Research Article

Agricultural Productive Service System Based on the Block Chain and Edge Computing

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With the rapid development of the service sector in economic growth, productive service industry has become a growing field of people's attention. Agricultural productive services are a supporting point to promote the development of modern agriculture, and at the same time, they also point out the direction for promoting the transformation of the agricultural development mode, which has very important strategic significance. In order to analyze and improve the rural productive service system and solve the "three rural" issues, this article designs an agricultural productive service analysis framework from the perspective of farmers, statistics of the investment in agricultural productive services in a certain region from 2015 to 2019, the expenditure of agricultural productive services in agriculture, forestry, fishery, and animal husbandry, and per capita wage income and operating income of farmers in the area under agricultural productive services, and in the process of agricultural production, farmers need agricultural productive services from the perspective of the whole process, land preparation, seeding, pest control, fertilization, and harvesting risks. The data in this experiment are stored in a distributed manner through the block chain, and the data are stored in the corresponding part in the chronological order; the data are transmitted to the edge server of the experimental network in the way of point-to-point transmission, and then edge computing technology is used to calculate and analyze the data collected in the experiment. The final result shows that, in this region, the input of the main agricultural producer service industry is growing very fast, the scale of productive services is expanding, and more and more attention is paid to the producer services in the process of agricultural production, but the internal composition of agricultural producer services is unbalanced. With the continuous improvement of the scale of agricultural productive services, the per capita income of farmers and the per capita income of management are also increasing year by year. When the scale of agricultural productive services reaches 0.09 in 2019, the per capita wage income of farmers has reached 3900 yuan, and the per capita income of farmers has reached 3750 yuan. And in the perspective of various risks in agricultural production, the higher the risk coefficient, the stronger the risk preference of farmers and the higher the risk investment in agricultural production services.

1. Introduction

1.1. Background Meaning. The producer service industry is an important part of modern agriculture, and it plays a very important role in the external effects of agriculture, broadening the income channel, and adjusting the structure of the agricultural industry [1]. With the development of agricultural modernization, farmers' demand for agricultural productive services has become more and more urgent. In recent years, the state has attached great importance to the development of agricultural productive services and has

continuously introduced encouraging policies. The development of modern agriculture requires a more complete and professional agricultural production process, which provides opportunities for the development of agricultural productive services. The coordinated development of agricultural productive services and the comprehensive development of the first, second, and tertiary industries in rural areas are objective requirements for realizing medium-scale agricultural operations, improving agricultural efficiency, and increasing farmers' incomes and are important measures to realize the transformation from small to large [2]. The

continuous advancement of our country's urbanization has released rural labor and increased the nonagricultural income of the peasants, and professional agricultural productive service organizations have developed rapidly. In order to analyze the economic benefits brought by the agricultural productive service system to the rural areas and farmers, we conducted research on the agricultural productive service system based on the block chain and edge computing. In addition, the computing edge of the edge server is closer to the terminal device, and the performance of the service device is relatively low. However, this server supports multiple communication protocols and provides distributed computing functions, which effectively improves the efficiency of the experiment and saves the time for calculating data.

The tertiary industry, that is, the service industry, plays an increasingly important role in economic development, and the agricultural productive service industry is an important part of the entire service industry. The development of the agricultural productive service industry has allowed breakthroughs in the traditional, primary, and tertiary industries, allowing the integration and penetration of agriculture and the service industry to achieve common development. Promoting the development of agricultural productive services will help improve the efficiency of agricultural production, increase the income of farmers, and promote the optimization and upgrading of the agricultural industry structure. Agricultural production services based on agricultural professional cooperatives can solve various problems in the development of modern agriculture in terms of capita, technology, and management.

1.2. Related Work. At present, many scholars have conducted relevant research on the agricultural productive service system. Jia-Ni researched the development of agricultural productive services in Suqian from five aspects and provided references for the further development of agriculture [3], but the experimental data of the research were incorrect, and the experimental results were inaccurate. Ming et al. used the tobit model to analyze the impact of agricultural production service segmentation on agricultural production efficiency [4], but the experimental model of this method has errors, and the experimental results are unreliable. Yingming et al. used the ordinary least-squares stepwise regression method to analyze the correlation between the farmland scale and agricultural production services [5], but the data calculation process of this method is too complicated. Tian et al. used the entropy method and the degree of coordination to measure the degree of coordination between agricultural productive services and the first, second, and tertiary industries of agriculture and studied the geographical distribution characteristics of the degree of coordination between the two [6], but the experimental study of data too jumbled. Zhu et al. constructed a measurement index system for the producer service industry and used the coupling coordination model to measure the extension of the agricultural industry chain and the coupling coordination between the producer service industry and

rural education [7], but the experimental procedures of this study are too complicated and not easy to operate. Wu and Chen analyzed the demand factors of the agricultural productive service industry and evaluated them [8], but the experimental subjects selected in this study were too one-sided, and the analysis of the experimental results was not comprehensive enough. Zhang and Sun analyzed the status quo of the development of agricultural productive services in our country, deeply analyzed the root causes of the backward development of agricultural productive services, and proposed a systematic optimization process from the perspective of system reform [9], but the research only has theoretical analysis, and there is a lack of data to prove the reliability of the results. Gao and Zhang compared the evaluation of the supply and demand status of agricultural productive services by three types of farmers and the farmers' demand for productive services [10], but the experimental objects and data in this study were too few to provide a strong proof for the experimental results. The above studies have certain flaws. Based on this, we have made certain improvements to the above studies and studied the agricultural productive service system of block chain and edge computing.

1.3. Innovation of this Article. This article counts the input and expenditure of agricultural productive services in a certain area, the income of farmers under agricultural productive services, and farmers' demand for agricultural productive services; from the perspective of farmers, research the agricultural productive service system based on block chain and edge algorithms. The innovations of this article are reflected in the following aspects: (1) use block-chain technology as a method of data storage to ensure data stability and security; (2) use edge computing technology to carry out related techniques and analysis of experimental data, which saves the calculation time of experimental data, improves the efficiency of the experiment, and has certain advantages in data security and privacy protection; (3) from the perspective of farmers, the analysis of agricultural productive services is in line with the development of the current national conditions, which is of great significance to promote the development of rural economy and realize a well-off society in an all-round way.

2. Related Technologies for Research on the Agricultural Productive Service System

2.1. Block Chain. Block chain is a data chain structure similar to the distributed ledger; it stores the data in the corresponding blocks in a chronological order and connects all the blocks and uses cryptography principles to realize encryption protection to ensure that economic data are not tampered with. As a distributed ledger, the block chain is usually managed by a peer-to-peer network that complies with internode communication and verification of new block protocols. Block chain enables us to have a distributed peer-to-peer network in which nontrusted members can interact with each other in a verifiable manner without a

trusted intermediary [11]. The block chain is mainly used to store data, and data can be written and stored here, so the block chain is a database. Chain block chains are classified as public, private, and union chain strands, in which three types have their own characteristics but also overlap each other in place, users can choose different types of blockchains according to their needs. The basic framework of the block chain is composed of the data layer, network layer, consensus layer, incentive layer group, contract layer, and consensus layer. Economic incentive strategies and smart contracts based on the time chain link structure, distributed node consensus mechanism, and consensus concept are the most representative innovations in block chain technology. Data layer, network layer, and basic layer are a consensus architecture block chain, and the absence of any portion of block chains cannot be called complete; the incentive layer, contract layer, and application layer are mainly used to build decentralized applications and are not a necessary part of block chain design.

The block chain does not have a central node, and every node in it is equal, and no node can handle or control other nodes. It is a series of data blocks containing information for a digital document timestamp which cannot be tampered with once it is labeled. Block chain is an open, distributed ledger that can record transactions securely, permanently, and very efficiently [12, 13]. In block chain technology, data are permanently stored in partitions, generated in a chronological order, and linked to the chain. Each chain records all transaction information generated during its creation. Each data block contains data, the hash value of the current block, and a hash value of the previous block of three parts, stored in the block depending on the type of section. Block chain represents a novel application of cryptography and information technology in the old problems of financial record keeping [14, 15]. After the block chain uses the peer-to-peer network, everyone can join; when someone enters the network, the person will get a copy of the entire block chain, and this person can verify the legality of all of the block chains, and constant verification is successful; each block will add a new block in their chain, so everyone reaches a “consensus.” Block chain is a new type of information technology, which combines many existing technologies to achieve unique functions and has important applications in the future [16].

2.2. Edge Computing. Edge computing is a new type of distributed computer architecture that performs computing functions at the edge of the network. In order to ensure the quality of service while processing large amounts of data for cloud computing, edge computing has been developed [17]. Edge computing technology can effectively help smart terminals improve their computing capabilities and participate in the consensus algorithm of the block chain. Edge computing technology is considered to be one of the key technologies to realize the vision of the future Internet of Things and the fifth-generation communication technology (5G). Its purpose is to provide a networked environment with large-scale connections, high access speeds, and low

latency. Integrating edge computing technology into the framework of the block chain can effectively enhance the computing power of smart terminals, thereby helping to solve the problem of proof of work. It combines computing edge nodes with the network to form a “device terminal-device edge cloud” architecture. Each level can provide the required resources and services for the application, and the application can choose the best configuration according to the needs. The architecture of edge computing is based on location-based mobility requirements, which improve system performance and service quality. It integrates independent scattered resources adjacent to users in the space or distance between networks and provides computing, storage, and network services for applications. This decentralized architecture can bring data analysis closer to users, process huge amounts of data more efficiently, and provide users with good service quality.

Edge computing can provide the user terminal equipment storage and computing and network services; cloud computing is extended at the edge of the network, and because of its unique performance advantages, it has been duly noted by scholars and technicians. Edge computing has the characteristics of solving response time requirements, battery life limitations, saving bandwidth costs, and data security and privacy [18–21]. The computing and storage nodes of edge computing are located at the edge of the internet, close to mobile devices or sensors [22]. It can deploy servers at the edge of the network and can share and upload some simple services requested by users to various local edge servers, the task calculation and data storage functions are completed through the edge server, and it is no longer necessary to upload to the cloud data center through the core network for processing. Consider uploading to the cloud data center for processing for relatively large data or data with relatively complex calculations. These operations reduce the bandwidth pressure of the cloud data center, reduce the possibility of data link congestion and failure, and improve the link capacity, which can improve the computing power of mobile devices while saving battery power [23]. And the edge server in the edge computing is closer to the terminal device and has unique advantages in data security and privacy protection.

2.3. Agricultural Productive Services. Agricultural productive services involve the entire agricultural production process, directly or indirectly providing nonpublic welfare services to all agricultural products in various production and management links before, during, and after production. Agricultural production of the service is the “separation of powers” product stage, and it belongs to large-scale operation services; agriculture is one of the methods of scale operations. The main feature of the agricultural productive service industry is based on intermediate inputs, which involve the exchange of knowledge and capita and provide customized services for participants [24]. Agricultural productive service is a typical model in practice, with regional characteristics, and the main body of its service is farmers’ professional cooperatives. The development of our

country's agricultural regions is not balanced, and there are differences in the degree of development of productive services in different regions and different agricultural production sectors. The agricultural productive service industry is the support point to promote the development of modern agriculture, and it also points out the direction for promoting the transformation of the agricultural development mode. Different from the consumer goods service industry, the producer service industry is a service provided by enterprises, nonprofit organizations, and the government to provide products and labor in the production process, rather than providing end-to-end services to the final consumer. Some people think that agricultural productive services are equivalent to agricultural socialized services [25], which can increase agricultural labor productivity. Although the agricultural productive service industry does not directly involve production activities or material conversion processes, every production link in agriculture is inseparable from the productive service industry.

With the development of agricultural production today, the demand for productive services in agricultural production is becoming increasingly diversified and multilayered [26]. With the rapid development of the agricultural productive service industry, various agricultural organizations are moving towards the new service mode step by step by means of market inspection and innovation and gradually become diversified, systematic, and specialized. At the same time of rapid development, the development of agricultural productive services has also ushered in a new situation, which has begun to show diversified network nodes and become more and more mature, providing more service subjects for agricultural activities [27]. Under the guidance of the government's incentive, diversified service organizations have been widely extended to agricultural production, integrating the resources in the process of agricultural production, and various services have been continuously extended, have been learned from each other, and have constantly promoted their own improvement and progress. The development of the operation model of our country's agricultural producer service industry continues to mature, and it mainly includes the public agricultural service model led by the government agricultural department, the socialized service model based on agricultural cooperatives and industry associations, a service model with leading enterprises as the backbone, the operation model represented by the service model with the agricultural market as an important platform, and the innovative development model of the traditional agricultural productive service industry.

2.4. Three Rural Issues. "Three rural" is a collective term for "rural, agriculture, and farmers," and the main problems of "three rural" refer to the problems that exist in the overall composition of these three. "Agriculture, rural areas, and farmers" is the top priority of the party's labor agenda, and it is related to the overall status of socialist modernization with Chinese characteristics [28]. The issue of "agriculture, rural areas, and farmers" accompanied the progress of China's revolutionary construction and reform and received great

attention from successive leaders. It is closely related to the overall quality of the people and economic stability and is directly related to social development. Strengthening the research on the "three rural" issues is the basis for realizing rural stability and rural economic development. We must pay attention to major issues in real life and go deep into the forefront of agricultural production governance [29]. The current development of "agriculture, rural areas, and farmers" faces many problems: the development of agriculture affects the simultaneous development of the four modernizations, rural areas have a great influence on the construction of a well-off society, and the uncoordinated development of towns and villages makes it very difficult to alleviate poverty. In the current national conditions, China is still a country with a large population, and the peasants are the most populous group in our country. Our country attaches great importance to the development of agriculture, but our country's agricultural production fluctuates greatly, the development of agricultural science and technology is not fast enough, the competitiveness of agriculture is not strong enough, the development of rural economy is backward, and the gap between urban and rural areas is still very large. In order to achieve the coordinated development of urbanization and new rural construction, we must attach great importance to the "three rural" issues [30]. Only by comprehensively solving the "three rural" issues can we build a more complete and prosperous society that benefits all farmers.

3. Agricultural Production Service-Related Experiments

3.1. Data Collection. This experiment is based on the statistics of agricultural production service capita investment in a certain area from 2015 to 2019, analyzes the development of agricultural productive services in the region, such as the expenditure on agricultural productive services and the per capita income of farmers in the region under agricultural productive services, and analyzes farmers' demand for agricultural productive services from the risk perspective of the whole process, land preparation, sowing, pest control, fertilization, and harvesting.

3.2. Agricultural Productive Service Analysis Framework. In agriculture-related research, the production function is generally defined as $F(K, T)$, where K is the capita element and T is the labor factor; in this experiment, for the convenience of analysis, the capita input S used to purchase agricultural productive services is separated from the capita element. The capita investment used to purchase agricultural productive services is $S(\alpha)$, the production function becomes $F(K, T, S(\alpha))$, the farmer's utility function $R(\pi, q)$ also becomes the expected utility function $E[R(\omega + \pi), q]$, ω is the initial wealth of the farmer, π is the profit of the farmer's agricultural production, and q is the characteristic variable of the farmer's family. The expected utility function of farmers in this experiment is,

$$E[R(\omega + \pi), q] = E[R(\omega + PQ - W), q]. \quad (1)$$

In the above formula, π is the profit, P is the product price, Q is the product quality, and W is the input cost of

$$\text{Max } E[R(\pi), q] = \text{Max } E\{[R(\omega + PF(K, T, S(\alpha)) - (X_1K + X_2T + X_3S(\alpha))), q]\}. \quad (2)$$

X_1 , X_2 , and X_3 are the unit prices of capita, labor, and productive services, respectively. Find the partial derivative of formula (2):

$$\begin{cases} \frac{\partial R}{\partial K} = \frac{\partial \pi}{\partial K} * \frac{\partial R}{\partial \pi} = \frac{\partial R}{\partial \pi} (PF_1 - X_1), \\ \frac{\partial R}{\partial T} = \frac{\partial \pi}{\partial T} * \frac{\partial R}{\partial \pi} = \frac{\partial R}{\partial \pi} (PF_2 - X_2), \\ \frac{\partial R}{\partial S(\alpha)} = \frac{\partial \pi}{\partial S(\alpha)} * \frac{\partial R}{\partial \pi} = \frac{\partial R}{\partial \pi} (PF_3 - X_3). \end{cases} \quad (3)$$

To obtain the optimal solution to formula (3), the demand function of farmers for agricultural productive services can be obtained:

$$Y_3 = Y(X_1, X_2, X_3, P, R, \alpha). \quad (4)$$

According to the above formula to analyze the farmers' input demand for agricultural productive services, according to formula (4), we can know that when $Y_3 = Y$, the farmers' input demand for agricultural productive services has an optimal solution.

4. Development of Agricultural Productive Services

4.1. Investment in Agricultural Productive Services. In order to study the development of agricultural productive services, this study analyzes the development of agricultural productive services in a certain area from the three perspectives of structure, overall, and space. The experimental data includes statistics on agricultural investment in the region's main productive service industries from 2014 to 2019, and the percentage of the region's agricultural, forestry, fishery, and animal husbandry production service expenditures in total expenditures. Table 1 shows the statistics of the main industries of productive services invested in agriculture in the region from 2014 to 2019.

According to the data in Table 1, we can see that, during the period 2014–2019, the main industries of productive services in the region increased in agriculture. By 2019, the investment in the logistics industry reached 128.61 billion yuan, retail investment reached 13.86 billion yuan, financial investment reached 127910 million yuan, scientific and technological investment reached 56.55 billion yuan, and the information service input was relatively small, only 13.36 billion yuan. In order to observe the investment of agricultural productive services in the region more intuitively,

each element. Substituting the production function into formula (1), it can be changed to solve the problem of maximizing farmers' utility:

we calculated the data in the table and obtained the annual investment situation compared with the last year as shown in Figure 1.

According to the data in Figure 1, we can see that the logistics industry's investment in agricultural productive services in 2017 increased by 49.13 billion yuan over the previous year; in 2018, the retail and financial industries invested 43.19 billion yuan and 44.33 billion yuan in agricultural productive services. The logistics, retail, and financial industries invest more in agricultural productive services, while other industries invest less in agricultural productive services. It can be seen that the investment in the main industries of agricultural productive services in this area has grown very fast, but the internal composition of the agricultural productive service industries is not balanced.

4.2. Expenditure of Agricultural Productive Services in Agriculture, Forestry, Fishery, and Animal Husbandry. This study analyzes the expenditure of agricultural productive services in the region from the agriculture, forestry, fishery, and animal husbandry. Statistics of expenditure on agriculture, forestry, fishery, and livestock production services in the region from 2015 to 2019, and the results are shown in Figure 2.

According to the data in Figure 2, we can see that the area's expenditure on agricultural, forestry, fishery, and animal husbandry in 2015 accounted for 10.72% of the total expenditure on agriculture, forestry, fishery, and animal husbandry; expenditure in 2016 accounted for 10.91%, an increase of 0.19% over the previous year; expenditure in 2017 accounted for 12.15%, an increase of 1.24% over the previous year; expenditure in 2018 accounted for 14.59%, an increase of 2.44% over the previous year; and expenditure in 2019 accounted for 15.17%, an increase of 0.58% over the previous year. It can be seen that the scale of agricultural productive services in the region is constantly expanding, and the importance of productive services in the agricultural production process is increasing.

4.3. Per Capita Income of Farmers under Agricultural Productive Services. In recent years, the strong growth of agricultural productive services has promoted the development of the rural economy. The agricultural productive service system is increasingly integrated. The agricultural productive service field has been expanded to preproduction and postproduction services, and agricultural foreign investment has increased significantly. This study counts the farmer's per capita wage income, farmer's per

TABLE 1: Statistics on the input of agricultural productive services in a certain place from 2015 to 2019 (unit: billion).

Year	Logistics	Retail	Financial	Technology	Information service
2014	814.3	697.4	413.8	142.5	50.9
2015	903.9	781.9	441.4	234.5	65.7
2016	857.9	752.3	416.3	358.1	137.7
2017	1349.2	955.2	541.5	643.8	248.3
2018	1154.8	1387.1	984.8	561	277.4
2019	1286.1	1328.6	1179.1	605.5	133.6

FIGURE 1: The input of agricultural productive services.

FIGURE 2: Agricultural, forestry, fishery, and animal husbandry production service expenditures.

capita operating income, and the scale of agricultural productive services in the region from 2015 to 2019. The specific situation is shown in Figure 3 (unit: yuan).

According to the data in Figure 3, we can see that, from 2015 to 2019, as the scale of agricultural productive services continues to expand, the per capita income of farmers' wages

FIGURE 3: The income of farmers and the scale of agricultural productive services.

FIGURE 4: Farmers' demand for agricultural productive services from the perspective of risk.

and per capita income of operators have also increased year by year. When the scale of agricultural productive services reached 0.09 in 2019, the per capita wage income of farmers had reached 3900 yuan, and the per capita income of farmers had reached 3750 yuan.

4.4. Farmers' Demand for Agricultural Productive Services from the Perspective of Risk. Set the interval of the farmers' risk preference index to $[0, 2]$; among them, the closer the risk preference characteristic index is to 2, it means that the more risky and willing the farmers are to make venture capita. On the contrary, it means that farmers tend to avoid risks. Analyze the risk appetite investment of farmers in the whole area of agricultural production, land preparation, seeding, pest control, fertilization, and harvesting for every 0.5 risk preference interval. The statistical risk investment data are shown in Figure 4 (unit: yuan/mu).

According to the data in Figure 4, we can see that, as the risk appetite index increases, the more farmers prefer risk and the more venture capita they invest in agricultural productive services. In the case of different links, farmers' risk investment in harvesting is the most, which is more than 703 yuan/mu, and the total investment is 2983 yuan/mu, and the risk investment in fertilization is the least, basically less than 3 yuan/mu, and the total investment is 4.853 yuan/mu.

5. Conclusions

Agricultural production services for modern agriculture are very important; after years of development, coupled with the support of relevant government policies, the development of agricultural production of various types of services has achieved remarkable results. The differentiation of farmers has led to the diversification of the main body of agricultural production in our country, and the requirements for

agricultural productive services have gradually increased. At the same time, it is necessary to realize that there is still an imbalance between the supply and demand of agricultural productive services, and the construction of the agricultural productive service system is still a long-term process.

In this study, the input of agricultural productive services in a certain region, the expenditure of agricultural productive services in agriculture, forestry, animal husbandry, and fishery, the farmers' per capita wage income and per capita operating income under the agricultural productive services, and the farmers' demand for agricultural productive services from the perspective of various risks in the process of agricultural production analyze the impact of agricultural productive services on the economic benefits of the region and the development of agricultural productive services in the region. Finally, according to the experimental results, the region's investment in agricultural productive services is growing very fast, and the scale of agricultural productive services is getting higher and higher, but the internal composition of the agricultural productive service industry is imbalanced. With the increase in the scale of agricultural productive services, the per capita wage income and per capita operating income of farmers in this area are also increasing, and from the perspective of risk, the higher the risk index, the stronger the preference of farmers for the risk, the greater the demand for agricultural productive services, and the greater the risk investment in agricultural productive services.

This research on agricultural productive services based on block chain and edge computing is fairly successful, but this research still has shortcomings in some aspects and needs later improvements: (1) in this study, only productive agriculture of service in the time direction of a particular area is analyzed; posttest services for agricultural production will be the number of areas of comparative analysis in the spatial direction; (2) in this study, the analysis of the agricultural production of the services is not comprehensive enough, and in later experiments, one can perform analysis from other productive agricultural service indicators; and (3) this study is lacking in consideration of endogenous issues, and later experiments can use a larger sample of panel data for analysis.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of the research article.

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