

Retraction

Retracted: Economic Benefit Evaluation and Analysis Based on Intelligent Agriculture Internet of Things

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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) Manipulated or compromised peer review

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. Liu and Y. Wu, "Economic Benefit Evaluation and Analysis Based on Intelligent Agriculture Internet of Things," *Journal of Mathematics*, vol. 2021, Article ID 9499197, 7 pages, 2021.

Research Article

Economic Benefit Evaluation and Analysis Based on Intelligent Agriculture Internet of Things

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There has been a consensus on the development of ecological agriculture to promote the leap from traditional agriculture to ecological agriculture, but the unavoidable fact is that the development of ecological agriculture is still relatively slow at the present stage and has not formed a major climate and great influence. The rise of the Internet is a technology that has promoted the transformation and upgrading of modern agriculture, changed the traditional agricultural production mode, and accelerated the scientific and technological integration of information. In view of the characteristics and difficulties of agriculture, this paper builds an Agricultural Internet of Things (IoT) management system to realize the integrated management of Internet equipment and realize the management of environmental data, video data, and agricultural expert knowledge. Then from perception technology, transmission technology, and the perspective of three intelligent information processing technologies, this paper introduces the present state of agricultural IoT, analyzes the Internet of Things to the economic benefits of agricultural production, to research the problems of China's agricultural development of the Internet of Things, and puts forward China's agricultural Internet of the future research emphasis and direction of development.

1. Introduction

The Internet of Things is an important symbol of the global information age. Its basic connotation includes the following two points. First, the Internet of Things is the expansion and extension of the Internet, telecommunications network, and broadcasting network, while the three networks provide technical support for the generation and development of the Internet of Things. Second, information exchange between traditional users has expanded to interactive communication between users and objects and between objects, with further development of intelligent objects [1, 2]. Agriculture is the primary industry and is an important part of the national economy; the narrow sense of agriculture refers to the planting industry. Nowadays, the international agricultural product market is a complex combination of commercialization, scale, science and technology, and internationalization. The development of Chinese agriculture is of great significance to the

international agricultural product market. Traditional agriculture relies on manpower and experience in the process of work, many problems in the process of work cannot be accurately answered, and the control of the process of work is also very difficult. Agricultural Internet of Things can realize parametric control to automatic control in the planting process through equipment and instruments, providing a scientific basis for the planting process of crops while reducing manpower and material resources, and it can increase at the same time.

Smart agriculture is a process of intelligent management such as agricultural visual remote diagnosis, remote control, and disaster warning by fully applying modern information technology achievements and integrating computer and network technology, Internet of Things technology, audio and video technology, 3S technology, wireless communication technology, and expert wisdom and knowledge [3]. Smart agriculture integrates the agricultural ecosystem, uses modern science and technology, realizes energy recycling,

saves labor costs, realizes intensive utilization of resources, and improves the quality of agricultural products to a certain extent. It is a new agricultural development model [4]. In the early 1980s, smart agriculture first emerged in the United States and gradually spread to all continents with the development of informatization and intelligence [5]. Although smart agriculture started late in China, the government attaches great importance to the introduction of high and new technologies. By 2013, the industrial scale of smart agriculture in China has reached 400 billion yuan [6]. From the 13th Five-Year Plan of National Science and Technology Innovation, smart agriculture has become a key part of the construction of efficient, safe, and ecological modern agricultural technology. However, in a strict sense, China's smart agriculture is still in its infancy and exploration stage [7]. As a big agricultural country, smart agriculture is an important way to transform the agricultural production mode at this stage by gradually replacing the traditional production mode.

The Agricultural Internet of Things (IoT) improves the speed and quality of agricultural products by addressing problems in extensive agricultural production, transportation, and marketing. It plays a great role in promoting and promoting the development of agriculture. In terms of economic benefits, the role of agricultural IoT is mainly reflected in the following aspects [8]:

- (i) The first aspect is agricultural productivity and production efficiency that has been greatly developed and improved: agriculture accounts for a large proportion in the development of the national economy. How to optimize agricultural productivity and improve production efficiency has been attached importance to by governments of all countries. Agricultural IoT can improve the speed and precision of data collection and information processing, make overall planning of agricultural production, transportation, and sales process, reduce the input of human, material, and financial resources, improve the operation efficiency of agricultural enterprises, and improve economic benefits.
- (ii) The second aspect is to reduce agricultural production expenditure and improve the utilization efficiency of funds: agricultural production, transportation, and sales require coordination from all aspects of society, which will consume a lot of human resources and capital costs. How to reduce costs and improve economic benefits is the focus of Agricultural Internet of Things research. Agricultural IoT can optimize the agricultural management of the whole process from production to sales, on the premise of ensuring that the quality of agricultural products will maximize cost at each stage of compression. Every step is closely focused on production, logistics, marketing resources, and so on to make reasonable allocations to avoid unnecessary waste of resources. Production, transportation, and sales are coordinated with each other,

and the cost will also be greatly reduced. In addition, the real-time change and sharing of information in the agricultural supply chain also enable all parties to grasp the production, transportation, and sales situation in a timely manner, facilitating timely adjustment for problems, realizing the circular flow of resources in the transaction process, and making win-win cooperation easier for all parties in the supply chain.

- (iii) The third aspect is to save resources and improve the efficiency of resource use: resource conservation and environmental friendliness are widely recognized by the world's mainstream ideas, traditional agricultural production methods and ideas are relatively old, there is a lot of unreasonable use of resources, and the most common is the unreasonable fertilization and irrigation methods. Traditional agriculture has been far from the concept of resource conservation advocated in modern society, while the Agricultural Internet of Things can accurately calculate and reasonably allocate resources in the agricultural production process, which is conducive to reducing or even eliminating resource waste. Taking the aquaculture industry of European and American developed countries as an example, the oxygenation and feed delivery in the traditional aquaculture process completely depend on the experience of workers. With the introduction of the Agricultural Internet of Things, the scale of breeding has been continuously expanded, and the whole process of breeding has realized the intelligent increase of oxygen and feed delivery. Through the real-time monitoring of oxygen content and feed residue in the water, relevant technicians can remotely control the oxygenation pump and feed delivery equipment from the mobile phone terminal. Compared with the traditional experience and a lot of human resources, the whole breeding process is more scientific, the cost of human and related resources is lower, and agriculture is truly unmanned, automated, and intelligent.

At present, the development of the Agricultural Internet of Things is still in the initial stage. The Agricultural Internet of Things architecture is not perfect, the threshold of building the underlying perception system is high, and the sharing of the Internet of Things resources is poor, presenting a fragmented state [9, 10]. Therefore, based on the Internet of Things technology, combined with wireless sensor network technology and data fusion technology, this paper designed a farmland environment monitoring and early warning system based on the Internet of Things to realize the real-time dynamic control of agricultural production factors information, so as to effectively promote the development of agriculture in the direction of refinement and intelligence. Then the advantages of the application of Internet of Things technology in agricultural informatization are explored, and the economic benefits of the application of Internet of Things technology in agriculture are analyzed by using the budget model. The experimental

results show that the input of Agricultural Internet of Things technology can improve the economic benefits of farms, agricultural machinery stations, and agricultural machinery households to varying degrees, and the equipment has an obvious price advantage, which has a good prospect of popularization and application.

Throughout this paper, we present in Section 2 a system designed in a way that reduces cost and needs less power, then analyze in Section 3 the method used, but to go forward for the effectiveness of methods, we need to do experiments and have results and that is what we do in Section 4, and finalize this paper by a conclusion in Section 5.

2. Agricultural IoT Architecture

Unlike greenhouse or other types of monitoring, farmland environmental monitoring does not require the real-time collection of environmental data. Therefore, some data transmission methods with low cost and low power consumption can be selected. Secondly, real-time acquisition technology also has a long data transmission cycle. In general, soil monitoring systems can monitor various soil data information every few months or longer [11]. Therefore, as long as the data upload cycle is set in advance, automatic monitoring and management can be realized.

2.1. Overall System Design. This system is mainly applied in farmland environment to collect soil temperature, degree, humidity, PH value, light, and other data [12]. By monitoring these data, we can provide a scientific basis for precise control of agricultural production so as to improve yield, economic benefit, and quality. Based on the consideration of the actual farmland environment, the system adopts ZigBee technology and 4G network to design an intelligent monitoring system suitable for the farmland environment [13]. The overall requirements of the system are as follows:

- (1) Cover 150 mu of farmland, set sensor nodes every 50 m, and set sink nodes every 20 mu on average.
- (2) Monitor soil temperature, humidity, PH value, air temperature, and light.
- (3) Sensor nodes require small size, low cost, simple installation and deployment, waterproof, and dust-proof and are suitable for outdoor operations.
- (4) Data transmission is stable, the upload cycle is automatically set, and the node battery is required to work continuously for more than 3 months.

The system mainly designs two modules of data acquisition and data monitoring [14]. The overall structure of the system is shown in Figure 1. Data are collected by the sensor terminal, uploaded to the sink node in the ZigBee network, and then transmitted to the PC end of the monitoring system platform through the 4G network for data display and analysis. In addition, the monitoring end provides WEB services to facilitate users to connect to the monitoring system in B/S mode to query real-time data.

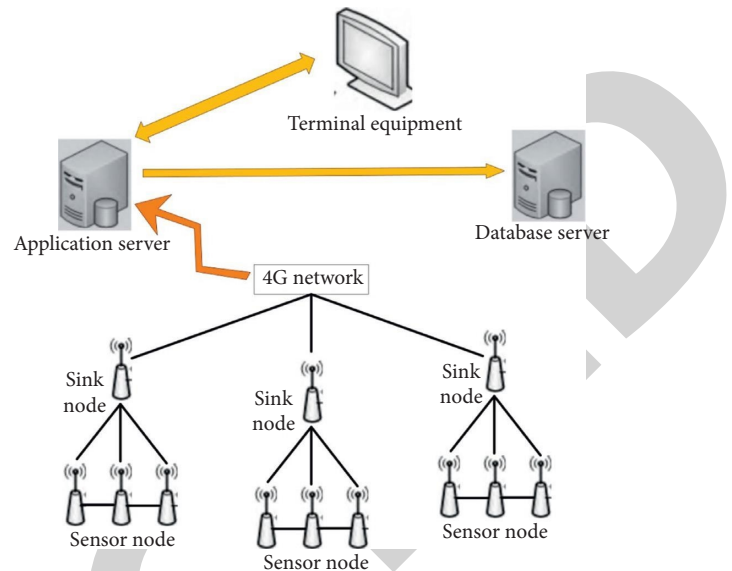


FIGURE 1: Overall system structure drawing.

The overall network structure of the system is divided into perception layer, network layer, and application layer from bottom to top [15]. The perception layer mainly collects and obtains information by using various sensors such as temperature and humidity sensors and sends the collected data to the transmission layer through the ZigBee transmission protocol [16]. The transmission layer mainly exchanges and shares the data collected by the equipment with the help of the 4G network. In the application layer, the system can provide a basis for intelligent and information management of agricultural production through data processing.

2.2. Data Acquisition Module. The data acquisition module in the system mainly completes the acquisition of farmland environmental parameters. The module consists of two parts: sensor and circuit. The acquisition nodes in the system mainly include air temperature and humidity sensor, soil temperature and humidity sensor, and light intensity sensor. Through ZigBee technology and 4G communication technology sensor and system communication, the ZigBee chip used in the system is TI's CC2530 chip, which uses an enhanced 8.51CPU, has the characteristics of ultralow power consumption, and can achieve multifunctional, high-efficiency wireless data transmission. Among them, the output data of the ZigBee wireless sensor network needs to be sampled. After digitization, the serial port data transmission between the collected data and the gateway is carried out. The hardware framework of the system is shown in Figure 2.

- (1) Air temperature and humidity sensor: the sensor is a composite sensor, its main application is digital acquisition technology, temperature sensing technology, and humidity sensing technology, and the main characteristics are strong anti-interference ability, small size, low power consumption, and cost-effectiveness

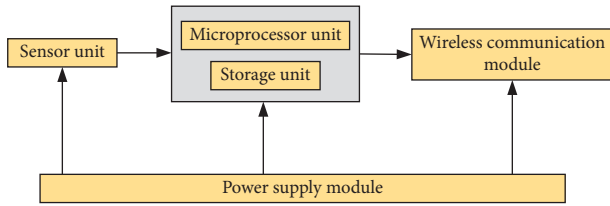


FIGURE 2: System hardware framework diagram.

- (2) Soil temperature and humidity sensor: soil stability and moisture content were measured by embedding thermistors in farmland
- (3) Light intensity sensor: the light intensity signal can be converted into an electrical signal and transmitted to the monitoring platform for analysis and summary

2.3. Wireless Communication Module. ZigBee technology is a two-way wireless communication technology with low power consumption, simple technology, and relatively low networking cost. Its main feature is that it is suitable for short-distance transmission ZigBee data communication rate, which is generally 250 kB/s, which does not require high data transmission rate. In the communication transmission process of the system, it is necessary to add a 4G transmission module in the ZigBee network to carry out data transmission, and all indirect interfaces of the 4G network are open. The physical network layer, intermediate environment layer, and application environment layer can provide wireless services with seamless and high data rate. The system separates the acquisition module and monitoring system in space through the mobile network of operators. ZigBee antennas generally require omnidirectional radiation and use inverted F antennas.

2.4. Functional Design. The farmland environment monitoring system is designed and developed in this paper. The monitoring system uses Eclipse as the development tool platform, and the system uses B/S architecture. The function of the whole system monitoring platform is divided into five modules, namely, news notification, farmland management, pest prevention, statistical analysis, and user management, as shown in Figure 3. The data fusion algorithm based on BP neural network is used to fuse the data collected in the system.

2.5. Database Design. In view that the traditional relational database cannot better solve the data storage problems of the Internet of Things, the system adopts the method of mixed data storage; MySQL and NoSQL databases are selected. NoSQL, a nonrelational database, selects MongoDB, a database of schema-free, collective-oriented storage and easy storage object type. It is a product between a relational database and a nonrelational database. The advantage of this database is that the

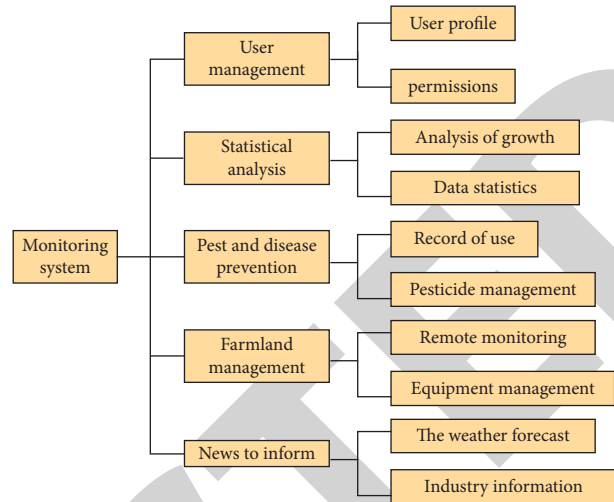


FIGURE 3: Schematic diagrams of system function modules.

structure of the table is variable, there are no strict requirements for the data structure, there is no need to predefine the structure image of the table, which is completely different from the relational database. The disadvantage is that there is no uniform query syntax. Therefore, the data obtained from sensors are first stored in MongoDB database, summarized after big data analysis, and then transferred to MySQL database, which provides users with data query service, thus improving the response speed and query quality of data service in the system.

3. Method of Economic Benefit Evaluation

The principle of the partial budget method is when a certain measurement index changes, it may lead to changes in some or all of the four aspects of cost reduction, low output, cost increase, and income. The net economic benefit will change as a positive change, and the cost will be reduced. Increasing revenue is a negative economic benefit (reducing revenue and costs). This method can be used to evaluate projects after certain indicators of the economy change, such as expansion projects and renovation projects (buying new machines to replace labor or old machines). This method of comparing expected costs with changes in benefits involves all direct and indirect factors that affect profits. Calculating the change caused by a certain action is the core part. When calculating the cost of some equipment with a useful life of more than one year, the total cost is converted into the annual cost. This method is suitable for analyzing the operation economic benefits of the Beidou navigation system from the perspective of large-scale agricultural production in the Yellow Sea.

The investment analysis method can also be used to analyze the economic benefits of Beidou navigation agricultural machinery automatic driving technology, including static analysis and dynamic analysis. The static analysis does not consider the time factor, and the evaluation index is the

income data of a certain year in the service life, such as the internal rate of return and investment payback period. Dynamic analysis needs to consider the economic effects of the project over its lifetime. Project investment analysis is based on the analysis of the cash flow statement, sorting the project investment, production costs, income, and so on into a cash flow statement in the form of a tabular arrangement and calculating and evaluating various evaluation indicators, net present value, and internal rate of return. Investment payback period and investment payback period are commonly used indicators. The higher the internal rate of return, the greater the difference between the investment in the industry and the greater the average level of return, that is, the greater the profit margin of a new investment project. This method is applicable to the economic benefit analysis of the Beidou navigation automatic driving system and its supporting equipment from the perspective of large-scale agricultural machinery operation of state-owned agricultural machinery stations (agricultural machinery cooperatives).

The quantitative indexes to measure the economic feasibility of agricultural IoT projects are mainly economic benefit evaluation indexes. The feasibility of the project is evaluated by comparing the specific indicators of the project with the benchmark (reference) indicators issued by the state and industry. There are two kinds of evaluation indexes: dynamic indexes and static indexes.

Dynamic indicators are mainly used to evaluate the time value of funds. Through the analysis of project cash flow, the inflow and outflow of cash are determined, the statement of project cash flow is formulated, and the internal recovery rate and the net present value of the project are calculated according to the principle of the time value of funds: 0 internal rate of return (IRR) refers to the discount rate when the cumulative net cash flow value of the project is zero during the calculation period; that is to say, IRR is the discount rate when the following formula is established:

$$\sum_{t=1}^n (CI - CO)_t (1 + IRR)^{-t} = 0. \quad (1)$$

In the formula, CI represents cash inflow; CO represents cash outflow; $(CI - CO)_t$ represents the net cash flow in the t year; n is the number of years calculated for the project. The project plan is feasible if the IRR is not less than the set judgment benchmark (commonly known as the benchmark rate of return); otherwise, it is not feasible. Net present value (NPV) refers to the sum of the present value of the net cash flows of the project during the calculation period calculated according to the set discount rate (generally using the benchmark rate of return I), which is calculated by the following formula:

$$NPV = \sum_{t=1}^n (IC - CO)_t (1 + i_c)^{-t}. \quad (2)$$

In the formula, IC represents the set discount rate (the same as the benchmark rate). When the net present value calculated according to the set discount rate (generally set at present $IC = 10\%$) is not less than zero, the project scheme can accept; otherwise, it cannot accept. This model only lists

the total rate of return on investment and the payback period. 0 total returns on investment (RQI) represents the profit rate of total investment; that is, the annual EBIT in normal years after the project reaches the designed production capacity or the average annual EBIT in operation period and the total investment of the project are being identified and translated online. The total return on investment should be calculated according to E :

$$ROI(\%) = \frac{EBIT}{TI} \times 100. \quad (3)$$

In the formula, EBIT represents the annual EBIT of the project in normal years or the average annual EBIT of the project during the operating period; TI represents the total investment of the project. The total return on investment exceeds the reference rate of return in the same industry, indicating that the profitability calculated by the total return on investment meets the requirements. The payback period is the time required to recover the total investment of the project based on the net income of the project. It can be calculated by the following formula:

$$\sum_{t=1}^n (CI - CO)_t = 0. \quad (4)$$

The project investment cash flow statement can be used to calculate the recovery of project investment. The payback period of a project is the point at which the accumulated net cash flow in the calculation of the project investment cash flow statement changes from negative to zero. The payback period can be calculated by the following formula:

$$P_t = T - 1 + \frac{\left| \sum_{i=1}^{T-1} (CI - CO)_i \right|}{(CI - CO)_T}. \quad (5)$$

In the formula, T represents the number of years in which cumulative net cash flow is positive or zero for the first time in each year. The short payback period indicates that the project has a fast recovery and strong risk resistance.

Uncertainty analysis is a process of hypothesizing the uncertainty factors that affect the project, calculating the influence of its change on the project benefit, finding out the most sensitive factors that affect the project, identifying the risk factors, and giving an early warning of the project risk. Break-even analysis (BEP) is to analyze the balance relationship between project cost and revenue by using the break-even point when the project meets the conditions of design production capacity. The break-even point is between the profit and loss of the project in the agricultural machinery business. When industry revenue is equal to the total cost, there is no profit or loss, which can be used to test the adaptability and antirisk ability of the project to change in agricultural machinery operations. The lower the break-even point, the greater the ability of the project to adapt to changes in agricultural machinery operations and the stronger the ability to resist risks. The break-even point of capacity utilization is often used in project evaluation.

TABLE 1: Prediction of profit from investment in Agricultural Internet of Things projects.

Project	Total money	Total period					
		1	2	3	4	5-9	10
Operating income	4000	400	400	400	400	2000	400
Business taxes and surcharges	0	0	0	0	0	0	0
Total cost and expenses	2770.7	277.07	277.07	277.07	277.07	277.07	277.07
Subsidizing income	102	34	0	0	34	34	0
Total profit	1569.3	156.93	156.93	156.93	156.93	784.65	156.93
Income tax payable	1569.3	156.93	156.93	156.93	156.93	784.65	156.93
Net profit	1569.3	156.93	156.93	156.93	156.93	784.65	156.93

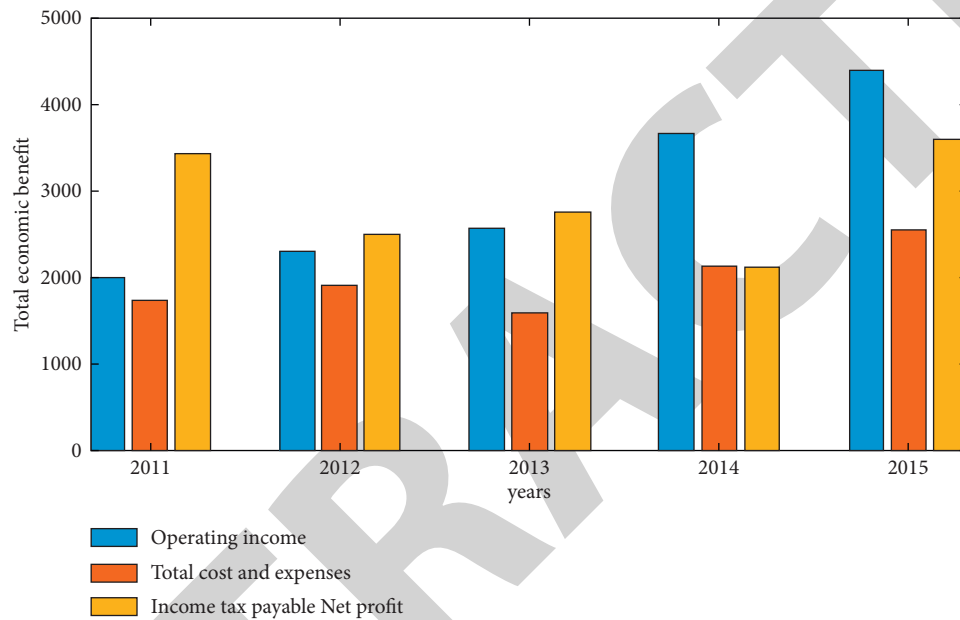


FIGURE 4: Schematic diagrams of economic benefit changes.

4. Experiments and Results

Assuming that an agricultural machinery station currently has 40 sets of equipment, calculated as 100,000 yuan/set, which is mainly engaged in farm field operations and transportation services of machinery and tools, it is estimated that only 20 sets of Agricultural Internet of Things can meet all farm machinery operations, and the annual operating income is expected to be 4 million yuan/year. A total of 2,400 square meters will be occupied, with 800 square meters for hangar and offices. 1.2 million yuan was invested in the purchase of Agricultural Internet of Things equipment (20 sets in total, 60,000 yuan per set); 800,000 yuan has been invested to construct hangar and office buildings. The total investment of the site occupation cost is 500,000 yuan, and the occupation time is 30 years. Operating capital needs 500,000 yuan. A total of 7 million yuan was invested in the project, of which 6.5 million yuan was invested in construction and 500,000 yuan was used for operation. The project is expected to have an annual operating income of 4 million yuan, mainly from agricultural operations. According to the current national policy, the income from the Agricultural Internet of Things

industry is not subject to business tax. See Table 1 for profits from agricultural IoT projects.

According to the calculation of other cost items, 63.17% is the break-even point of the project, and 36.83% is the profit area of the project. The break-even point is relatively low, and the ability to resist risks is relatively strong. 18.08% is the internal rate of return of the project, and 12% is the reference rate of return of the industry. This scheme is feasible. 5.3498 million yuan is the net present value of the project (IC-10%), which is acceptable. 4.22 years is the payback period of the project investment. The payback period is relatively short, and the project has relatively high economic benefits. 17.78% is the total investment rate of the project, which meets the requirements. Operating income is the income change of the Agricultural Internet of Things and is a sensitive factor for project operation. Special attention should be paid to operating income during project operation.

According to the above calculation results, the input of the Internet of Things in the agricultural network conforms to the situation that both net income and variable input have increased, and it is necessary to determine whether to adopt new technology according to the rate of return. Assuming an

annual interest rate of 10% on agricultural investment capital and that two crops of rice and wheat are planted in the farm area, the minimum acceptable annual rate of return after taking into account the cost of capital is -110% ($100\% + 10\%$). After changing the conventional consistent fertilization into variable fertilization, the income rate of increased investment reached 370.8%, far higher than the minimum acceptable annual income rate of 110%. It meets the third measure of whether the new technology in part of the budget law should be recommended for use, so the adoption of technology related to the North Agricultural IoT system for large-scale agricultural production management is recommended in large farms such as farms. The economic benefit changes with years are shown in Figure 4.

5. Conclusions

China's Internet of Things industry is developing rapidly. As a recognized agricultural country in the world, it is an important milestone for China's agricultural development to promote agricultural reform and innovation through the Internet of Things. Developed countries have made great achievements in the theoretical and technical practice of the Agricultural Internet of Things, but there is a big gap between China and the Agricultural Internet of Things, which still needs to be improved in the following aspects. First, the application environment of the Agricultural Internet of Things in China is still not perfect, and it is difficult for the Internet to be put into practice in agricultural production, which indirectly affects the popularity of the Agricultural Internet of Things. Second, China's agricultural IoT application environment is still not perfect. Third, the transmission technology of the Agricultural Internet of Things is unstable, and the reliability of data collection is poor. The future development direction of the agricultural Internet in China should strengthen the stability and security construction in the information transmission process of the Internet and improve the anti-interference ability of the equipment. The Internet has network security problems in the process of information exchange and transmission. The way to encrypt the information in the process of transmission with a small amount of computation has always been the focus of the research on the security of the Internet. In addition, the information transmission equipment of agricultural Internet is greatly interfered with by irrelevant external signals, which affects the stability of data transmission and the accuracy of information. In the process of outdoor signal transmission, more research efforts are needed to enhance the stability of transmission equipment.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

- [1] Y. Huang and G. Li, "Descriptive models for internet of things," in *Proceedings of the International Conference on Intelligent Control and Information Processing*, pp. 483–486, IEEE, Dalian, China, August 2010.
- [2] G. Hao, "Research on the technology thought and application strategy of Internet of Things," *Audio Engineering*, 2018.
- [3] Z. Sun, K. Du, and F. Zheng, "Big data in smart agriculture research and application prospects," *Review of China Agricultural Science and Technology*, vol. 15, no. 6, pp. 63–71, 2013.
- [4] H. Liu, "Accelerate the construction of digital agriculture to add new momentum for agricultural and rural modernization," *Chinese Journal of Agricultural Resources and Regional Planning*, vol. 38, no. 12, pp. 1–6, 2017.
- [5] L. Liu, "USA: building smart agriculture," *Informatization Construction*, vol. 5, no. 12, pp. 44–46, 2011.
- [6] D. Yang, "Development strategy of China's smart agriculture industry," *Jiangsu Agricultural Sciences*, vol. 42, no. 4, pp. 1–2, 2014.
- [7] Y. Hu and R. Zhang, "Operational mode problems and strategic countermeasures of smart agriculture in China," *Economic System Reform*, vol. 6, no. 4, pp. 70–76, 2017.
- [8] K. Tang, "Development of agricultural internet of things technology in foreign countries and its enlightenment to China," *Chinese Journal of 2nd Academy*, vol. 2, no. 6, pp. 700–707, 2013.
- [9] X. Xu, Y. Zhang, M. Ji, and Y. Song, "Determination of effective signal transmission distance of wireless sensor nodes in agricultural ecological environment monitoring," *Transactions of the Chinese Society of Agricultural Engineering*, vol. 29, no. 14, pp. 164–170, 2013.
- [10] J. Yan, F. Xia, and Q. Li, "Top strategy design of comprehensive land consolidation in China," *Transactions of the Chinese Society of Agricultural Engineering*, vol. 28, no. 14, pp. 1–9, 2012.
- [11] M. Mao, "Remote intelligent agricultural monitoring system based on arduino and labview J1 microcomputer application," vol. 35, no. 6, pp. 35–37, 2019.
- [12] Y. Gong and H. Nie, "Design and implementation of agricultural planting environment monitoring system based on agricultural internet of things technology," *Electronic Design Engineering*, vol. 58, no. 13, pp. 52–54, 2016.
- [13] K. M. Du, J. X. Chu, and Z. F. Sun, "Design and implementation of monitoring system for agricultural environment based on WebGIS with Internet of Things," *Transactions of the Chinese Society of Agricultural Engineering*, vol. 32, no. 4, pp. 171–178, 2016.
- [14] X. Yuan, *Design and Implementation of Internet of Things Open Platform Based on Cloud Computing*, Zhejiang University of Technology, Hangzhou, China, 2015.
- [15] X. Zhou, T. Zhang, and H. Lu, "Design of precision intelligent agricultural greenhouses system based on internet of things," *Foreign electronic measurement technology*, vol. 35, no. 12, pp. 44–49, 2016.
- [16] F. Chen, L. Qin, X. Li, G. Wu, and C. Shu, "Design and implementation of zigBee wireless sensor and control network system in greenhouse," in *Proceedings of the Control Conference (CCC), 2017 36th Chinese*, pp. 8982–8986, IEEE, Dalian, China, July 2017.