Hindawi
Wireless Communications and Mobile Computing
Volume 2022, Article ID 4949242, 11 pages
https://doi.org/10.1155/2022/4949242

Research Article

Design and Service Effect Evaluation of Agricultural Social Service Platform Based on 5G and Cloud Computing

Mengling Zhang, Yuhan Zhang, Zhenling Weng, and Zhaojiu Chen

College of Economics and Management, Jiangxi Agricultural University, Nanchang, 330045 Jiangxi, China

Correspondence should be addressed to Zhaojiu Chen; zjchen@jxau.edu.cn

Received 10 June 2022; Revised 29 July 2022; Accepted 6 August 2022; Published 21 August 2022

Academic Editor: Kuruva Lakshmanna

With the continuous development of information technology, various industries continue to use information technology to promote industrial upgrading and optimize the industrial structure. Agricultural informatization, as the only way for future agricultural development, will become an inevitable direction for the rejuvenation of traditional industries. The proposal of the development concept of "Mass Entrepreneurship, Mass Innovation" marks that my country has gradually entered an innovative society, and the development of public services and service products will become a powerful guarantee for promoting the construction of the agricultural informatization industry chain. This paper starts from the application of cloud computing and 5G in agriculture, considers the impact of big data on agriculture, and combines the business requirements and functional requirements of agricultural social services. The design of agricultural socialization service platform is realized, and finally, the service effect of the platform is evaluated by neural network. The following is a summary of the work done in this paper: (1) The research background and significance of the development concept of agricultural informatization services are expounded. Finally, the research content and method of this paper are discussed. (2) The technical principle and optimization algorithm of BPNN are introduced, and the evaluation index of the service effect of agricultural information platform is designed. (3) Select the appropriate parameters to build the experimental model and then train it, then compare the experimental effects of the traditional BP algorithm and the optimized three algorithms, and comprehensively evaluate the LM-BP model with the best performance.

1. Introduction

The technological upgrading of the agricultural informatization industry and the upgrading of the development concept cannot be delayed. The concept of "mass entrepreneurship and innovation" provides a new idea for the sustainable development of the agricultural informatization industry [1]. At present, in the field of agricultural informatization in my country, there are mainly problems such as insufficient innovation capability of the industrial value chain, lack of upgrading and transformation of traditional agricultural production models, excessive reliance on government subsidies, and low social participation. The concept of innovation and entrepreneurship development can open up new ideas for solving these problems. The concept of innovation and entrepreneurship development is of great help in increasing social participation and improving innovation ability. The new development concept will encounter more problems that need to be solved. Therefore, the construction of an innovation and entrepreneurship service platform in the field of agricultural informatization is also imminent [2]. Now, agricultural informatization has entered a new stage of development, from a single industry upgrade to a multilevel, multiindustry service upgrade. The informatization upgrade of a single agricultural industry will be transformed into a service upgrade process involving various stages and different levels of multiple industries [3]. From the current point of view, my country's agricultural social service system has been characterized by fragmentation and fragmentation for a long time. From the perspective of decentralized decision-making, the overall income of the industry chain is not optimal. Based on this, the national government has also proposed to develop agricultural socialization service support projects, and coordinately promote agricultural socialization services through various service functions such as agricultural industry planning, agricultural material supply, agricultural technology promotion, information services, financial services, and logistics distribution [4]. With the wide application of 5G and cloud computing, a series of information technologies will provide information services throughout all links in the agricultural industry chain. It is committed to breaking the information barriers between various agricultural service entities in my country, thereby reducing the problem of supply and demand dislocation caused by information asymmetry and improving the efficiency of resource allocation. Taking the agricultural socialization service platform as an effective agricultural socialization service tool, it is committed to breaking the information barrier between the main bodies of the agricultural industry chain and realizing the seamless connection of information. Ensure the coordinated development of the agricultural industry chain and achieve the goal of my country's agricultural supply-side structural reform [5]. In view of the current characteristics of my country's agricultural development, promote the construction of agricultural informatization service system, achieve industrial transformation under the conditions of the information society, and take information resource sharing as the goal of service system construction. Since the beginning of the twenty-first century, all countries in the world have been actively exploring the development model of combining information technology with agricultural production. Agricultural development has undergone a transition from mechanized agricultural production to information-based agricultural production, from a rough production model to a refined production model, and from improving production speed and scale to improving production quality and efficiency. Formed by the combination of multiindustry, multiangle, and multidirectional development, under the background of economic globalization, make full use of modern and convenient transportation and logistics network, from Haiti to air, to send agricultural products to every corner of the world [6]. The USA, France, and other countries have established a complete service system in the industrial development of agricultural informatization, providing complete services for their own agriculture from innovation to entrepreneurship in the field of agricultural informatization. The "complete and open" sharing policy of the USA provides a strong guarantee for innovation and entrepreneurship activities in the agricultural information industry. France adopts a multiangle approach to provide effective information and help for the development of the agricultural information industry. Germany mainly establishes a complete agricultural science and technology electronic information system and provides support for its agricultural development [7, 8]. Machine learning techniques in association with 5G have been used in various verticals of agricultural industry. As an example, the study in [9] proposed a technique to monitor the soil quality in order to prevent cotton plant diseases. The study used regression techniques for the classification of leaf diseases. An app was developed to deliver the information to the customer once infection in the plant was identified. The app also measured various soil parameters, namely, moisture, humidity, and temperature, which would be displayed in a container, and this information would automatically regulate the motor and chemical sprinklers used in the field. The paper identified support vector machine (SVM) as one of the best techniques for detection of plant diseases.

The development models in the field of agricultural informatization in these countries have their own systems, which can be used for reference compared to my country. However, combined with my country's national conditions and the development concept of "mass entrepreneurship and innovation," a sustainable development of agricultural information with Chinese characteristics has been explored. The road of agricultural development is the only way for my country's agricultural development. On the basis of studying the current situation and existing problems of agricultural informatization development in my country, this paper explores the construction mode and path of innovation and entrepreneurship service platform in the field of agricultural informatization. The design of agricultural socialization service platform based on 5G and cloud computing is proposed, and then, the service effect of the platform is evaluated by neural network. On the one hand, this research is conducive to the self-improvement of my country's agricultural informatization development theory, and on the other hand, it is a beneficial exploration of promoting agricultural informatization to advance supply-side reform, supporting agricultural modernization development and entrepreneurship and innovation activities, and has good theoretical value and practical significance.

The unique contributions of the paper include

(i) The technical principle and optimization algorithm of BPNN are presented

(ii) The evaluation index of the service effect of agricultural information platform is designed

(iii) The most significant parameters required to build the experimental model are selected, and then, the model is trained. The experimental effects of the traditional BP algorithm and the optimized three algorithms are comprehensively evaluated

2. Related Work

Due to different socioeconomic backgrounds, the research on agricultural socialization services started earlier in foreign countries. The agricultural socialization service system in some countries with relatively high economic development levels such as the USA, Japan, and Western Europe has reached a very mature level, which can meet the various needs of agricultural creators in the process of planting, production, and sales. At present, foreign countries are gradually developing from traditional agricultural informatization to using modern information technology to upgrade the traditional service system and create an agricultural information service ecosystem that adapts to the new era and new environment [10]. The USA, France, Germany, and other countries have their own successful experiences and unique practices in the construction of agricultural informatization services. They have established a joint information service platform supported by multiple service entities in the agricultural information service system to ensure the diversity of service products [11]. The USA mainly takes the government as the main body to construct the service platform, which is composed of five major information institutions: the National Bureau of Statistics, the Bureau of Economic Research, the World Agricultural Outlook Committee, the Agricultural Market Service Bureau, and the Foreign Agricultural Bureau, which constitute a diversified information-based system consisting of five major information agencies. The service platform has formed a multilevel agricultural information service system from the national, regional, and state three-level agricultural information service network [12]. France is a comprehensive system in which a variety of information service subjects coexist. The entire service system adopts the form of vertical registration, and its service mode presents the characteristics of scattered, direct, multichannel, and market-oriented. Moreover, the French information service system focuses on marketization, and government departments provide agricultural information services such as policy information, statistical data, and market dynamics for free on a regular or irregular basis [13]. Germany mainly uses the sharing characteristics of the Internet to establish a data service system from the aspects of document collection and information data management to provide information resource sharing and query services. German government departments give full play to the advantages of information resources, adjust the market structure of product production and supply, and play the role of policy formulation, technical research, data analysis, and information release of their service system, and become a multifunctional and all-round service platform [14]. Japan is mainly a service system established by the "Central Agricultural Products Wholesale Market Federation" for the market to provide market sales information. Secondly, on the basis of the "Comprehensive Agricultural Combination" covering the whole country, the "Japan Agricultural Association" established a service platform to release the price information and production quantity information of agricultural products in a timely manner, relying on the market intelligence information of agricultural products provided by the information service system covering the whole country [15]. Compared with foreign countries, the research on agricultural information service platform in my country started relatively late. However, under the vigorous promotion of governments at all levels and many technology companies, agricultural informatization services have developed rapidly in my country and have achieved good results. Reference [16] introduces the basic concepts of agricultural informatization services, and how to obtain data, and explains the application scope of agricultural informatization services. Reference [17] gave a more detailed description of the way of obtaining agricultural information and the current situation and application of agricultural information services. Reference [18] expounds the issues related to big data and cloud computing in agricultural information services from three technical aspects: intelligent processing, decision-making, and cloud service human-computer interaction. It also looks forward to the application prospects of Internet technology in the field of agricultural information services. Reference [19] introduced the development of early warning work for agricultural products in terms of cloud computing and 5G and explained the transformation of early warning work in the future. Reference [20] proposes a precision agriculture model. With the support of big data, by monitoring various environmental factors and growth trends in the process of crop growth, the crop species and soil can be accurately matched, so as to achieve precise irrigation and fertilization, and seek advantages and avoid disadvantages, to achieve refined management of the entire production process, and to improve quality and productivity. Reference [21] develops a visual interaction system based on the characteristics of agricultural big data, which provides users with multilevel network data services and provides agricultural information interaction services. Combined with the data visualization analysis function, Reference [22] developed a web GIS-based agricultural geographic data visualization system. The system has the characteristics of interactivity, multidimensionality, and visibility. It successfully analyzes and reconstructs the abstract geographic data sources and displays the relationship between data through curves, two-dimensional, three-dimensional, and animated images. It displays complex data in a graphical way that is more acceptable to humans, which is convenient for users to manage and develop data through human-computer interaction. Reference [23, 24] implemented 5G and next-generation mobile networks to develop precision agriculture use cases. Once the requirement assessment and 5G network capabilities were analyzed, the quality indicators of 5G and relevant slice types in precision agriculture were defined. This helped to identify the missing features in case of precision agriculture. Reference [25, 26] presented the prerequisites for the implementation of 5G in agriculture that would lead to agricultural revolution.

3. Method

3.1. BP Neural Network. BPNN is a forward ANN based on direction propagation. It can quickly and effectively respond to the nonlinear and complex relationship between influencing factors. It is one of the most mature and widely used neural networks. It usually consists of an input layer, a hidden layer, and an output layer. The learning process of the network is carried out through the forward propagation of the signal and the back propagation of the error. If the error between the predicted value of the forward propagation and the expected output does not meet the requirements, then, the error is back propagated, and then, the network weights are updated until the network error reaches the set threshold or the number of learning times. A typical 3-layer BPNN structure is shown in Figure 1.

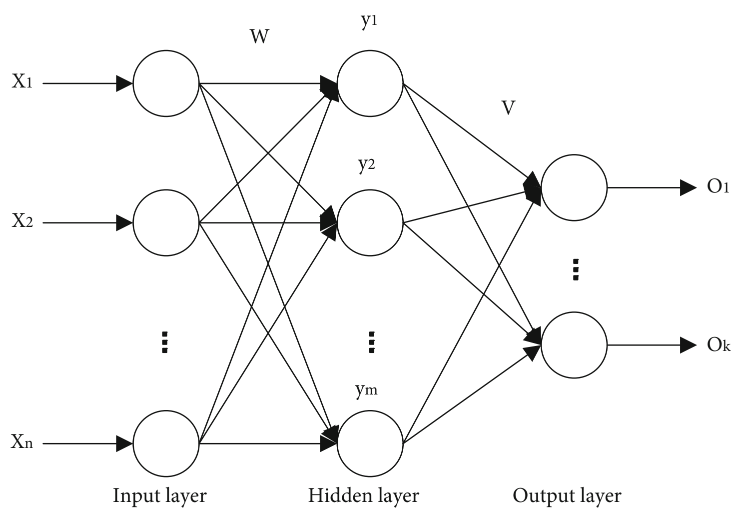

Figure 1: Three-layer BP neural network structure diagram.

The output of each layer of neurons can be mathematically expressed as

$$y = \sum_{i=0}^{n} w_i \times x_i. \tag{1}$$

The network error is calculated by the output of the network training and the expected output, and its mathematical expression is as follows:

$$E = \frac{1}{2}\sum_{i=1}^{j} \left(y_i' - y_i\right)^2. \tag{2}$$

The BP network is a supervised training network algorithm. Through continuous learning, the sum of squared errors of the result output reaches the minimum value. The specific steps of the BPNN flow chart are as follows: (1) Sample input, including network training samples and expected output samples. (2) Initialize the number of network iterations, set the weight matrix to a random number, set the error E to 0, set the allowable error to E, and set the learning rate to 0-1. (3) Determine whether the number of iterations is less than the set value, and calculate each layer input. (4) Calculate the hidden layer input and the output of each layer. (5) The error is back-propagated and the weights are recalculated. (6) Determine whether the error meets the expected value, and end the training if it is satisfied; otherwise, continue the training.

3.2. BP Neural Network Optimization. The traditional BPNN training method is to use the steepest descent method, that is, to find the optimal solution along the direction of the gradient, but there are disadvantages of slow convergence speed and easy to fall into local optimum during the training process. In actual training, it is often necessary to optimize the BPNN structure. The main direction of optimization is to optimize the network weights and adjust the network structure. The commonly used optimization algorithms are as follows:

(1) Conjugate gradient algorithm (CG): CG is an improved method based on the gradient method. Its principle is to find the conjugate direction of the current negative direction and the last search direction as a new search direction, thereby speeding up the search speed. Its mathematical expression is

$$p_{k+1} = -g_k + \alpha p_k. \tag{3}$$

The initial search reverse is

$$p_0 = -g_0. \tag{4}$$

(2) Particle swarm optimization algorithm: It is a general global search algorithm, which is widely used in many fields because of its simple concept, few adjustment parameters, and easy implementation. Particle swarm optimization is a random search algorithm based on group optimization developed by imitating the foraging behavior of birds. The origin of the algorithm can be described as the foraging process of birds. At the beginning, each bird was randomly distributed in different positions, and each flew in different directions for feeding. As the flight time progressed, birds at random positions at the beginning gradually gathered within a small flock by learning from each other, and fly in the same direction at the same speed, and eventually, the entire flock will gather in the same location

The process of particle swarm optimization algorithm is as follows: Firstly, initialize to a group of random particles, then find the optimal solution through iteration, and update itself through two "extreme values" in each iteration process. One of the extremes is the optimal solution found by the particle itself, which is also called *p*best. The other extreme value is the optimal solution currently found by the population, that is, the global extreme value *g*best. After finding the two optimal solutions, the particle updates its velocity and position through the following formulas. Its expression is as follows:

$$v_i = v_i + c_1 \times \text{rand}\,() \times (p\text{best} - x_i) + c_2 \times \text{rand}\,() \times (g\text{best} - x_i), \tag{5}$$

$$x_i = x_i + v_i. \tag{6}$$

In the iterative process, if the speed and position exceed the boundary range, the value is the boundary value, and the above formula is the standard form of PSO. The velocity formula of the standard particle swarm algorithm consists of three parts. The first part is the memory item, which represents the historical velocity of the particle. The second part is the self-cognitive item, which represents the learning ability of the particle itself. The third part is the social cognition term, which represents the cooperative ability between particles. The memory item reflects the global search ability of the algorithm, while the cognitive item represents the local search ability of the algorithm. In order to further improve the optimization performance of PSO, inertia weight is introduced. After the introduction, the speed formula of particle swarm algorithm is expressed as

$$v_i = w \times v_i + c_1 \times \text{rand}\,() \times (p\text{best} - x_i) + c_2 \times \text{rand}\,() \times (g\text{best} - x_i). \tag{7}$$

Among them, the inertia weight w value is nonnegative, indicating the influence of the particle's previous speed on the current speed. When the value is large, the global optimization ability is good, and when it is small, the local optimization ability is better. At present, the linear decreasing weight strategy is mostly used, and its expression is as follows:

$$w = w_{\max} - \frac{(w_{\max} - w_{\min}) \times p}{P_{\max}}. \tag{8}$$

(3) LM optimization algorithm: LM is a method that provides numerical solutions for nonlinear minimization. This algorithm can combine the advantages of the Gauss-Newton algorithm and the gradient descent method by modifying the parameters during execution and improve the shortcomings of the two. Its iteration formula is

$$W_{k+1} = W_k + \Delta W. \tag{9}$$

(4) Bayesian regularization algorithm: Bayesian regularization is to prevent overfitting by correcting the performance of the network, thereby improving the generalization ability. The calculation formula of the adjusted objective function is as follows:

$$E = \lambda_1 E_w + \lambda_2 E_D. \tag{10}$$

Table 1: Agricultural platform service effect evaluation index.

Index	Label
Full-featured nature	R1
Service interactivity	R2
Service personalization	R3
Service professionalism	R4
Information is easy to understand	R5
Comprehensiveness of information	R6
Order of information	R7
Interface friendliness	R8
Color coordination	R9
Platform stability	R10
Platform compatibility	R11
Platform security	R12
Platform extensibility	R13
Running speed	R14
Deployment ease	R15

3.3. Evaluation Indicators of Agricultural Platform Service Effect. Information service is an activity to meet the needs of users for information, and it is one of the core businesses provided by the agricultural information platform. The service effect of agricultural information service platform is closely related to the agricultural information itself. The audience of agricultural-related platforms is single, but the breadth and depth of information resources far exceed other public information platforms. Therefore, in the evaluation of service effects, a multidimensional and multilevel comprehensive evaluation must be carried out according to different characteristics. The evaluation index system designed in this paper is shown in Table 1.

Machine learning and deep learning algorithms often divide data sets into three categories, namely, training sets, validation sets, and test sets. By building a model from known data and then generalizing the model to more unknown data, model evaluation is an important part of regression prediction. Model validation requires the selection of appropriate evaluation metrics. Different types of machine learning algorithms have different evaluation performance metrics. This paper mainly introduces the commonly used model evaluation indicators in regression problems.

(1) Mean absolute error (MAE): It represents the average value of the absolute error between the predicted value and the actual value. MAE is obtained by adding the absolute values of all samples. This indicator can avoid offsetting errors due to too high or too low

of the predicted value and the actual value and can intuitively reflect the overall error indicator of the evaluation model. The mean absolute error is defined as follows:

$$\mathrm{MAE} = \frac{1}{n}\sum_{i=1}^{n}\left|y_{i(t)} - \widehat{y}_{i(t)}\right|. \tag{11}$$

(2) Mean squared error (MSE): It represents the average value of the absolute error between the predicted value and the actual value. MSE can evaluate the degree of change in the data. The smaller the value, the better the accuracy of the prediction model. The mean squared error is defined as follows:

$$\mathrm{MSE} = \frac{1}{n}\sum_{i=1}^{n}\left(y_{i(t)} - \widehat{y}_{i(t)}\right)^{2}. \tag{12}$$

(3) Root mean square error (RMSE): It is rooted on the basis of the mean square error. The root mean square error is defined as follows:

$$\mathrm{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(y_{i(t)} - \widehat{y}_{i(t)}\right)^{2}}. \tag{13}$$

(4) The coefficient of determination (R^2): It is popular statistical information in regression analysis, indicating the percentage of the correlation between the predicted value and the actual value. Its value range is [0,1], and its value represents the model and the target variable. An R^2 of 1 indicates that the model fits the scalar well, and an R^2 of 0 indicates that the model cannot predict the target scalar

3.4. Design of Agricultural Socialization Service Platform. This agricultural informatization platform is based on cloud computing IaaS services, combined with 5G transmission technology, to improve business processing capabilities and data processing response speed. At the same time, the platform uses Redis and HBase as data cache and ultra-large-scale data storage, which effectively improves the display of calculation results and the speed of data analysis. The platform adopts distributed service framework technology, which can effectively cope with changes in data volume by dynamically expanding the scale of the cluster. Sort and clean the data according to business computing requirements and business classification, save the subject data required for business computing, or store it in the cache for easy application system calls. The platform integrates a lot of basic software and application software for application requirements to form a complete solution. Use the microservice architecture to separate the front and back ends of the system to reduce system coupling. The specific technical architecture is shown in Figure 2.

(1) Source data layer: It is the data source of the platform. At present, the main data sources are the internal information system data of the Agriculture Department, external data files, and internal and external application log files that may be generated later

(2) Acquisition layer: It is divided into real-time data acquisition and offline data acquisition. By monitoring the database log files, the database changes are synchronized to the data processing layer in time, and the offline data is synchronized with the ETL tool to achieve timing and incremental data synchronization, analyze the application value of the data, and configure the data collection frequency

(3) Processing layer: The data processing layer is divided into real-time data processing and offline data processing. Data processing is processed through the MapReduce program for data cleaning, filtering, deduplication, report data display, and data analysis content calculation

(4) Storage layer: The storage layer is to realize the storage of large amounts of data. The distributed file system HDFS is used to realize multiple backup storage of data that helps in effective improvement in data security. The secured communication in new versions of Hadoop is achieved using the transport layer security (TLS) protocol. This protocol ensures privacy in communication among all concerned parties, namely, the nodes and name servers. The use of columnar storage HBase to realize data distributed database can effectively improve the application system based on execution efficiency for large data volumes. It is subdivided into three layers: the base layer, the middle layer, and the application layer. Base layer: The data needs to be consistent with the source data layer and stored for a long time so that historical data can be searched later. The reason for the consistency with the source data layer is that once the subsequent processing requirements change, historical data may have to be reprocessed. If the original data is not maintained, data loss will occur. Middle layer: It is a data layer modeled by topic, and the data table of this layer is established by topic. The data of this layer is obtained by cleaning and processing from the base layer. For general data processing, build a general parsing library. Application layer: It is based on the middle layer and is formed through data analysis and data mining. At this level, there is no detailed data, and all are aggregated analysis indicator reports, or data models, thereby, forming personalized data reports,

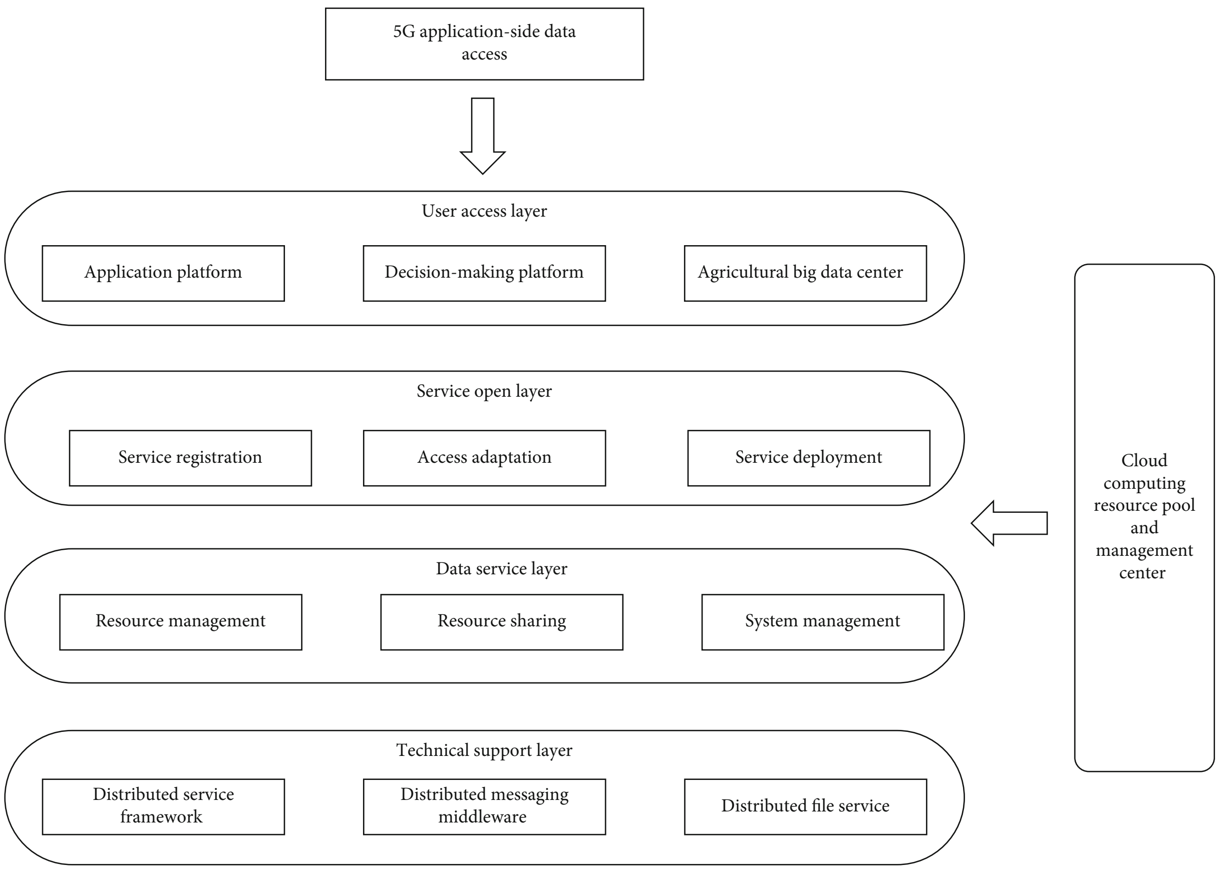

Figure 2: Technical architecture of agricultural socialization service platform.

as well as village portraits, village personalized data, and correlation mining data. Combined with the data mining algorithms developed by the business, a general algorithm library is formed

(5) Computing layer: It realizes real-time ad hoc query of data through spark and phoenix components and supports data display of data access layer. The real-time analysis layer is more flexible. After the real-time data stream is collected by the FLUME of the data source layer, it is written to KAFKA, and the real-time spark analysis application reads the data of the corresponding topic from KAFKA for quasi-real-time analysis

(6) Access layer: For applications such as report display and personalized recommendation, it needs to obtain and write data to HBase or Redis through the general kv storage read and write interface. From a vertical perspective, there are two major modules that serve the overall framework, namely, the automated operation and maintenance and visual scheduling. Automated operation and maintenance monitors the entire structure and provides basics such as email and SMS alarms, and operation, and maintenance reports. Platform monitoring is divided into cluster status monitoring, infrastructure monitoring, data access monitoring, business computing monitoring, and platform usage monitoring. Cluster status monitoring mainly monitors hard disks, memory, CPU, and network IO, and infrastructure monitoring mainly monitors Hadoop clusters, HBase clusters, message queues, and real-time computing engines. Data access monitoring mainly monitors data source status, data access status, and access data fluctuations. Business computing monitoring mainly monitors the status of business computing tasks and the consistency of computing results. Platform usage monitoring mainly monitors indicators such as basic data usage frequency, business data usage frequency, and function PV. Cloud computing and big data architecture data storage adopt a distributed, multiredundant, and multicopy architecture model. The advantage of this architecture is that it can better ensure the security and availability of data, and it can improve the security of data according to the customer's choice during deployment, such as choosing 3 copies. In a three-copy cluster, when a node in the database cluster fails and data is damaged, data files can still ensure data security and provide data services. It not only ensures the security of the data, but also ensures the high availability of the data

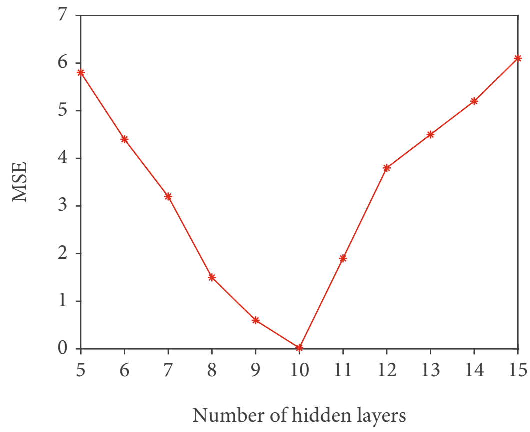

Figure 3: MSE comparison under different hidden layers.

4. Experiment and Analysis

4.1. Data Source and Parameter Selection

(1) According to the evaluation indicators set before, this paper designs a data set suitable for neural network evaluation, named Ser1, including 1,500 sets of data, of which 1,200 sets are used as training sets and 300 sets are used as test sets

(2) Parameter selection: The input layer, that is, the number of evaluation indicators, is 15, and the output is the service effect level of 3. For the design of the hidden layer, if the number of neurons is too small, the network design is simple, and the fault tolerance is poor; that is, the sample learning ability is poor. Too many neurons in the hidden layer will lead to longer network training time, weak network generalization ability, and overfitting. When determining the number of neurons in the hidden layer, there are two commonly used methods. One is to determine by the subtraction method or the growth method. The subtraction method is to design a more complex network structure. At the beginning of the network training process, according to the according to the results of many experiments, the nodes that have little influence on the network are continuously deleted, and the network is simplified until a better network is obtained. The growth method is the opposite of the subtraction method. At the beginning, a relatively simple network structure is designed. During the training process, the network is gradually improved by continuously increasing the nodes and connection weights, and finally, a relatively ideal result is obtained. Another method is to use the empirical formulas summarized by experts and scholars in various fields to assist judgment. The empirical formulas used in this paper are as follows:

$$H = \sqrt{m + n} + a. \tag{14}$$

Table 2: Neural network model parameter settings.

Parameter	Setting
Activation function	Sigmoid
Weight	0.05
Learning rate	0.2
Number of input layers	15
Number of hidden layers	10
Number of output layers	3

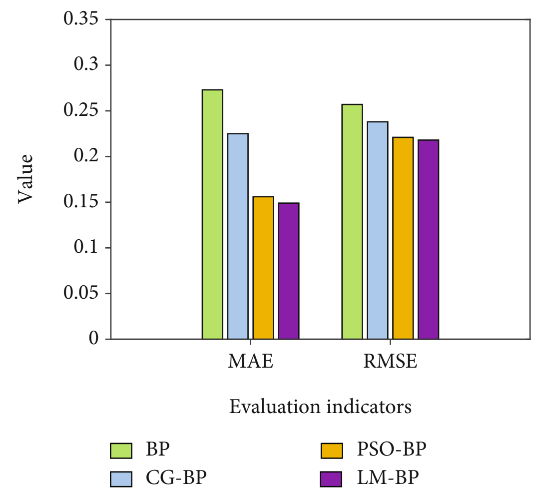

Figure 4: Comparison of MAE and RMSE indicators in different models.

The range of the hidden layer is obtained as [5, 16], and the specific value of the number of hidden layers is determined according to the trial and error method. The experimental results are shown in Figure 3. It can be seen that the MSE is the smallest when the number of hidden layers is 10, so the number of hidden layers is selected to be 10.

The final neural network model parameter settings are shown in Table 2.

4.2. Model Comparison Test. A comparative experiment is done on the commonly used optimization algorithms of BP. The experiment includes the traditional BP algorithm and the CG-BP, PSO-BP, and LM-BP algorithms. The experiment uses four models to evaluate the service effect of the agricultural information platform, the evaluation value, and the actual value. If the difference is within 5%, the prediction is considered to be accurate. In the experiment, MAE and RMSE are used as the indicators to measure the prediction model, and the network model is tested many times. The results are shown in Figure 4.

It can be seen from Figure 4 that under the same conditions, the LM optimization algorithm has a smaller MAE and higher accuracy than other algorithms. The larger the value of the coefficient of determination R^2, the smaller the volatility of the network regression prediction result and the actual value, and the more stable the network performance.

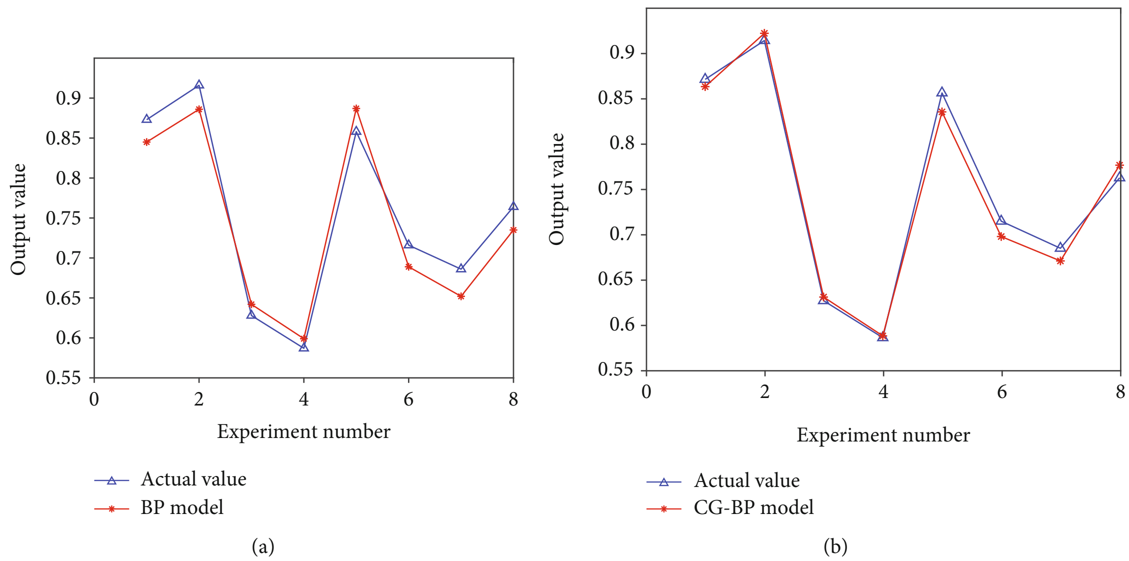

FIGURE 5: Output comparison between BP model, CG-BP model, and actual value.

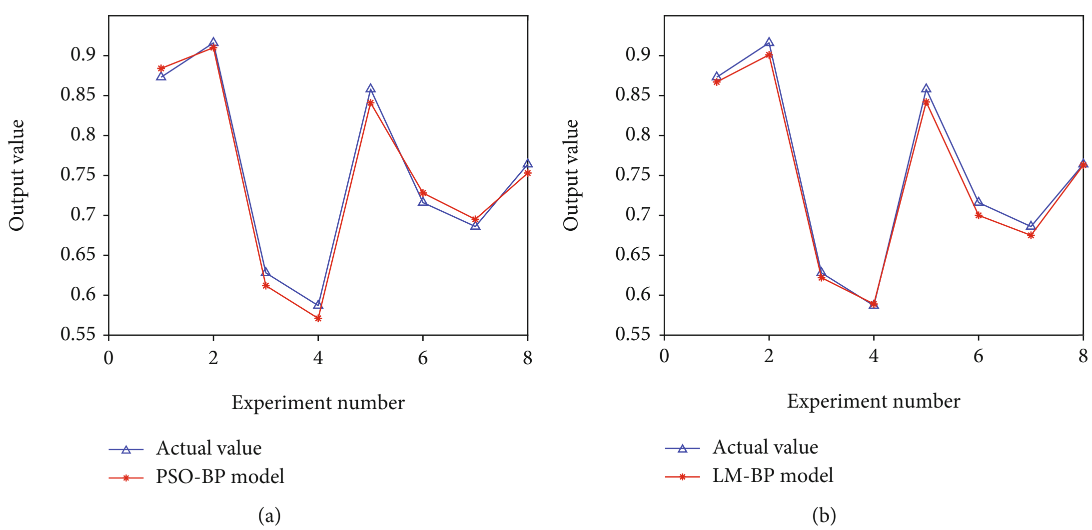

FIGURE 6: Comparison of output between PSO-BP model, LM-BP model, and actual value.

Due to the limited experimental samples, the training set and the test set are divided according to the ratio of 80% and 20%. Finally, 8 groups of sample data were randomly selected as verification. It can be seen from Figures 5 and 6 that the predicted value of the traditional BP model is quite different from the actual value, and the predicted value of CG-BP, PSO-BP, and LM-BP is relatively close to the actual value, and there is no significant difference.

According to the above results, this paper selects the LM-BP algorithm as the final evaluation model.

5. Conclusion

At present, my country's agricultural informatization industry has huge market prospects and still has huge development space. For entrepreneurial entities, this is both an opportunity and a challenge. The construction of an innovation and entrepreneurship service platform in the field of agricultural informatization will be an effective combination of information technology and the development concept of "mass entrepreneurship and innovation," which will add vitality to the market and enhance the core competitiveness of various market players. It will greatly promote the technological upgrading and service upgrading of the agricultural informatization industry. Using the guiding role of the platform to optimize the structure of the agricultural informatization industry chain will provide a strong guarantee for the construction of agricultural informatization. Starting from the application of cloud computing and 5G in agriculture, considering the impact of big data on agriculture, and combining the business requirements and functional requirements of agricultural information services, an agricultural information service platform is realized. The following summarizes the work done in this paper: (1) The research background and significance of the development concept of agricultural informatization services are expounded. Finally, the research content and method of this paper are discussed. (2) The technical principle and optimization algorithm of BPNN are introduced, and the evaluation index of the service effect of agricultural information platform is designed. (3) Select the appropriate parameters to build the experimental model and then train it, then compare the experimental effects of the traditional BP algorithm and the optimized three algorithms, and comprehensively evaluate the LM-BP model with the best performance.

Although the proposed methodology yields promising results, the parameters used in the study were quite limited. The superiority of the proposed approaches could be further justified by extending the number of parameters relevant to precision agriculture, and the generated results could be evaluated against the traditional state of the art models.

Data Availability

The data sets used during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The author declares that he has no conflict of interest.

Authors' Contributions

Mengling Zhang and Yuhan Zhang contributed equally to this work and should be regarded as co-first authors.

Acknowledgments

This work was funded by the National Natural Science Foundation of China (funding numbers: 71573111, 71863019, and 72163014).

References

[1] Y. Zhang, L. Wang, and Y. Duan, "Agricultural information dissemination using ICTs: a review and analysis of information dissemination models in China," *Information processing in agriculture*, vol. 3, no. 1, pp. 17–29, 2016.

[2] W. Chen and S. Guo, "Current situation and existing problems of agricultural informatization in China," *Transactions of the Chinese society of Agricultural Engineering*, vol. 29, no. 22, pp. 196–205, 2013.

[3] W. M. Rivera, "The changing nature of agricultural information and the conflictive global developments shaping extension1," *The Journal of Agricultural Education and Extension*, vol. 7, no. 1, pp. 31–42, 2000.

[4] O. Nishiguchi and N. Yamagata, "Agricultural information management system using GIS technology," *Hitachi Review*, vol. 58, no. 6, p. 265, 2009.

[5] L. Xu, N. Liang, and Q. Gao, "An integrated approach for agricultural ecosystem management," *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, vol. 38, no. 4, pp. 590–599, 2008.

[6] C. J. Zhao, X. T. Yang, B. Li, L. Ming, and Y. Hua, "The retrospect and prospect of agricultural information technology in China," *Journal of Agriculture*, vol. 8, no. 1, p. 180, 2018.

[7] P. Ballantyne, "Accessing, sharing and communicating agricultural information for development: emerging trends and issues," *Information Development*, vol. 25, no. 4, pp. 260–271, 2009.

[8] E. E. Adomi, M. O. Ogbomo, and O. E. Inoni, "Gender factor in crop farmers' access to agricultural information in rural areas of Delta State, Nigeria," *Library Review*, vol. 52, no. 8, pp. 388–393, 2003.

[9] S. M. Lord, R. A. Layton, and M. W. Ohland, "Trajectories of electrical engineering and computer engineering students by race and gender," *IEEE Transactions on Education*, vol. 54, no. 4, pp. 610–618, 2011.

[10] K. Demiryurek, H. Erdem, V. Ceyhan, S. Atasever, and O. Uysal, "Agricultural information systems and communication networks: the case of dairy farmers in Samsun province of Turkey," *Information Research*, vol. 13, no. 2, pp. 13–22, 2008.

[11] W. Mokotjo and T. Kalusopa, "Evaluation of the agricultural information service (AIS) in Lesotho," *International Journal of Information Management*, vol. 30, no. 4, pp. 350–356, 2010.

[12] S. Farooq, S. Muhammad, K. M. Chauhdary, and I. Ashraf, "Role of print media in the dissemination of agricultural information among farmers," *Pakistan Journal of Agricultural Sciences*, vol. 44, no. 2, pp. 378–380, 2007.

[13] O. J. Okwu, A. A. Kuku, and J. I. Aba, "An assessment of use of radio in agricultural information dissemination: a case study of radio Benue in Nigeria," *African Journal of Agricultural Research*, vol. 2, no. 1, pp. 14–18, 2007.

[14] M. Reichardt and C. Jürgens, "Adoption and future perspective of precision farming in Germany: results of several surveys among different agricultural target groups," *Precision Agriculture*, vol. 10, no. 1, pp. 73–94, 2009.

[15] S. Cole and B. Kirwan, "Between the corporation and the household: commodity prices, risk management, and agricultural production in the United States," *American Journal of Agricultural Economics*, vol. 91, no. 5, pp. 1243–1249, 2009.

[16] G. Wen, F. Zetian, L. Daoliang, Y. Longyong, Z. Jian, and Z. Xiaoshuan, "Agrilnfo: an agricultural information system based on a call centre in China," *New Zealand Journal of Agricultural Research*, vol. 50, no. 5, pp. 797–806, 2007.

[17] Y. Lu, Y. Lu, B. Wang, Z. Pan, and H. Qin, "Acceptance of government-sponsored agricultural information systems in China: the role of government social power," *Information Systems and e-Business Management*, vol. 13, no. 2, pp. 329–354, 2015.

[18] L. I. Xiu, "Technological innovation of agricultural information service in the age of big data," *Journal of Agricultural Science and Technology*, vol. 16, no. 4, p. 10, 2014.

[19] T. Guo and Y. Wang, "Big data application issues in the agricultural modernization of China," *Ekoloji*, vol. 28, no. 107, pp. 3677–3688, 2019.

[20] D. Qu, X. Wang, C. Kang, Y. Liu, 1. Ministry of Agriculture and Rural Affairs, P. R. C, Beijing 100125, China, and 2. Information Center, Ministry of Agriculture and Rural Affairs, P. R. C, Beijing 100125, China, "Promoting agricultural and rural modernization through application of information and communication technologies in China," *International Journal of Agricultural and Biological Engineering*, vol. 11, no. 6, pp. 1–4, 2018.

[21] S. Lin, B. Zheng, G. C. Alexandropoulos, M. Wen, F. Chen, and S. Mumtaz, "Adaptive transmission for reconfigurable intelligent surface-assisted OFDM wireless communications," *IEEE Journal on Selected Areas in Communications*, vol. 38, no. 11, pp. 2653–2665, 2020.

[22] K. Z. Ghafoor, L. Kong, S. Zeadally et al., "Millimeter-wave communication for internet of vehicles: status, challenges, and perspectives," *IEEE Internet of Things Journal*, vol. 7, no. 9, pp. 8525–8546, 2020.

[23] K. Lakshmanna and N. Khare, "FDSMO: frequent DNA sequence mining using FBSB and optimization," *International Journal of Intelligent Engineering and Systems*, vol. 9, no. 4, pp. 157–166, 2016.

[24] C. Murugamani, S. Shitharth, S. Hemalatha et al., "Machine learning technique for precision agriculture applications in 5G-based internet of things," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 6534238, 11 pages, 2022.

[25] L. Tomaszewski, R. Kołakowski, and M. Zagórda, "Application of mobile networks (5G and beyond) in precision agriculture," in *In IFIP International Conference on Artificial Intelligence Applications and Innovations*, pp. 71–86, Cham, 2022.

[26] L. Benos, N. Makaritis, and V. Kolorizos, *From Precision Agriculture to Agriculture 4.0: Integrating ICT in Farming*, Information and Communication Technologies for Agriculture—Theme III: Decision, Cham, 2022.