and beauty salons, etc., in Table 4.

Based on the information above, the town is in Group C, which is for towns with a town under normal Ethiopian conditions. So, in this work, a socioeconomic adjustment factor of 1 was chosen.

*3.7. Institutional and Commercial Demand.* Institutional water demand is the amount of water demanded by schools, offices, hospitals, universities, etc. Commercial water demand includes water required for hotels, restaurants, bars, fuel stations, and local drink houses (Tej, Areke, and Tella). This quantity will vary depending on the number and type of institutions and commercial buildings present in the city, which were both shown in Table 5 and Table 6.

*3.8. Livestock Water Demand.* The demand for livestock watering from the public water supply system shall be assessed in the Yirgalem-Tula Kebele during the socioeconomic survey(Table 7). When animal watering is to be allowed, the following specific demands will be adopted: Standard water demand for livestock is shown in Table 8.

*3.9. Educational Institutions.* The number of students attending schools is normally expected to grow parallel to the total population growth. The current number of students of Yirgalem-Tula Kebele is according to the information from the socioeconomic report (Table 9).

*3.10. Health Institutions.* Based on the socioeconomic report of Yirgalem-Tula Kebele the area is group three. The number of beds available in the health center total is 30 in 2019 (Table 10).

*3.11. Religious Institutions.* The water demand of religious institutions for the design period is computed based on the current total population and the computation is shown in Table 11.

*3.12. Unaccounted for (or Nonrevenue) Water.* UFW happens when a system leaks, water is taken through illegal

Table 3: Climatic factors.

| Mean annual temp. (C) | Description | Altitude | Factor |
|---|---|---|---|
| <10 | Cool | >3300 | 0.8 |
| 10–15 | Cool temperature | 2300–3300 | 0.9 |
| 15–20 | Temperature | 1500–2300 | 1 |
| 20–25 | Warm temperature | 500–1500 | 1.3 |
| 25 and above | Hot | <500 | 1.5 |

Source: Data Compilation and Analysis Project (1997).

Table 4: Socioeconomic factors.

| Group | Description | Factor |
|---|---|---|
| A | Towns enjoying high living standards and with very high potential for development | 1.1 |
| B | Towns have a very high potential for development but lower living standards at present | 1.05 |
| C | Towns under normal Ethiopian conditions | 1 |
| D | Advanced rural towns | 0.9 |

Source: Ministry of Water, Irrigation, and Electricity, Ethiopia.

Table 5: The daily demand of institutions.

| Item | Consumer category | Daily demand |
|---|---|---|
| 1 | Boarding schools | 60 l/pupil |
| 2 | Day schools | 5 l/pupil |
| 3 | Public offices | 5 l/employee |
| 4 | Workshops/shops | 5 l/employee |
| 5 | Mosques and churches | 5 l/worshipper |
| 6 | Cinema houses | 4 l/seat |
| 7 | Public baths | 30 l/visitor |
| 8 | Railway and bus stations | 5 l/user |
| 9 | Military camps | 60 l/person |
| 10 | Public latrines (with water facility connection) | 20 liters/seat |
| 11 | Hospitals | 50–75 l/bed |

Source: (Urban Water Supply Design Criteria by Ministry of Water Resources, January 2006).

Table 6: The daily demand for commercials.

| Consumer category | Quantity | Daily demand (l/d) | No of beds/visitors | Total demand (currently) |
|---|---|---|---|---|
| Hotels | 0 | 30 | 0 | 0 |
| Bars and restaurants | 1 | 10 | 50 | 500 |
| Abattoirs | 0 | 150 | 4 | 0 |
| Barbers | 2 | 5 | 10 | 100 |
| Beauty salons | 1 | 5 | 6 | 30 |
| Local drink centres | 6 | 5 | 75 | 2250 |
| Public latrines/no water flash | 0 | 5 | 80 | 0 |
| Average demand (l/d) | | | | 2880 |
| Average daily demand ($m^3$/day) | | | | 2.88 |
| Average daily demand (l/s) | | | | 0.033 |
| % of AJDD | | | | 1.612 |

Table 7: Standard water demand for livestock.

| | |
|---|---|
| Cattle, donkeys, horses, etc. | 50 l/head/day |
| Goats/sheep | 10 l/head/day |
| Camels | 150 l/head/month |

Source: Ministry of Water Resources, 2006.

Table 8: Water demand for livestock.

| Consumer category | Quantity (numbers) | Daily demand (l/d) | Consumption demand (l/d) |
|---|---|---|---|
| Cattle | 1510 | 50 | 75500 |
| Goats/sheep | 384 | 10 | 3840 |
| Poultry | 4770 | 0.2 | 954 |
| Average demand (l/d) | | | 80,294 |
| Average demand ($m^3$/day) | | | 80.294 |
| Average demand (l/s) | | | 0.929329 |
| % of AJDD | | | 44.96874 |

Table 9: Water demand for educational institutions.

| Consumer category | Daily demand | No. of students and teachers | Demand (l/d) |
|---|---|---|---|
| Yirgalem-Tula primary school (1–8) | 5 | 1300 | 6500 |
| Average daily demand (l/d) | | | 6500 |
| Average daily demand ($m^3$/day) | | | 6.5 |
| Average daily demand (l/s) | | | 0.075231 |
| % of AJDD | | | 3.640332 |

Table 10: Water demand for health institutions.

| Consumer category | Quantity | Daily demand | No of beds/visitors | Demand (l/d) |
|---|---|---|---|---|
| Health centre | 1 | 60 | 30 | 1800 |
| Average demand (l/d) | | | | 1800 |
| Average demand ($m^3$/day) | | | | 1.8 |
| Average demand (l/s) | | | | 0.021 |
| % of AJDD | | | | 1.01 |

Table 11: Water demand for religious institutions.

| Religion | % | The year 2019 (G.C) | No. of worshippers | Allowed litre per worshipper | Daily consumption l/ worshipper | The demand of worshippers four days per month (in litres) | Demand (l/d) | Demand (m3/day) |
|---|---|---|---|---|---|---|---|---|
| Protestant church | 100.00 | 7,935.79 | 7,935.79 | 5.00 | 39,678.93 | 158,715.70 | 5,290.52 | 5.29 |
| Orthodox church | 0.00 | — | — | 5.00 | — | — | — | 0.00 |
| Catholic church | 0.00 | — | — | 5.00 | — | — | — | 0.00 |
| Muslim mosque | 0.00 | — | — | 5.00 | — | — | — | 0.00 |
| Others | 0.00 | — | — | 5.00 | — | — | — | 0.00 |
| Total (excluding others) | | | | | | | 5,290.52 | 5.29 |
| % of AJDD | | | | | | | | 2.96 |

Table 12: Recommended Peak hour Factors.

| Population range | Peak hour factor |
|---|---|
| <20000 | 2 |
| 20001 to 50000 | 1.9 |
| 50001 to 100000 | 1.8 |
| >100000 | 1.6 |

Source: Ministry of Water Resources, 2006.

Table 13: Summary of water demand.

| Description | Unit | Present population | % Proportion by mode of service | | | | |
|---|---|---|---|---|---|---|---|
| | | | Phase I | | | Phase II | |
| Year | — | 2007 | 2019 | 2024 | 2029 | 2034 | 2039 |
| Population growth rate | — | — | 3% | 3% | 3% | 3% | 3% |
| Per capita demand | l/c/d | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |
| Projected/forecasted population | No. | 5, 566 | 7, 936 | 9, 200 | 10, 665 | 12, 364 | 14, 333 |
| Domestic water demand | $m^3$/d | — | 198.39 | 229.99 | 266.63 | 309.09 | 358.32 |
| | l/s | — | 2.30 | 2.66 | 3.09 | 3.58 | 4.15 |
| Socioeconomic factor | — | — | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 |
| Climatic factor | — | — | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adjusted domestic water demand (AJDD) | $m^3$/d | — | 178.56 | 206.99 | 239.96 | 278.18 | 322.49 |
| | l/s | — | 2.07 | 2.40 | 2.78 | 3.22 | 3.73 |
| Institutional and commercial water demand; including public utilities, health centres, schools, and religious institutes (15% of AJDD). | $m^3$/d | — | 26.78 | 31.05 | 35.99 | 41.73 | 48.37 |
| Livestock water demand (% of AJDD) | $m^3$/d | — | 80.29 | 93.08 | 107.91 | 125.10 | 145.02 |
| Total adjusted demand (TAD) water | $m^3$/d | — | 285.63 | 331.13 | 383.87 | 445.01 | 515.88 |
| | l/s | — | 3.31 | 3.83 | 4.44 | 5.15 | 5.97 |
| Percent of nonrevenue water (15–25% of TAD) | % | — | 15% | 15% | 15% | 15% | 15% |
| Nonrevenue (15% water of TAD) | — | — | 42.84 | 49.67 | 57.58 | 66.75 | 77.38 |
| | — | — | 0.50 | 0.57 | 0.67 | 0.77 | 0.90 |
| Average daily demand (ADD) water | $m^3$/d | — | 328.48 | 380.80 | 441.45 | 511.76 | 593.27 |
| | l/s | — | 3.80 | 4.41 | 5.11 | 5.92 | 6.87 |
| Maximum daily (1.2 ∗ ADD) factor | | — | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Maximum daily demand | $m^3$/d | — | 394.17 | 456.95 | 529.74 | 614.11 | 711.92 |
| (Mdd) | l/s | — | 4.56 | 5.29 | 6.13 | 7.11 | 8.24 |
| Peak hour factor | — | — | 2 | 2 | 2 | 2 | 2 |
| Peak hour demand (2 ∗ MDD) | $m^3$/d | — | 788.35 | 913.91 | 1059.47 | 1228.22 | 1423.84 |
| | l/s | — | 9.12 | 10.58 | 12.26 | 14.22 | 16.48 |
| Water production from existing source (BH) | l/s | — | 16 | 16 | 16 | 16 | 16 |
| New plan water source for phases I and II (BH) | l/s | — | -6.88 | -5.42 | -3.74 | -1.78 | 0.48 |
| Reservoir capacity for phases I and II | $m^3$ | — | 109.49 | 126.93 | 147.15 | 170.59 | 197.76 |
| Adopted reservoir capacity (m̃3) 1/3 of ADD | $m^3$ | — | 110.00 | 125.00 | 150.00 | 175.00 | 200.00 |

connections, metering is not accurate, reservoirs overflow, and water is used without a meter for things like fighting fires, flushing, etc. Without good and reliable metering, UFW is hard to measure. Others have said that 25 to 30 percent of the water made in Addis Ababa might not be accounted for. Since other towns are usually less well taken care of, the situation may be even worse there. 50 percent is not a number that has never been used before. Most people think that 15 percent is a good number, and it would not make sense to try to lower it. So, we decided to use 5% unaccounted-for water (also called nonrevenue water) for this project.

## 4. Demand Variations

*4.1. Seasonal Peak.* The rural communities of Ethiopia are characterized by climatic conditions which result in the change of consumption rate during the year, reflected by a seasonal peal factor that varies similarly. Some consultants have adopted a seasonal peak factor of 1.1. The particular climatic conditions are responsible for selecting the seasonal peal value. It is noted that a value between 1 and 1.2 is taken as the seasonal peak value which represents a relative increase in the average daily demand during the dry months when compared with the average annual demand. For convenience, we adopted 1.0 as the peak factor in the analysis of this project.

*4.2. Peak Day Factor.* One day of the week has a higher demand for water by many communities than other days. This situation shall be considered by the use of a peak day factor. The proposed maximum day factor usually varies between 1.0 and 1.3 as per the design Criteria (MoWR, 2006). In this study, we adopted the 1.2 peak day demand factor for 'Yirgalem-Tula' Kebele.

*4.3. Peak Hour Factor.* Water demand varies greatly during the daytime than the night. Hence, the peak hour factor has to be taken into consideration while designing the distribution system. The peak hour factor varies with the size of the consumer base inversely. Based on the Ministry of Water and Energy design criteria (MoWE, 2006), for a population size less than 20,000, the peak hour demand factor is 2 as shown in Table 12.

*4.4. Summary of Water Demand.* The total water demand used for designing the water supply system components is summarized in Table 13.

## 5. Conclusion

The water distribution network must take into account not only the existing residential population but also the projected increases in that population as it is being

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*Retraction*

# Retracted: Evaluation of Water Resource Utilization Efficiency in Provincial Areas of China Based on the Unexpected Output SBM Model

**Journal of Environmental and Public Health**

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] X. Zhang and Z. Lin, "Evaluation of Water Resource Utilization Efficiency in Provincial Areas of China Based on the Unexpected Output SBM Model," *Journal of Environmental and Public Health*, vol. 2022, Article ID 9554730, 9 pages, 2022.

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*Research Article*

# Evaluation of Water Resource Utilization Efficiency in Provincial Areas of China Based on the Unexpected Output SBM Model

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Based on the SBM model including unexpected output, this paper studies the water resource utilization efficiency of 30 provinces in China from 2003 to 2019. The study found that China's water resource utilization efficiency showed obvious provincial differences. The water resource utilization efficiency of most eastern coastal provinces was relatively high, and that of most central and western inland provinces was not high. There are also significant differences among the three regions of the East, the middle, and the West. The utilization efficiency of water resources in the East is the highest, followed by the middle, and the West is the lowest. The redundancy of input factors, such as labor, capital, and water consumption, is the main reason for the low efficiency of water resource utilization, and the redundancy of wastewater discharge also affects the efficiency of water resource utilization. The clustering results show that the utilization efficiency of water resources in most provinces of China is located in medium efficiency area and low efficiency area, and the efficiency needs to be improved. There are relatively few provinces in high-efficiency areas, highlighting that China's water resource utilization still faces severe challenges.



## 1. Introduction

As an important natural resource, water resources are an important prerequisite for human survival and sustainable development. Due to the rapid development of human economy and society, it not only consumes a lot of water resources but also causes serious water pollution. Coupled with industrial wastewater pollution, it worsens water resources [1]. The resulting water resources crisis has become an important factor restricting economic and social development. At present, many countries in the world are facing the problem of water shortage. It is estimated that, by 2025, nearly 40 countries will be seriously short of water resources, and up to 3 billion people will be seriously short of water [2]. For China, the rapid economic growth after the reform and opening up is accompanied by the shortage of water resources and the deterioration of water ecological environment, which has brought great challenges to the utilization of water resources in China. Nationwide, there is a shortage of water resources in China. In 2018, the total amount of water resources in China was 2796 billion $m^3$, and the per capita water resources was 2007.57 $m^3$/person. Compared with 3246.640 billion $m^3$ and 2354.90 $m^3$/person in 2016, the per capita water resources decreased, and the per capita water resources were less than 25% of the world average. At the same time, China has a huge demand for water resources. In 2018, China's total water supply was 611 billion $m^3$, which is the same as the total water supply. The utilization of water resources is extensive. For example, the effective utilization coefficient of farmland irrigation water in 2015 was 0.53, which is still far from the world level of 0.7~0.8. China's total freshwater resources account for 6% of the world's total water resources, and the per capita share of water resources is only 2034 $m^3$/person, which is 1/4 of the global per capita level. The water consumption per 10,000 US dollars of GDP is 4749 cubic meters, 9.8 times, and 25 times that of the

United States and Japan, respectively, which fully shows that the shortage and inefficient utilization of water resources are particularly prominent in China [3]. From the perspective of regional distribution, China's water resources are in an unbalanced state of regional distribution. In addition, the pollution of water resources in China is becoming more and more serious. From 2009 to 2017, the area of waterlogging removal and the area of soil and water loss control in China continued to rise. The total amount of wastewater discharge continued to rise, peaked in 2015, and improved slightly in 2016 and 2017. From the perspective of regional distribution, China's water resources are in an unbalanced state of regional distribution. For example, the water resources in the north are relatively scarce, while the south is vulnerable to waterlogging. The impact of climate change on inter-regional precipitation has been strengthened, the precipitation in the western region has increased, and the precipitation in the northeast and north China has decreased. It can be seen that there are many water resources problems in China, such as insufficient total amount, unreasonable structure, and unbalanced regional distribution. To this end, the state council issued the opinions on the implementation of the strictest water resources management system in 2012, which clearly stipulates three important red lines: water efficiency, total water consumption, and pollution limitation in water functional areas, especially putting the improvement of water resource utilization efficiency in the first place. The proposal of the 13$^{th}$ five-year plan of the Fifth Plenary Session of the 18$^{th}$ CPC Central Committee in 2015 clearly stipulates that "the strictest water resources management system" must be implemented. In view of this, solving the deterioration of water environment and water ecological imbalance and strengthening the protection and utilization of water resources have become an important problem for the Chinese government. It can be seen that there are many water resources problems in China, such as insufficient total amount, unreasonable structure, unbalanced regional distribution and so on. Agricultural water consumption, industrial water consumption, domestic water consumption, and total ecological water consumption all have a negative impact on water resource utilization efficiency, of which domestic water consumption and industrial water consumption have a greater impact [4]. The water resource utilization efficiency is greatly promoted by natural resource endowment, economic development level, degree of industrialization, and technical progress [5]. Therefore, it needs to analyze the influence factors of them. In view of this, solving the deterioration of water environment and water ecological imbalance and strengthening the protection and utilization of water resources have become an important problem for the Chinese government. In order to effectively solve the contradiction of China's current shortage of water resources, we should use scientific methods to objectively evaluate the current utilization efficiency of China's water resources, understand the shortcomings of water resource utilization, and explore the root causes of low efficiency of water resource utilization, which has important guiding significance for China to build a resource-environment-friendly society.

## 2. Research Review

Water resource utilization efficiency mostly refers to the maximization of the efficiency of water resources in economy, society, and ecological environment of a country or region in order to promote the efficient and sustainable utilization of water resources under limited water resource supply [6]. The utilization of water resources has always been a hot issue in academic circles, and many scholars at home and abroad have conducted indepth research on this issue. The findings mainly include the following aspects:

*2.1. Evaluation Index of Water Resource Utilization Efficiency.* In the construction of evaluation indicators, there are not only single factor indicators such as water consumption per 10000 yuan of GDP [7] but also all factor indicators through the construction of index system [8, 9]. In terms of specific indicators, there are achievements in constructing indicators from the aspects of per capita water resources, industrial water consumption, domestic water consumption, per capita GDP, degree of opening to the outside world, industrial structure, and technological progress [10]. It also includes agricultural water, industrial water, domestic water, ecological water, employment, and fixed asset investment [11]. In addition, 15 indicators are selected from the five aspects of synthesis, industry, agriculture, life, and ecology to build the evaluation index system of water resource utilization efficiency [12].

*2.2. Evaluation Method of Water Resource Utilization Efficiency.* With the indepth research on the evaluation of water resource utilization efficiency by scholars at home and abroad, they are widely used in evaluation methods, but most scholars use data envelopment analysis (DEA) [13, 14] and stochastic frontier method (SFA) [15, 16]. A few scholars used DEA and Malmquist Index [17], SBM model [18], extended Markov chain and spatial Markov chain model [19], and Tobit regression model [20]. In addition, some scholars also used the LMDI decomposition method [21], principal component analysis method [22], water resource footprint [23], ratio analysis method [24], ecological function method [25], reference method [26], and other methods to evaluate the utilization efficiency of water resources.

*2.3. Evaluation Object of Water Resource Utilization Efficiency.* In terms of specific evaluation objects, many scholars have carried out more research. In the application field, some scholars evaluated the utilization efficiency of industrial water [27], agricultural water [28], and domestic water [29]. In terms of regional scope, some scholars focus on the national water resource utilization efficiency [30–33], while others study the water resource utilization efficiency of some provinces [34, 35] and also study the water resource utilization efficiency of a single province [36]. At the same time, there are also studies on the utilization efficiency of urban water resources [37, 38].

It can be seen that although domestic and foreign scholars have used a variety of methods to evaluate the efficiency of water resource utilization from different angles, the relevant research is still less related to the "unexpected" output generated in the process of water resource utilization, and the used data are relatively old, resulting that existing research results cannot timely and truly reflect the utilization level of water resources. Therefore, this paper constructs an SBM model including "unexpected" output to evaluate the water resource utilization efficiency of various provinces in China and carries out a comprehensive evaluation on this basis, so as to provide an important reference for effectively improving the sustainable utilization level of water resources.

## 3. Research Method

*3.1. Nonradial and Nonangular SBM Model.* Data envelopment analysis (DEA) is a systematic analysis method developed by operational research scientists, Charnes and Cooper, on the basis of the concept of "relative efficiency evaluation" [39, 40]. DEA is a method to measure the relative efficiency of decision-making unit based on multi-input and multioutput [41]. Compared with the SFA method, the DEA method has incomparable flexibility in dealing with multiple input and output indicators, so it is widely used to evaluate the efficiency evaluation of multiple departments or fields. The principle of this method uses the idea of mathematical programming. Through the predetermined decision-making unit (DUM), on the premise of constant input and output indicators, the mathematical programming method is used to find the optimal frontier and then compare the distance between different decision-making units and the frontier, so as to evaluate the relative effectiveness of different decision-making units. Traditional radial DEA model has not considered the influence of "relaxation variable" on the efficiency value. Moreover, it has not considered the technical changes that increase the expected output and reduce the unexpected output at the same time. This is not accurate enough to measure the efficiency value. When evaluating the efficiency of water resource utilization, the traditional DEA method only takes into account the single output index of GDP and fails to involve the problem of water pollution in the process of water resource utilization, which is obviously inconsistent with the actual situation of water resource utilization. In addition, the relaxation problem caused by the input index and output index cannot be analyzed, which leads to the inevitable large error of the traditional DEA method in calculating the efficiency of water resource utilization. Based on this, in order to solve this problem, Tone proposed an environmental efficiency evaluation model based on input and output relaxation variables, namely, SBM model in 2001 [42]. On this basis, Tone put forward the SBM extension model in 2004, so as to realize the evaluation of environmental efficiency under the condition of unexpected output [43]. The nonradial and nonangular SBM model proposed by Tone, which includes unexpected output indicators, has the greatest feature that it can accurately calculate the relaxation value of input-output indicators in the process of measuring efficiency, which is helpful to improve from ineffective efficiency to effective efficiency.

Compared with the traditional DEA model, the SBM model calculates the relaxation variable of the input-output index to the greatest extent, so as to measure the efficiency value of the investigated object. It is assumed to build a complete production system, which includes N decision-making units (DMUs). Each decision-making unit needs to input $m$ units of production factors in the operation process, so as to produce $S_1$ units of expected output and $S_2$ units of unexpected output.

Assuming that the final decision-making unit is expressed in $DMU_0 = (x_0, y_0^g, y_0^b)$ and the element input variable is $X = (x_1, x_2, \ldots, x_n) \in R_+^{m\times n} > 0$, the expected output and unexpected source are expressed as follows:

$$Y^g = \left(y_1^g, y_2^g, \cdots, y_n^g\right) \in R_+^{s_1\times n} > 0, \tag{1}$$

$$Y^b = \left(y_1^b, y_2^b, \cdots, y_n^b\right) \in R_+^{s_2\times n} > 0. \tag{2}$$

By setting these assumptions, we can establish the SBM type including the unexpected output:

$$P^t(x) = \left\{\left(x_0, y_0^g, y_0^b\right) | x \geq X\lambda, y_0^g \geq y_0^g\lambda, y_0^b = y_0^b\lambda, \sum_{i=1}^{n=1} \lambda = 1, \lambda \geq 0\right\}. \tag{3}$$

It can be seen from equation (3) that the equation part of the whole model shows the important characteristics of zero combination of the expected output and unexpected output and joint weak disposability. The inequality part of the model is a constraint condition, which reflects the strong disposability between input variables and output variables. This means that the model is convex and bounded and is used to examine the weight of the cross section of the whole model, $\lambda$, showing a positive value.

When dealing with these characteristics, the whole operation process of the SBM model is expressed as follows:

$$\min \rho = \frac{1 - (1/m)\sum_{i=1}^{m} s_i^{x-}/x_{io}}{1 + \left(1/\left(s_d + s_u\right)\right)\left(\sum_{d=1}^{d} s_d^{y+}/y_{do} + \sum_{u=1}^{u} s_u^{b-}/b_{uo}\right)},$$

$$\text{s.t.}\quad \begin{aligned} x_o &= \sum_{j-1}^{n} \lambda_j x_{ij} + s_i^{x-}, \quad i = 1, 2, \ldots m, \\ y_o &= \sum_{j-1}^{n} \lambda_j y_{dj} - s_d^{y+}, \quad d = 1, 2, \ldots d, \\ b_o &= \sum_{j-1}^{n} \lambda_j b_{uj} + s_u^{b-}, \quad u = 1, 2, \ldots u, \\ \lambda &\geq 0, s_i^{x-} \geq 0, s_d^{y+} \geq 0, s_u^{b-} \geq 0. \end{aligned} \tag{4}$$

In equation (4), $s^{x-} \in R^m$, $s^{y+} \in R^d$, and $s^{b-} \in R^u$ represent the relaxation variables of input index, expected output index, and unexpected output index, respectively. If these relaxation variables are greater than zero, it means that there are problems such as input redundancy, insufficient expected output, and undesired output redundancy in the whole model. Equation $\rho$ is expressed in the form of ratio. If

it is not 1, the molecule represents the proportion that the input index can be reduced in the improvement process of realizing the optimization of efficiency, that is, the input is inefficient. The denominator means that, in the process of efficiency optimization, the expected output can increase or the unexpected output can decrease, that is, the output is inefficient. In the whole decision-making unit, only when the conditions of $s^{x-} = 0$, $s^{y+} = 0$, and $s^{b-} = 0$ are met, that is $\rho = 1$, the whole efficiency is optimized. If $\rho < 1$ occurs, it reflects the invalid situation of the whole solution unit. Only by reducing the slack variables of input and output indicators can we ensure that the invalid state of the whole decision-making unit is optimized to an effective state.

*3.2. Cluster Analysis Method.* Cluster analysis method is used to analyze the regional characteristics of water resource utilization efficiency in China. By setting different grouping criteria, the clustering method divides the water resource utilization efficiency into different groups according to the value of the investigated object. Clustering methods are mainly divided into two different clustering analysis methods: C-means cluster and K-means cluster. Compared with the two, the application of the latter is more flexible and universal. Therefore, the K-means cluster method is selected. The basic principle of the K-means cluster is to assume that the overall sample set is $\{x^{(1)}, \cdots, x^{(n)}\}$, and each sample is $x^{(i)} \in R^n, \mu_1, \mu_2, \ldots, \mu_k \in R^n$ represented by K-cluster centroids selected to represent the whole sample. K-means cluster is to minimize the distance between the sample and the cluster centroid.

$$J = \sum_{n=1}^{N} \sum_{k=1}^{K} \Gamma nk \left\| x_n - \mu_k \right\|^2. \tag{5}$$

In equation (5), $\Gamma nk$ represents the value range of cluster K. When $\Gamma nk$ is 1, it means $\Gamma nk$ is within the range of cluster K. When $\Gamma nk$ is 0, it means $\Gamma nk$ is outside the scope of cluster K.

Generally speaking, it is very difficult to select the optimal clustering centroid directly by the observation method, which can only be gradually selected by using professional software according to the iterative method. The specific steps are as follows: firstly, assuming that $\mu_k$ does not change, it is easier to select the optimal one. On the premise that the whole data point is closest to its central point, the whole function can be minimized. Secondly, assuming that the whole of $\Gamma nk$ is constant, the optimal $\mu_k$ is selected. Finally, take the derivative of $\mu_k$ and assume that the derivative is zero, then the minimum $J$ distance can be calculated finally. Then, the optimal $\mu_k$ can be expressed as follows:

$$\mu_k = \frac{\sum_n \Gamma nk x_n}{\sum_n \Gamma nk}. \tag{6}$$

In equation (6), $\mu_k$ is the average value of data points in the whole cluster K, that is, the optimization is realized. This means that, in each iteration, the value of j-distance is the smallest, so that the whole j-distance will only continue to shrink without increasing and finally achieve a minimum value of K-means. On the premise of obtaining the minimum value, through multiple iterative aggregation, the whole investigation object will be divided into different clustering groups according to the clustering standard.

*3.3. Evaluation Index System.* Water resource utilization efficiency is a process that includes the ecological value function of water resources, can produce the maximum green economic benefits with the minimum investment of water resources, and ensure the minimization of pollution discharge [44]. In the process of participating in economic activities, water resources can produce not only expected outputs such as GDP but also unexpected outputs such as sewage discharge. In view of this, in order to deeply investigate the utilization and ecological value of water resources, it is necessary to bring unexpected output into the research framework of water resource utilization efficiency.

As an important natural resource, water resources cannot be used alone to measure its utilization efficiency. It must be combined with other production factors to complete the whole economic production activities. In the construction of the evaluation index system of water resource utilization efficiency, the input indexes include the following: first, the participation of water resource consumption as the primary input element not only reflects the degree of water use in a region but also is the key condition to measure the efficiency of water resource utilization; second, as an input factor in economic production activities, labor force is the user of water resource utilization, and it is an essential input factor index in the analysis of water resource utilization efficiency; third, in addition to the necessary natural resources and labor force, capital investment is also an essential factor in the economic activities of a region. Without the participation of capital, the whole economic production activities cannot be completed. Therefore, this paper takes the capital stock as an important input factor index.

The utilization efficiency of water resources specifically refers to the degree of economic benefits it produces. Therefore, the important output index is the gross domestic product (GDP), which is also the expected output index of the evaluation index system. Because the water resource utilization efficiency includes the ecological and environmental value of water resources, the pollutant discharge generated in the process of water resource utilization is another important output. Therefore, it is necessary to take the wastewater discharge as the unexpected output index of the evaluation index system.

To sum up, the input indicators determined by the evaluation index system of water resource utilization efficiency are water resource consumption, labor force, and capital stock, and the output indicators are divided into expected output indicators and unexpected output indicators, in which the former is GDP and the latter is wastewater discharge.

## 4. Result Analysis

*4.1. Comparison of Regional Differences in Water Resource Utilization Efficiency.* From formulas (3) and (4), the data of input and output indicators are brought into the mSBM model, and the water resource utilization efficiency of 30 provinces and cities in China from 2003 to 2019 is calculated by using MaxDEA software, as shown in Figure 1. From the average value of water resource utilization efficiency of each province, only the water resource utilization efficiency of Tianjin and Shanghai municipalities directly under the central government has been 1 in the sample period, that is, it has reached the frontier of efficiency. The utilization efficiency of water resources in other provinces has not been optimized, and there is some room for improvement.

From the comparison of the differences among various provinces, Tianjin, Shanghai, Shandong, Heilongjiang, and Liaoning ranked among the top five provinces in China in terms of water resource utilization efficiency, and the average value of water resource utilization efficiency exceeded 0.88. Among the five provinces, Heilongjiang is located in the central region, and the other four provinces are located in the eastern region. There are reasons why these five provinces are in the leading position in the country. Tianjin, Shanghai, Shandong, and Liaoning are located in the eastern coastal areas. They are also economically developed areas in China. Their market economy has developed relatively well, their industrial structure has gradually realized the transformation and development from heavy industry to modern service industry, the level of resource utilization intensification has been continuously improved, and water-saving technologies have been continuously innovated, popularized, and applied, resulting in high water resource utilization efficiency. Heilongjiang is a traditional "northern wasteland" area in China. In recent years, the state has vigorously advocated the policy of returning farmland to forests. Heilongjiang's forests and wetlands have been well protected, and the water resources conservation benefits of forests and wetlands rank among the top in the country. The government implements strict water resource utilization policies, so Heilongjiang's water resource utilization efficiency is also high.

Xinjiang, Guangxi, Guizhou, Qinghai, and Ningxia are the last five provinces in China in terms of water resource utilization efficiency, and their water resource utilization efficiency is less than 0.35. The economic development level is relatively backward, the market mechanism is not perfect, the industrial structure is dominated by traditional agriculture and industry, and the water resource utilization mode is relatively extensive, which are important incentives for the low efficiency of water resource utilization in these provinces.

It can be seen that China's water resource utilization efficiency has significant provincial differences. Most of the provinces with high water resource efficiency are located in the eastern coastal areas; while most of the inland provinces in the central and western regions have relatively low water resource efficiency. Therefore, for China, accelerating the improvement of inland provinces in central and Western China with low water resources efficiency is of great significance to realize the sustainable utilization of water resources.

Analyze the change trend of water resource utilization efficiency according to the eastern, central, and western regions, as shown in Figure 2. On the whole, the national water resource utilization efficiency has little change from 2003 to 2019, and its change trend is relatively gentle. The utilization efficiency of water resources in the eastern region shows an inverted "U" trend in this annual cycle, and its significant change characteristics are "high in the middle and low at both ends." The change trend of water resource utilization efficiency in the central region is similar to that in the whole country, with little change during the sample period. The only significant change is the significant decline of water resource utilization efficiency in 2017. Taking 2006 as the node, the western region showed a slow decline before 2006, and there was no obvious change after 2006. From the difference of water resource utilization efficiency in each region, the regional differentiation is more obvious. During the period from 2003 to 2019, the average value of water resource utilization efficiency in the eastern region is as high as 0.734, far higher than the national average level of 0.543, the average value of water resource utilization efficiency in the central region is 0.518, close to the national average level, and the average value of water resource utilization efficiency in the western region is only 0.351, far lower than the national average level. It can be seen that the utilization efficiency of water resources in the East is the highest, followed by the middle and the West. The utilization efficiency of water resources shows a decreasing trend from the eastern region to the central and western regions.

*4.2. Ineffectiveness Analysis of Water Resource Utilization Efficiency.* According to the operation results of the mSBM model, further differential variable analysis is carried out to find out the input factor redundancy, expected output insufficiency, and unexpected output redundancy of water resource utilization efficiency, and then dig out the specific reasons for the ineffective water resource utilization efficiency. On this basis, through the corresponding improvement range, the noneffective DEA decision-making unit is improved into an effective DEA decision-making unit. The input redundancy, expected output deficiency, and unexpected output redundancy of the five provinces with the lowest water resource utilization efficiency in China in 2003 and 2019 are calculated. It can be seen from Table 1 that whether in 2003 or 2019, the main factors leading to the ineffectiveness of water resource utilization efficiency in Xinjiang, Guangxi, Qinghai, Guizhou, and Ningxia are due to the redundancy of labor, capital, and water resource consumption, and the redundancy of total wastewater discharge also has a certain impact.

*4.3. Regional Cluster Analysis.* Based on equation (5) and equation (6), SPSS22.0 software is used for K-means cluster analysis of water resource utilization efficiency of each province. According to the three criteria of high-efficiency

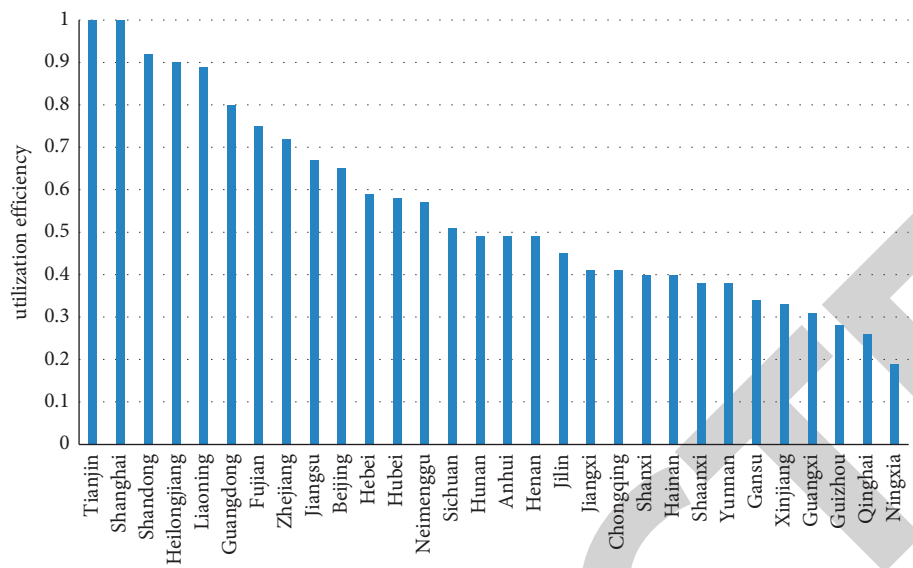


Figure 1: Average value of water resource utilization efficiency of various provinces in China during 2003–2019.

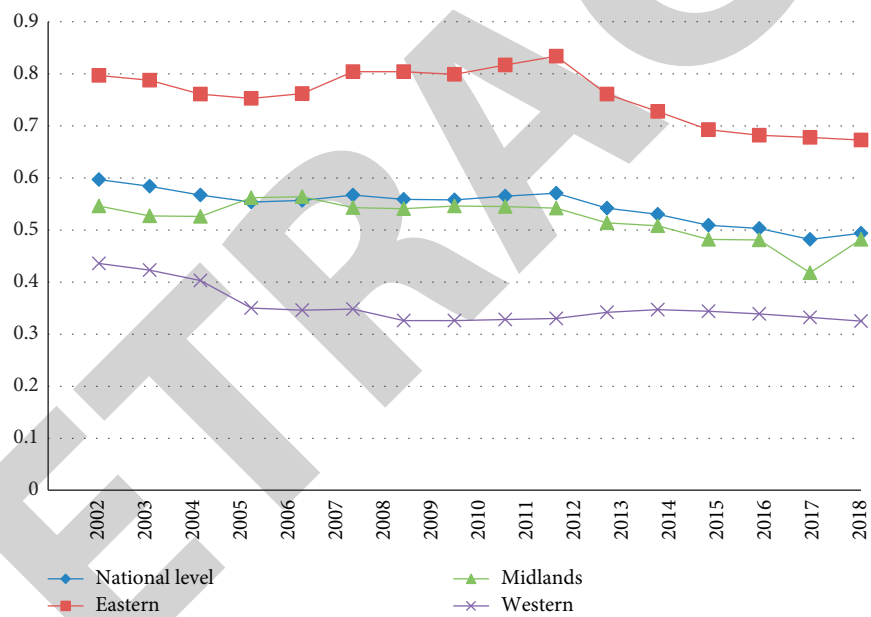


Figure 2: Change trend of water resource utilization efficiency in China and its three regions.

Table 1: Input redundancy, expected output deficiency, and unexpected output redundancy of five provinces in 2003 and 2019.

| Province | 2003 | | | | | 2019 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Labor | Capital stock | Water consumption | GDP | Wastewater discharge | Labor | Capital stock | Water consumption | GDP | Wastewater discharge |
| Xinjiang | −325.023 | −228.517 | −464.148 | 0 | −1.117 | −837.522 | −14218.633 | −538.418 | 0 | −2.515 |
| Guangxi | −1757.351 | −446.254 | −227.622 | 0 | −7.292 | −2087.719 | −22165.515 | −233.520 | 0 | −7.121 |
| Qinghai | −171.231 | −268.153 | −24.472 | 0 | −0.524 | −221.819 | −4958.217 | −23.311 | 0 | −1.522 |
| Guizhou | −1741.457 | −404.127 | −71.105 | 0 | −3.157 | −1577.152 | −5322.521 | −88.204 | 0 | −5.813 |
| Ningxia | −168.362 | −361.468 | −79.034 | 0 | −0.329 | −278.149 | −8071.422 | −57.348 | 0 | −1.785 |

area, medium efficiency area, and low efficiency area, the regional case standard is selected, and the clustering results of water resource utilization efficiency of each province are obtained by means of step-by-step iteration and classification. Tianjin, Shanghai, Shandong, Heilongjiang, Liaoning, and Guangdong are in the high-efficiency area of water resource utilization efficiency. A total of 11 provinces, including Fujian, Zhejiang, Jiangsu, Beijing, Hebei, Hubei,

Inner Mongolia, Sichuan, Hunan, Anhui, and Henan, are in the medium efficiency zone. Jilin, Jiangxi, Chongqing, Shanxi, Hainan, Shaanxi, Yunnan, Gansu, Xinjiang, Guangxi, Guizhou, Qinghai, and Ningxia are in low efficiency areas. It can be seen that there are relatively few provinces with high water resource utilization efficiency in China, and the number of high efficiency provinces is accounting for only 20%. Most provinces are located in the low campus of the medium efficiency area where the efficiency needs to be improved, and the number of low efficiency provinces is accounting for as much as 80%. The provinces in low efficiency areas are mainly distributed in the inland areas of the central and western regions, which are also the areas that the state should focus on while formulating water resource utilization policies.

## 5. Conclusion and Discussion

By constructing the SBM model including unexpected output, and on the basis of constructing the evaluation index system of water resource utilization efficiency, MaxDEA software is used to measure the water resource utilization efficiency of 30 provinces in China from 2003 to 2019, and a comprehensive evaluation is carried out accordingly. The results show that (1) the top five provinces in China are Tianjin, Shanghai, Shandong, Heilongjiang, and Liaoning. Except that Heilongjiang is located in the central region, the other provinces are located in the eastern coastal region. The last five provinces in China are Xinjiang, Guangxi, Guizhou, Qinghai, and Ningxia, which are located in the inland regions of the central and western regions. (2) From the perspective of the three major regions of the East, the middle, and the West, the regional differentiation is more obvious. In order, the utilization efficiency of water resources in the East is the highest, the middle is the second, and the West is the lowest. (3) From the perspective of causes, the key factor leading to the low efficiency of water resource utilization is the redundancy of input factors such as labor, capital, and water resource consumption, and the redundancy of wastewater discharge also has a certain impact. (4) The clustering results show that up to 80% of the provinces' water resource utilization efficiency is located in the medium efficiency area and low efficiency area, and its efficiency needs to be improved, and only 20% of the provinces are in the ideal high-efficiency area.

China is still the largest developing country in the world. Although the speed of economic development is still in the forefront of the world, the problems brought by economic growth, including the utilization of water resources are becoming more and more serious, which undoubtedly brings great challenges to China's promotion of sustainable development strategy. China is still facing a dilemma in the utilization of water resources: (1) the rapid development of economy will inevitably lead to a significant increase in the use of water resources, but the utilization of water resources in most provinces is still characterized by certain extensive characteristics. Not only the water-saving technology is lagging behind but also some local governments fail to really realize the importance of efficient utilization of water resources; (2) China's economic development is in a critical period of transformation, and the efficient and economical utilization of water resources, including water resources, has become an important measurement index. However, to truly realize this index, local governments still have a lot of work to strengthen.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The authors declare that there are no conflicts of interest.

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