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Research Article

Research on Big Data-Driven Rural Revitalization Sharing Cogovernance Mechanism Based on Cloud Computing Technology

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The political arrangement and strategic action to realize socialist sharing in the new era is the rural revitalization strategy, which is a development strategy to complete the historical task of farmers living a better life and solve the problem of insufficient rural development. Data sharing and driving, on the other hand, remain the weak links in China's digital village construction. This paper proposes to develop a BD (big data)-driven rural revitalization governance, sharing, and monitoring platform based on CC (cloud computing) technology to promote the reshaping of rural governance patterns and to provide systematic support for the implementation of rural revitalization strategies. Knowledge governance rules and processes for rural community public affairs are created in a BD environment. Clustering in feature space is considered to address the low efficiency caused by clustering algorithms in high-dimensional data. The method proposed in this paper is perfectly matched in both the preprocessing and clustering steps, which not only ensures the algorithm's accuracy but also significantly improves its efficiency.

1. Introduction

In recent years, the country has strongly supported the strategy of rural revitalization, strengthened the rural construction, provided a guarantee for the construction of beautiful countryside, and enabled the rural areas to gain greater development and space, thus becoming a new growth point of the national economy. Driven by BD based on CC technology, digitalization has become a new form to promote the economic and social development of urban and rural areas in China [1]. The key to digitalization is reconstruction, that is, the reconstruction of the existing system, which is by no means the concept of traditional informationization. Informatization emphasizes the improvement of efficiency, while digitalization emphasizes the reconstruction of the system and the change of thinking mode [2]. At present, in the economically underdeveloped western regions of China, successful examples of rural governance are constantly emerging. Through the exploration and practice of rural governance, based on the actual situation of rural areas, actively carry out learning activities, introduce advanced rural governance concepts, learn from the corresponding practical experience and governance models, combine local characteristics, adhere to the principle of adapting to local conditions, and adopt effective rural governance strategies, so as to realize the effectiveness of regional rural governance.

The CC technology is a new technology for reasonable and safe scheduling of network information, which plays a great role in sharing network information, has great practicability for safe and fast management of network information, and has made great contributions to the fast and safe sharing of global information resources [3, 4]. CC is highly scalable and very suitable for processing large-scale data. If the traditional data mining technology can be reformed based on CC, it is believed that it will help to solve the problem of large-scale data information mining on the Internet. Farmers get information on rural public affairs and services through network devices and mobile applications, and their participation in decision-making and management

is constantly improving [5]. The 19th National Congress of the Communist Party of China proposed to promote the modernization of the national governance system and governance capacity. Obviously, rural governance is an important part of it [6]. This is a very common feature of the Internet. At the same time, the strong seller is also an important force to drive the industrial development. At the same time, the author finds that the personalized buyer and the absence of a third party between the buyers and sellers have broken the barriers of traditional marketing, which makes the Internet era play an important role in the industrial development.

Rural revitalization is a major historical task that must be accomplished if a prosperous society and a socialist modern country are to be built. The task is difficult and time is limited [7, 8]. The implementation of this strategic project must be based on the most recent scientific and technological advances, and BD can only play its one-of-a-kind role in driving innovation and transformation. Scientific methods and means for scientific decision-making, agricultural modernization, precise governance, and high-quality public services can all be provided by BD technology. This paper begins with the rural revitalization mechanism of sharing and cogovernance, then explores the working mode of rural revitalization in the new era, promotes the modernization of agriculture and rural areas, and addresses the rural development imbalance.

2. Related Work

Literature [9] discusses the definition, development status, and key technologies of agricultural BD from the perspective of BD and agricultural informatization and finally points out the challenges and difficulties faced by the development of BD in the agricultural field at present. Literature [10] expounds the development background of BD, introduces the relationship between BD and the Internet of Things, the basic connotation, and key technologies of BD, and points out the direction and position of BD application in the agricultural field combined with the characteristics of agricultural production. Literature [11] pointed out that agricultural BD is a data processing process that involves a wide range of industries and disciplines. This feature of agricultural BD requires multidisciplinary collaboration in research to solve application problems. Precipitation and air temperature are selected as input variables, and the output of American agricultural products is predicted by the regression model. In literature [12], by establishing the regression model of China's poultry and egg industry, the short-term forecast of China's poultry and egg market price is made, and the experimental results are in good agreement with the real value. Literature [13] shows the spatial propagation process of urban events intuitively by using BD analysis and visualization technology and has made great progress in urban disaster emergency response and planning process.

Literature [14] holds that "smart countryside" is a new concept different from "smart city," and it is a modern new rural construction based on Internet of Things technology. As a new theory, the essence lies in the intelligent governance of public affairs in rural communities by combining the comprehensive application of smart tools such as BD, Internet of Things, and mobile Internet, aiming at the underdeveloped status quo of rural communities, so as to realize the modernization of the governance level and ability of public affairs in rural communities. Literature [15] specifically studies the evolution stage of users' use of the CC platform. Literature [16] puts forward four government modes: market-oriented government, participatory government, flexible government, and coordinated government, emphasizing more diverse participation, flat structure, and cooperative management. Literature [17] points out that when analyzing contemporary Chinese society, the perspective of corporatism has great theoretical potential. No matter in China's urban society, rural society, or grass-roots government organizations, there are many organizational forms of corporatization, and such a social feature can be clearly displayed through many studies with the perspective of corporatism. Literature [18] further points out that the framework of "state-society" studies the three main directions of rural areas, namely, civil society, the construction of state power, and the state in society. The first one has gradually faded out, the second one tends to holism and substantialism excessively, and the third one pays attention to the specific relationship between the state and society, showing great vitality. Literature [19] focuses on the analysis of the practical application of cooperative governance, including conditions, difficulties, and paths. Theoretical explanations of cooperative governance's connotation, value orientation, and development trend can be found in the literature [20]. In general, current cooperative governance research primarily addresses the theoretical background, theoretical connotation, value orientation, governance principles, and practical mechanism. The governance environment has changed dramatically as a result of tax and fee reform. A new cogovernance platform and mechanism between villages and towns are urgently needed, and the pattern of cogovernance between government and people should be formed along the "cogovernance between villages and towns" path.

3. Research Method

3.1. Effective Design of Path of Rural Revitalization, Sharing, and Governance. The cogovernance mechanism mainly includes farmers' rights protection mechanism, government rights restraint mechanism, and capital tension regulation mechanism. It pays attention to the problem-solving and guiding role. In the specific governance, should pay attention to the vital interests of farmers, farmers' knowledge, and decision-making power, pay attention to farmers' practical interests, build a perfect right guarantee mechanism, and effectively deal with farmers' external negative impacts.

Measures should be taken to combine the rule of virtue with the rule of law, encouraging and punishing both ways, effectively regulating capital tension, enhancing farmers' rights to speak in governance, solving various types of contradictions, and ensuring social stability and harmony.

There are primarily three types of sharing mechanisms: land revenue, industrial revenue, and ecological revenue. First and foremost, do a good job with farmer resettlement, improve the interest linkage system, combine the modern agricultural system, improve the value of human capital, and improve the access mechanism, among other things. Second, the principle of equal exchange should be followed in revenue sharing, with appropriate humanistic care combined to protect farmers' legitimate interests. Farmers and capital are encouraged to experiment with different revenue-sharing models in order to benefit from land revenue, environmental revenue, and industrial revenue. In terms of sharing, clear governance standards should be established, the income distribution contract should be improved through equal consultation between capital and farmers, farmers' interests should be increased, and farmers' lives should be made richer.

Market economy requires organized competition, and organizational revitalization has laid the foundation for farmers to enter the market [21]. Governance serves development, and the key to development lies in how the government locates and handles the relationship with the market. Rural revitalization has created opportunities for rural marketization. Facing the rural development potential, industrial and commercial capital is eager to try. Figure 1 is a brief relationship structure diagram of village-enterprise pairing and coconstruction.

In this cooperative relationship, two basic principles are followed. First, elements complement each other. The modern production technology, management mode, capital, and marketing technology of enterprises are sent to the countryside, while the villagers put the land resources, labor resources, and certain funds into the cooperative, and the two sides form a mutual-based partnership, which lays a prerequisite organizational foundation for cooperation and common economic development and public affairs cooperation and governance.

The second is to build and share. This model protects farmers' interests and their subjective roles with "three changes" mechanism and democratic consultation mechanism and enables them to gradually acquire advanced production technology and management knowledge. Because of the government's support, coordination, and supervision, enterprises successfully implemented the project development and effectively used rural land and labor force, expanding the industrial scale. Villages and enterprises invest in cooperation with their own factors of production, build and share, and achieve mutual benefit and win-win situation [21]. Figure 2 shows the architecture diagram of data mining based on CC.

BD thinking is not obsessed with the pursuit of accuracy but emphasizes the integrity and hybridity of data; instead of focusing on the study of causality, more attention should be paid to the relationship between things. To decide the way out, vigorously promote and popularize science and technology, and promote the whole society to form BD thinking that meets the needs of modern decision-making and management as soon as possible.

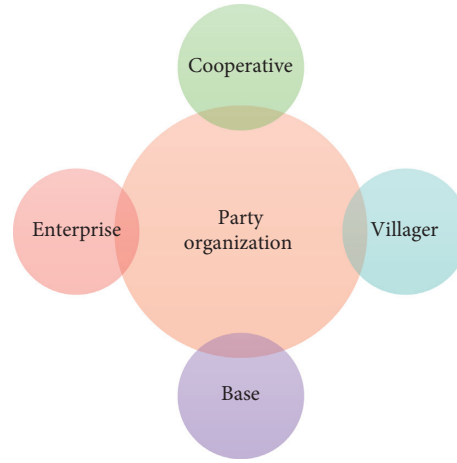

Figure 1: Structure diagram of village-enterprise coconstruction.

3.2. Effective Strategies of Sharing and Cogovernance in Rural Revitalization

3.2.1. Knowledge Governance in Rural Community Public Affairs under BD Environment. Using BD, mobile Internet, and other science and technology to build a "smart countryside" platform, the problem of "difficulty in handling affairs" while achieving a multisubject understanding of policy documents can be solved. This helps the villagers to communicate and learn anytime and anywhere. Digital rural communities fundamentally realize the villagers' "one place at a time" to solve practical problems. By building a "smart countryside" platform, the two committees can communicate efficiently among villagers, grass-roots governments, enterprises, and other rural organizations.

The main goal of developing a rural smart platform is to integrate fragmented and dynamic knowledge, improve the governance ability of public affairs in rural communities, strengthen communication with villagers and other multiagents, and provide villagers with a convenient communication platform. Villagers can use mobile Internet, WeChat, Weibo, and other platforms to communicate quickly at home. The creation of a "smart countryside" allows grass-roots government and village committees to better understand villagers' needs and ideas, allowing for more targeted and scientific governance of public affairs in rural communities.

At present, the governance of community public affairs in rural areas mainly includes three mainstream modes: bureaucratic governance, market governance, and network governance, without analyzing the knowledge status of villagers, which cannot fundamentally solve the problem of rural governance [22].

This paper holds that the content of knowledge governance mainly includes knowledge resources themselves, intellectual capital, and knowledge tools, thus making a knowledge governance network (as shown in Figure 3), which includes five parts: knowledge tools, activating knowledge, knowledge resources, intellectual capital, and creating knowledge.

To begin, identify and assess collaborative opportunities. The villagers can reach a consensus on the governance goal after many times of communication and coordination, and through the performance test, determine whether the

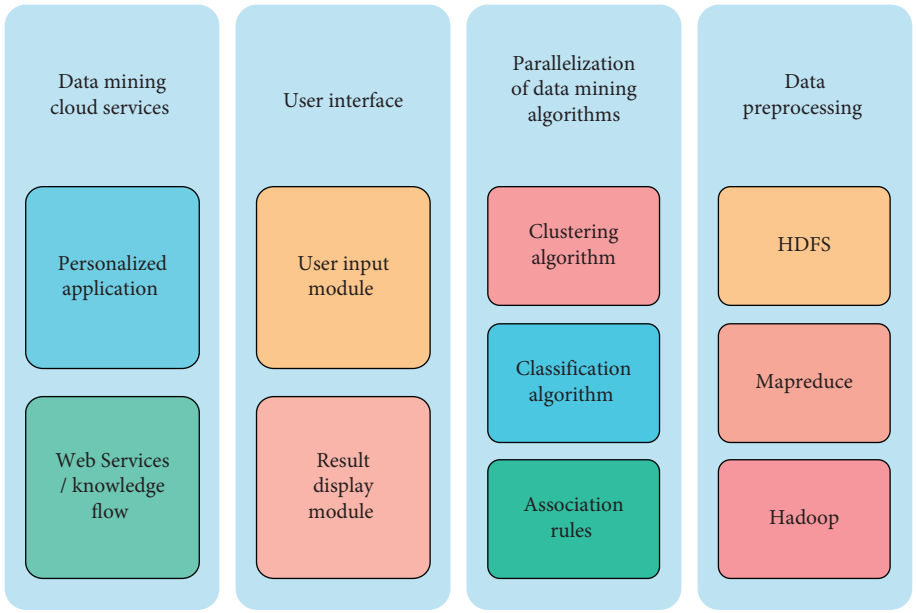

Figure 2: Architecture diagram of data mining based on CC.

Figure 3: Knowledge management network.

expected goal is truly achieved; if not, continue to coordinate and communicate until the villagers' consensus is reached; according to the governance objectives, performance management should be carried out effectively, and the consensus among subjects will eventually promote the coordination.

3.2.2. Data Mining Based on CC. In the environment of CC, faced with massive amounts of data, how to deal with the occurrence of parallel data of SPRINT (scalable parallel induction of classification tree) algorithm, deal with the parallel data well, and reduce the data fault tolerance in the implementation process of the algorithm is a problem to be

solved. It takes less time to build the decision tree in the pruning stage, so it mainly focuses on the construction stage of the decision tree. From the idea of SPRINT algorithm, the research on the parallelism of SPRINT algorithm mainly focuses on the following three aspects:

(1) The data of the training sample set is distributed on multiple processes

(2) The best splitting scheme of attribute list is determined in parallel

(3) The attribute list of the best splitting point is divided into the corresponding child nodes in parallel

Apart from the data structures such as attribute list and class histogram, the SPRINT algorithm requires the introduction of a new data structure, the hash table, which is used to store the data information of subnodes on both sides of each split node and provides a basis for parallel division of nodes.

In the SPRINT algorithm, the main data structures are attribute list and class histogram, so in the multiprocessor environment, in order to achieve the load balance of each processor as much as possible, it is natural to think of dividing the training sample set evenly into N processors, and each processor handles $1/N$ of all sample data. The steps of dividing the sample data set are as follows:

(1) Firstly, all the sample data are evenly distributed on each processor

(2) According to the obtained sample data, each processor performs parallel processing to obtain its own attribute list

(3) If the attributes in the attribute list are discrete attributes, then the data can be divided directly

Assuming that set S contains m records of n categories, the corresponding expression of Gini index is shown as follows:

$$\text{Gini}(S) = 1 - \sum_{i=1}^{n} p_i^2, \tag{1}$$

where $\frac{i}{p}$ represents the probability of occurrence of category i.

If the set S is divided into two parts of S_1, S_2, and there are m_1, m_2 records corresponding to S_1, S_2, respectively, then the value of Gini index divided at this time is shown as follows:

$$\text{Gini}_{sp}(S) = \frac{m_1}{m_2}\text{Gini}(S_1) + \frac{m_2}{m}\text{Gini}(S_2). \tag{2}$$

The smaller the value of Gini, the greater the information gain and the better the quality of node splitting. For the continuous attribute, the numerical node splitting form is like $A \le v$.

3.2.3. Fast Algorithm of BD Clustering. As one of the most popular clustering algorithms at present, the K-means model divides n data points into disjoint k subsets by assigning each data point to the nearest center, and its objective function minimizes the distance within the class:

$$\min_{c_j, C_j} \sum_{j=1, i \in C_j}^{k} \text{dist}\left(m_i - c_j\right), \tag{3}$$

where dist is a given distance function, c_j is the cluster center, and C_j represents the index set of the j-th data point.

The cosine difference degree of the spherical K-means model is defined as follows:

$$d(x, y) = 1 - \cos(x, y) = 1 - \frac{\langle x, y \rangle}{\|x\| \cdot \|y\|}. \tag{4}$$

According to Cauchy–Schwartz inequality, if and only if

$$c_j \longleftarrow \sum_{i=1}^{n} u_{ij} \frac{m_i}{\|m_i\|}, \forall_j. \tag{5}$$

If the text data is normalized, that is, $\|m_i\| = 1$, the clustering center of spherical K-means can be expressed as

$$c_j \longleftarrow \sum_{i=1}^{n} u_{ij} m_i = \sum_{i \in C_j} m_i, \tag{6}$$

that is, the sum ratio of the cluster center c_j and all data in the j-th class.

In order to make the concise and efficient K-means algorithm reasonably used in BD clustering, this section will consider the improved algorithm of K-means in dimension reduction space (feature space). Assuming that the rank of the data matrix is $r = \text{ranj}(M) \le \min(d, n)$ and the singular value of M is decomposed into $M = U \sum V^T$, then

$$U^T M = \sum V^T = \begin{bmatrix} \sum_r & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} V_1 & V_2 \\ r & n-r \end{bmatrix}^T = \begin{bmatrix} \sum_r V_1^T \\ 0 \end{bmatrix} \triangleq \begin{bmatrix} \widehat{M} \\ 0 \end{bmatrix}, \tag{7}$$

where $\frac{1}{V}$ contains the first r right singular vectors of data M. With regard to the original problem and the problem of feature space, there are the following theorems, that is, the original problem is completely equivalent to the problem of feature space under certain conditions.

Based on the above discussion, when using K-means to deal with the clustering problem of BD, the data can be preprocessed by dimension reduction first, and then clustering analysis can be carried out in the feature space.

4. Results Analysis and Discussion

4.1. Algorithm Performance Test and Evaluation. The sample set used in this experiment comes from the database in the current system, including 8 categories, such as education, finance, medical care, public security, transportation, society, science and technology, and sports. In order to reflect the characteristics of high performance in CC, the above data samples are copied to generate 0.25 GB, 0.5 GB, 1 GB, 2 GB, 4 GB, and 8 GB data. It is shown in Figure 4.

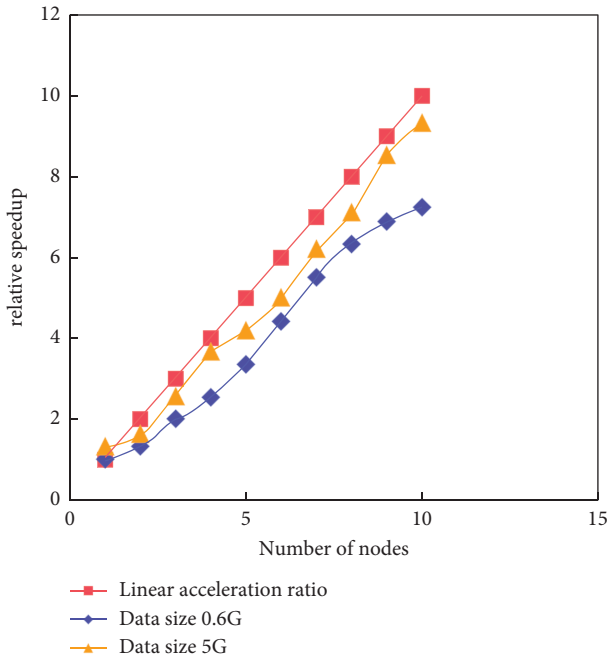

Figure 4: Performance acceleration ratio after MapReduce.

It is not difficult to see from Figure 4 that after MapReduce processing of the Hadoop platform, the running efficiency of the SPRINT algorithm in processing ultra-large-scale data on the experimental platform is almost comparable to linear growth. Moreover, with the increase of data scale, the speedup ratio of the whole algorithm is closer to the linear speedup ratio. Considering an environment where processing nodes are also increased, the execution efficiency of the algorithm will be more superior.

k-NN (K-Nearest Neighbor) algorithm is to find one or several historical records that are most similar to the current record in a group of historical data records and use the known characteristic values of these similar historical records to predict the unknown or missing characteristic values of the current record. It is a typical negative algorithm. Before classification, no classification model is established, and all classification processes are carried out only when new samples need to be classified. The principle of this algorithm is simple and easy to implement, especially for massive data, which has obvious advantages. Moreover, the larger the data, the higher the accuracy.

The essence of the k-NN algorithm is considered to be highly parallel because the distance calculation between the input sample and any single training sample is independent of any other sample. In this way, the work of segmentation calculation can be minimized. The key value of the intermediate result is defined as a flag, and the value is a combination of similar attribute values and sample labels. In the reduce function, the key represents the flag information, and the value is the label of prediction. The training set was 5000, 10000, 15000, 20000, 25000, and 30000 samples, respectively. The time cost of training was compared with that of the traditional serial method as shown in Figure 5.

As can be seen from Figure 5, the time cost of training sample data of traditional serial k-NN algorithm

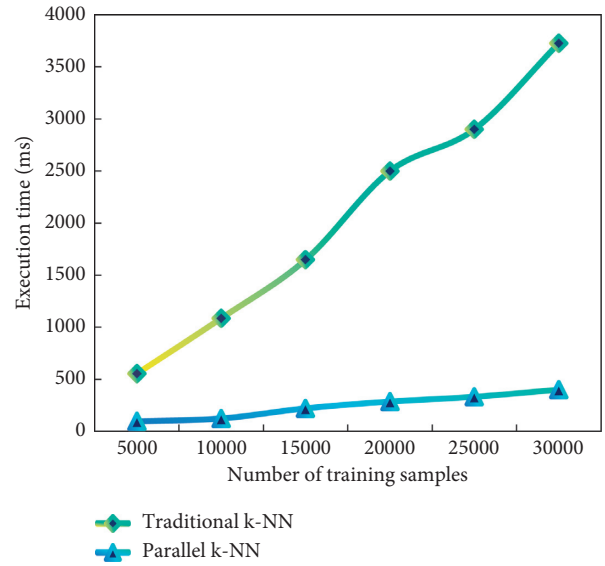

Figure 5: Comparison of algorithm training time cost.

increases sharply with the increase of training samples, and it is obvious that the response time of the system slows down and the execution efficiency begins to decrease. Therefore, it can be concluded that the parallelized k-NN algorithm can save time and cost to a great extent, improve the running speed and efficiency of the system, and respond to requests quickly. The test results are shown in Figure 6.

When k is small, but the speedup ratio is clearly increased as k is increased, it is certain that the speed of parallel mode is clearly faster than that of serial mode when k is large and that the acceleration effect is more obvious as the number of parallel server nodes is increased. Figure 7 depicts the performance of the test results after testing the training results with 3 test samples.

In rural construction, we should pay more attention to rural governance, effectively implement measures of coconstruction, cogovernance, and sharing, ensure the smooth development of rural governance, and promote the harmonious and stable development of society. Therefore, in the specific rural governance, we should pay attention to the improvement of the system of coconstruction, cogovernance, and sharing and carry out rural governance from various angles to ensure the smooth implementation of the rural revitalization strategy.

4.2. Numerical Experiment. Rural civilization is an important goal of rural revitalization, and "the key to realize rural civilization is to reconstruct rural culture and vigorously build a rural public culture in the new era." The construction of rural public culture should not only be based on the regional cultural characteristics of the countryside, inherit and carry forward the excellent traditional culture of the countryside, but also conform to the spirit and dimension of modern culture.

In this section, we use artificial data and actual data to test the performance of the algorithm (Figure 8).

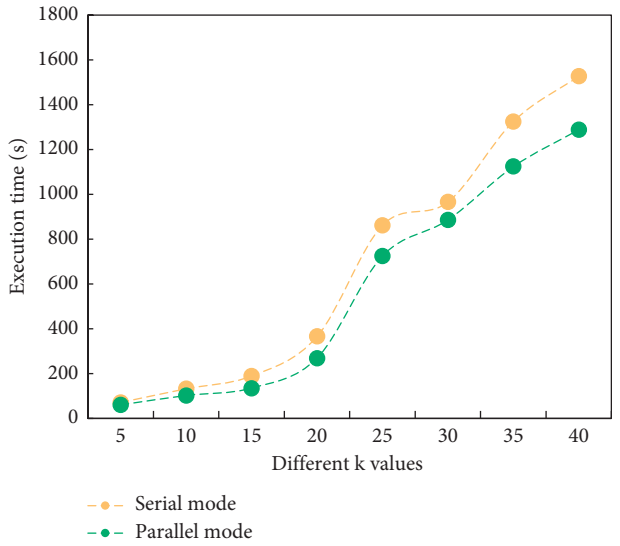

Figure 6: Comparison of time cost between parallel and serial modes with different k values.

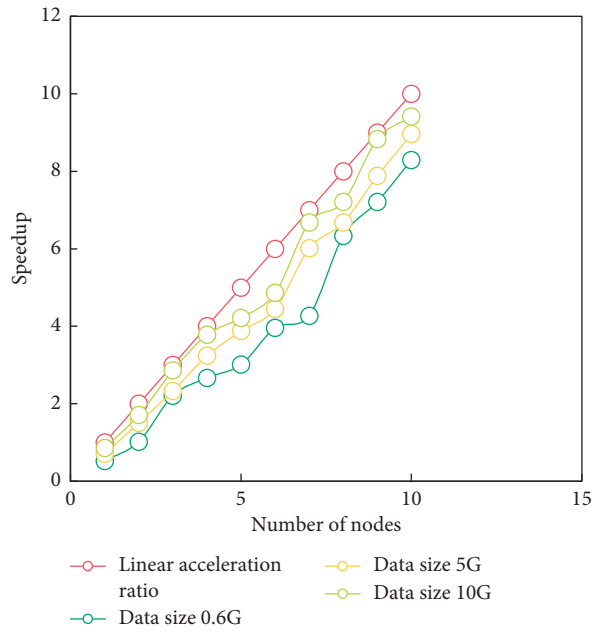

Figure 7: Performance of parallel k-NN algorithm under different nodes.

The core of rural revitalization is people. Only by cultivating and bringing up the modern pluralistic coconstruction subject can we lay a solid foundation for rural revitalization. Therefore, it is necessary to clarify the position of rural multisubjects in the rural revitalization and cultivate multisubjects with high cultural literacy, strong survival and development ability, and sense of responsibility, so as to lay the foundation of human resources for rural revitalization.

Sharing mode will activate the factors of production in rural areas, promote the upgrading of the agricultural industry, and make farmers really increase their income. It is no exaggeration to say that shared agriculture has pointed out the direction for the development of rural industries. In

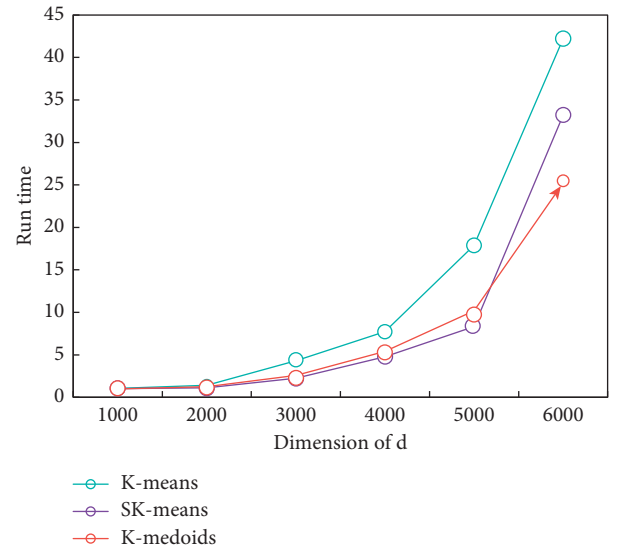

Figure 8: Comparison of running time on manual data.

the practice of rural revitalization, it is necessary to actively promote the construction of shared industries represented by shared agriculture, encourage farmers' participation, strengthen government guidance, and play the role of market guarantee, so as to build the industrial foundation of rural revitalization.

Figure 9 records the information of various data. The first three are image data and the last six are manual data.

For rural revitalization, home is fundamental, and this home not only refers to the beauty of the ecological environment but also refers to the harmony, gentleness, and temperature of ethical and cultural life, that is, the community of rural life. People live and work together with their peers in the community. From birth, they share weal and woe. It can be seen that the community itself contains the value pursuit of sharing, and the strategy of promoting rural revitalization inherently requires the reconstruction of shared rural communities.

Figure 10 records the ratio of the running time of K-means, spherical K-means, and K-medoids in the original space and feature space.

Sharing should be comprehensive, and China's socialist sharing has a foundation of civilization sharing. The basic requirement for realizing all-round sharing and the basic representation of the logic of Chinese historical continuity is the rejuvenation of Chinese civilization. The Chinese nation's self-confidence and rejuvenation are rooted in rural civilization. The root and soul of rural revitalization in China is homesickness, which is derived from the countryside as the carrier and local roots.

It is the goal that the Chinese people have worked hard for more than 100 years to modernize. China is a big country of farmers and agriculture. To realize China's comprehensive socialist modernization and build a strong socialist modernization country, the problem of imbalance and uncoordinated and unsynchronized modernization must be solved, and we must focus on rural modernization, make up for the shortcomings of farmers' modernization, and

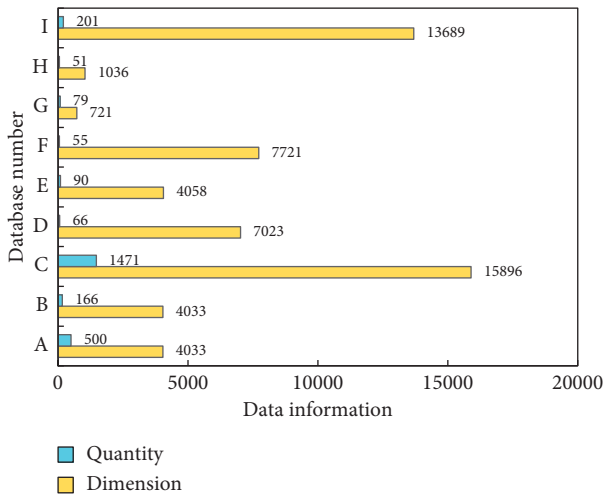

Figure 9: Data information for algorithm testing.

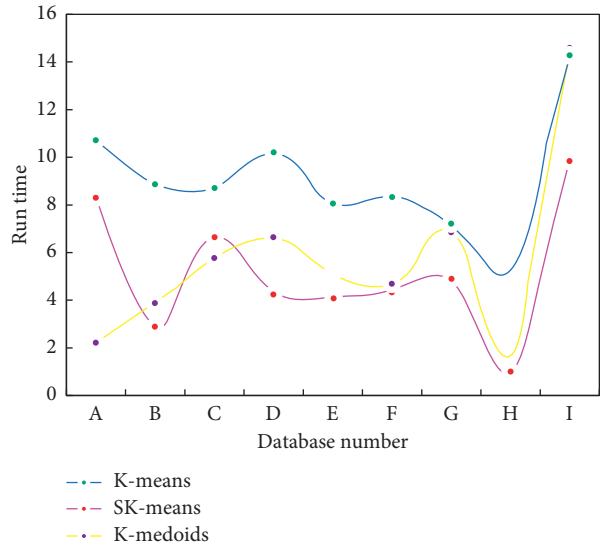

Figure 10: Comparison of the actual running time of data.

strengthen the weaknesses of agricultural modernization. The elements of modernization are integrated into the daily life, production, ecology, cultural breeding, and rural governance of agricultural and rural farmers, and the strategic objectives, tasks, and means of rural development in China are reconstructed, thus opening a new era of rural modernization in China.

5. Conclusion

Rural revitalization is a process of promoting rural social construction, so in the practice of rural revitalization, special attention should be paid to developing and improving social policies aimed at ensuring farmers' survival and development. As a result, it is necessary to investigate the path of rural revitalization that involves sharing and cogovernance. The goal of this paper is to develop a new governance pattern for implementing a rural revitalization strategy using BD technology and a social governance system based on sharing and cogovernance. To do so, we must solve the massive data storage, processing, and mining problems, and the birth of CC provides a direction and path to do so. The map function and reduce function in the algorithm module are implemented, as well as the parallel k-NN algorithm. The efficiency of the k-NN algorithm after parallelization is determined through experimentation. To ensure the smooth implementation of the rural revitalization strategy, we should focus on improving the sharing and cogovernance system and carrying out rural governance work from various perspectives.

The development of a BD environment in rural communities is still in its early stages. With the government's implementation of a BD strategy in rural communities and the modernization of the rural community governance system, the author's future research will focus on identifying and solving problems in the construction of a BD environment in rural communities from the perspective of knowledge governance.

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 there are no conflicts of interest.

Acknowledgments

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