THE IMPACT OF THE COMBINED ECONOMIC SYSTEM OF ARTIFICIAL INTELLIGENCE, BLOCKCHAIN AND BIG DATA ON RURAL ECONOMY IN SOUTHWEST CHINA

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Abstract: With the continuous development and innovation of science and technology, artificial intelligence, blockchain and big data have become the representative technologies of the new era, and they play an increasingly important role in the development of economic society. Especially in southwest China, the rural economy is facing many challenges, and these three technologies are widely seen as effective means to solve these problems. This paper first discusses the role of these technologies in the economic field, as well as the potential and challenges they can bring, through a comprehensive introduction to artificial intelligence, blockchain, and big data. Then, according to the specific situation and needs of the rural economy in southwest China, the responsibilities and opportunities in the rural economic development after the combination of these three technologies are deeply analyzed, such as the specific application of artificial intelligence in agricultural production, blockchain in agricultural product traceability, big data in precision poverty alleviation and other aspects, as well as the transformation and driving force of these technologies on the rural economic structure. The results show that the integration of these three technologies can not only improve the efficiency, accuracy and reliability of rural economy, but also open a new door for rural technological innovation and economic development. However, this also raises issues such as technical standards, adaptability, and security, which pose a challenge to policy makers' decision-making. Therefore, relevant preparations should be made to seize opportunities, cope with challenges and promote the vigorous development of rural economy in southwest China.
Keywords: Artificial intelligence; Blockchain; Big data; Rural economy; Fusion application

1 INTRODUCTION

In the wake of rapid technological advancements, artificial intelligence (AI), blockchain, and big data have become instrumental in propelling socio-economic progress. This paper examines their potential to address the transformational challenges faced by the rural economy in China's southwestern region, a region rich in resources but grappling with development disparities. The study will elucidate the impact of these technologies and project their developmental prospects in this context.

The paper will first assess the current rural economic landscape in China's southwestern region, focusing on resource endowments, demographic structures, and the influence of external funding and policy support. It will then identify the critical needs for rural economic development, such as improving agricultural efficiency, enhancing product circulation and traceability, precision poverty alleviation, and modernizing educational and healthcare services.

Subsequently, the paper will dissect the roles, potentials, and challenges of AI, blockchain, and big data within the economic sphere. It will explore their applications in agricultural production, financial services, and the traceability of agricultural products, as well as their capacity to drive precision agriculture and market forecasting. The discussion will also address the adaptability and security concerns of integrating these technologies into the rural economy, offering policy recommendations to foster their effective integration.

In conclusion, this paper aims to provide a structured analysis that underscores the significant influence of AI, blockchain, and big data on the rural economy of China's southwestern region. It will highlight the transformative potential of these technologies and suggest future research directions to guide policy-making and rural economic advancement.

2 TECHNICAL PANORAMA

2.1 Potential and Challenges of Artificial Intelligence in Rural Economy

As an important representative of modern science and technology, artificial intelligence (AI) has achieved remarkable results in its application in various fields of the global economy [1-2]. For the rural economy in southwest China, AI technology also shows great potential. The application of artificial intelligence technology in agricultural production, agricultural product management, financial services and other fields is expected to effectively improve the efficiency and income of rural economy [3-6].

In agricultural production, artificial intelligence can accurately predict weather, pests and diseases through big data

analysis, machine learning and other technical means, so as to assist farmers to develop scientific planting plans. By using drones and smart sensors, artificial intelligence can also realize real-time monitoring and management of farmland, greatly improving the degree of automation of agricultural production [7-9]. By analyzing soil, climate, and crop growth data, AI can provide precise irrigation and fertilization recommendations to reduce resource waste and increase yields.

In the management of agricultural products, artificial intelligence technology can run through all aspects of production, processing, and circulation. From planting to harvesting, packaging, and transportation, intelligent supply chain management systems can optimize resource allocation, reduce losses, and improve product quality. The intelligent agricultural product traceability system allows consumers to understand the whole process of products from field to table through blockchain and other technologies, thus enhancing the trust and market competitiveness of agricultural products.

The informatization and intellectualization of financial services is another important aspect of rural economic development [10-12]. Through credit scoring and risk assessment of farmers and agricultural enterprises, artificial intelligence can provide a reliable basis for financial institutions to make decisions, reduce capital risks, and promote more financial resources to flow to rural areas. AI applications such as intelligent customer service and intelligent financial advisors can provide farmers with convenient financial services and improve their financial literacy and financial management ability.

In seeing the broad prospects of artificial intelligence application, we can not ignore the challenges it faces. The high cost and maintenance of artificial intelligence technology puts economic pressure on widespread application. The economic foundation of southwest rural areas is relatively weak, so how to reduce the application cost and improve the penetration rate of technology has become a key issue. The lack of relevant technical personnel is also an important factor restricting the application of AI. Education resources in rural areas are relatively insufficient, and the technical training and personnel training system still needs to be improved to support the wide application of artificial intelligence technology.

Data privacy and security issues are equally important. For rural areas, data management and protection mechanisms are not yet mature, and the risk of data leakage and abuse is higher. In the process of data collection, storage and analysis in the application of artificial intelligence, it is necessary to establish a perfect data privacy protection mechanism to protect the rights and interests of farmers.

The application potential of artificial intelligence in the rural economy is huge, which can significantly improve agricultural production efficiency and product quality, and promote the development of rural financial services. However, in the face of challenges such as technology cost, shortage of talents and data security, it is necessary to establish perfect supporting measures and policy guarantees to promote the effective promotion and application of technology and realize the sustainable and healthy development of rural economy in southwest China.

2.2 Impact of Blockchain Technology on Rural Economic Development

Blockchain technology, as a distributed ledger technology, has the characteristics of decentralization, immutability and transparency, and is setting off a technological revolution in various fields. In terms of rural economic development, the application of blockchain technology also shows great potential. Agricultural traceability is a key area where blockchain technology plays an important role. By recording the data of every production, transportation and storage link on the blockchain, the problems of counterfeiting and shoddy and information asymmetry existing in the agricultural product market at this stage can be effectively solved. Consumers can query the entire production process of agricultural products through the blockchain traceability system, thereby enhancing trust in the quality of agricultural products.

The application of blockchain technology in the flow of agricultural funds also shows its potential to improve the rural economy. The traditional rural financial system is difficult to obtain loans and financial services because of information asymmetry and imperfect credit system. Blockchain technology can promote agricultural production and rural economic development by creating a transparent and credible agricultural financial system, linking farmers' production and operation data such as planting information and sales records, forming a credible credit system, improving farmers' loan capacity and the availability of financial services.

The application of blockchain technology in rural land ownership can not be ignored. Land ownership confirmation is a major issue involving the vital interests of farmers. At present, the work of rural land ownership confirmation in China still faces many challenges, mainly in the unclear definition of land ownership and complicated work. Through blockchain technology, land ownership confirmation information can be tampered with, transparent and open, to ensure that the ownership and use rights of each piece of land are clear, reduce land disputes, protect the legitimate rights and interests of farmers, and also provide strong support for rural land transfer and financing.

Although blockchain technology has great potential in promoting rural economic development, it also faces many challenges in practical application, such as the high cost of technology implementation, technical complexity, and weak network infrastructure in rural areas. Policy makers and technology developers need to consider these challenges and develop appropriate roll-out strategies and technical standards to ensure that blockchain technology truly benefits rural economic development.

Through the analysis of the potential and challenges of blockchain technology in rural economic development, it can be seen that its wide application prospects and far-reaching impact are expected to bring new development opportunities for the rural economy in southwest China.

2.3 Impetus and Challenge of Big Data to Rural Economic Transformation

As a revolutionary technology, big data is having a profound impact on the transformation of rural economy in southwest China. The role of big data in rural economy is mainly reflected in precision agriculture, market forecasting and resource allocation. In precision agriculture, large amounts of environmental data such as soil, climate and crop growth can be obtained and analyzed through big data technology, so as to scientifically guide farmers to make planting decisions and improve agricultural production efficiency and crop yield. Big data also plays an important role in market forecasting, by analyzing consumption trends and market demand, farmers and agricultural practitioners can more accurately carry out market layout and product sales, reducing the imbalance between supply and demand. Big data can also optimize the allocation of rural resources, which is reflected in the procurement of agricultural materials, the circulation of agricultural products and the improvement of resource utilization.

In the process of promoting big data technology also faces many challenges. For example, problems with the integrity and accuracy of data acquisition limit its effective application. Data security and privacy issues need to be given adequate attention to prevent the risk of data misuse and leakage. The information infrastructure in rural areas is relatively weak, and the breadth and depth of technology application are limited [13-15]. To realize the full application of big data in the rural economy, continuous improvements in technical training, policy support and infrastructure construction are also needed. The popularization of big data not only depends on the advanced nature of the technology itself, but also needs to pay attention to its adaptability and operability in combination with the actual situation in rural areas [16-19].

3 DEVELOP BACKGROUND AND NEEDS OF RURAL ECONOMY

3.1 Status of Rural Economy in Southwest China

The present situation of rural economy in southwest China not only has its unique resource advantages, but also faces many challenges. Geographically, southwest China includes Yunnan, Guizhou, Sichuan and other provinces and autonomous regions. The region's climatic conditions, topographic features and ecological environment provide abundant resources for its agricultural production, but these factors also pose multiple challenges to economic development.

(1) Resource advantage and agricultural diversity. The natural conditions in southwest China are very suitable for the cultivation of a variety of special agricultural products, such as flowers from Yunnan, tea from Guizhou, fruit from Sichuan, etc. These agricultural products not only have distinct regional characteristics, but also enjoy a high market reputation at home and abroad. Due to the mountainous terrain and relatively inconvenient transportation, the market circulation of agricultural products has been restricted. The construction of rural infrastructure is relatively weak, the popularization of modern agricultural production technology is low, resulting in low production efficiency and slow growth of farmers' income.

(2) In terms of population, the labor force in the rural areas of southwest China is generally engaged in agricultural production, and the quality and skill level of the labor force is relatively low. Due to the lack of adequate technical training and educational resources, agricultural production efficiency is not fully utilized. In this context, farmers' acceptance of new technologies and new knowledge is also low, which further restricts the development of rural economy. In addition, there is a phenomenon of population outflow in some areas, and a large number of young labor forces are lost, making the problem of rural population aging gradually prominent.

(3) The lack of external financial and policy support is also an important issue. Although the state has issued a series of policies to promote rural economic development, aiming at promoting agricultural modernization and rural infrastructure construction, the actual effect of many policies has failed to meet expectations due to the problems such as insufficient execution and unreasonable allocation of resources in the specific implementation process of policies. Private and external capital investment in rural areas is also insufficient, resulting in the rural economic development faced with a shortage of funds.

(4) The low degree of marketization and information asymmetry seriously restrict the vitality of rural economy. Farmers' individual economic activities and loose cooperative organizations make the market circulation of agricultural products less organized and difficult to obtain market information. Many farmers still follow the traditional production and sales model, lack of brand awareness and market development ability, which makes them at a disadvantage in the market competition.

(5) In terms of technology, although some rural areas in southwest China have begun to introduce the concept of digital agriculture and intelligent management, the application of modern agricultural technology is still quite limited due to backward infrastructure and limited capital technology. The slow process of the popularization of this technology makes it difficult to significantly improve agricultural production efficiency .

In general, the current situation of rural economy in southwest China is characterized by abundant resources but insufficient utilization, pending strengthening of policy support, prominent problems of population structure and labor quality, asymmetric market information, and limited application of modern technology. In this context, how to effectively introduce and apply the three major technologies of artificial intelligence, blockchain and big data has become the key to solve this development dilemma. It is in this complex and multiple economic situation that the future technology integration application is more necessary and urgent.

3.2 Needs of Rural Economic Development

The rural economic development in southwest China is faced with many demands, which are mainly reflected in the following aspects:

The need to improve the efficiency of agricultural production is particularly prominent. Due to the complex terrain and diverse natural conditions in this region, the traditional agricultural production mode has been difficult to meet the requirements of modern development, and there are problems such as insufficient labor force, single production mode and waste of resources. Through the introduction of artificial intelligence, precision agriculture technology and automation equipment, it is expected to achieve optimal allocation of resources and improve the yield and quality of food crops and cash crops.

Agricultural product circulation and traceability systems need to be upgraded. In southwest China, agriculture is the main economic pillar, but the circulation channels of agricultural products are not smooth, and the information asymmetry between producers and consumers is prominent, which leads to the instability of farmers' income. The addition of blockchain technology can realize the full traceability of agricultural products from production to sales, enhance the trust of consumers, reduce transaction costs, improve the circulation efficiency of agricultural products, and thus increase the economic benefits of farmers.

Targeted poverty alleviation in rural areas needs the support of big data. The region's poverty problems are complex and diverse, and traditional poverty alleviation models have limited effect. Big data technology can provide data support for the country to formulate scientific and effective poverty alleviation policies through the collection and analysis of multi-dimensional data of rural households, economic activities, environmental resources and so on. Accurately identify the poor population, rationally allocate poverty alleviation resources, and effectively evaluate the effect of poverty alleviation, so as to achieve the target of precise poverty alleviation.

There is an increasingly urgent need to modernize rural education and medical services. Limited by geographical location and economic conditions, there is a big gap in educational resources and medical conditions in southwest rural areas. Through big data analysis and artificial intelligence technology, online education and telemedicine services can be introduced to make up for the imbalance of urban and rural education and medical resources, and improve the comprehensive quality and health level of the rural population.

The demand for rural economic restructuring and industrial upgrading is obvious. At present, the southwest rural economy is dominated by traditional agriculture, with a single industrial structure and weak ability to resist risks. With advanced technologies, emerging industries such as agricultural product processing, tourism and agriculture, and modern logistics can be developed, the integrated development of the primary, secondary and tertiary industries can be promoted, the sustainability and resilience of the rural economy can be enhanced, and the overall revitalization of the rural regional economy can be promoted.

The development needs of rural economy in southwest China mainly focus on five aspects: production efficiency improvement, circulation system improvement, targeted poverty alleviation, education and medical care improvement, and economic restructuring.

3.3 Possibility and Challenge of Technology Application

The application of technology in the rural economy of southwest China has shown great potential, but it also comes with many challenges. The application of artificial intelligence in agriculture can improve production efficiency and yield, but it needs to address issues such as technology access, operational complexity and cost. Blockchain technology can ensure transparency and trust in agricultural product traceability, and inconsistent technical standards and imperfect infrastructure may limit its wide application. Big data provides personalized services and reasonable allocation of resources in targeted poverty alleviation, and data privacy and data security issues need special attention. Technology acceptance and training of technicians in rural areas are also important challenges. Taken together, only the system to deal with these problems, in order to fully unleash the potential of technology.

4   PROSPECTS FOR THE FUTURE DEVELOPMENT OF RURAL ECONOMY IN SOUTHWEST CHINA

4.1 Transformation and Driving Force of the Integration of Three Technologies on Rural Economic Structure

The integration of artificial intelligence, blockchain, and big data has brought about significant transformations and impetus to the economic structure of rural areas in Southwest China. The synergistic effects of these advanced technologies can markedly enhance the efficiency, transparency, and sustainability of the rural economy. The confluence of artificial intelligence, blockchain, and big data has propelled the vigorous development of the rural economy in Southwest China. Combining blockchain with big data analytics is beneficial in addressing issues of low production efficiency, information isolation, and irrational resource allocation in the Southwest region.

Firstly, the distributed ledger technology and cryptographic mechanisms of blockchain ensure the security and immutability of agricultural data, preventing malicious tampering and data leaks. Big data, on the other hand, can efficiently store, manage, and analyze massive and heterogeneous agricultural data, extracting valuable information. The integration of blockchain and big data technologies enables trustworthy data sharing among different entities, breaking down data silos and enhancing the efficiency and collaboration in agricultural production and management in

Southwest China. Secondly, utilizing big data analytics, multidimensional data such as soil, meteorology, crop growth, and pest and disease information can be mined and analyzed to provide farmers with precise decision-making recommendations for planting, irrigation, fertilization, and pest control. Blockchain technology can record the generation and updating process of these data, ensuring their credibility and traceability. The convergence of blockchain and big data technologies allows farmers to confidently base their agricultural production decisions on data analysis results, improving the precision of agricultural production and the efficiency of resource utilization. Lastly, blockchain facilitates real-time information sharing and synchronization among all participants in the supply chain, enhancing its transparency and collaboration, reducing information asymmetry and communication costs in intermediary links, and lowering the risks of logistics loss and delays. Big data analytics can integrate and analyze logistics, information flow, and financial flow data within the supply chain, optimizing resource allocation and processes, and improving the efficiency and profitability of the supply chain.

At present, the rural economy in Southwest China is confronted with the issues of excessive costs and incomplete information. The integration of automated processing, utilizing artificial intelligence (AI) to analyze big data, can effectively address these challenges. On one hand, AI in agricultural production can accurately predict weather, pest and disease conditions, and other factors through big data analysis and machine learning technologies. The use of drones, smart sensors, and AI enables real-time monitoring and management of farmlands, significantly enhancing the level of agricultural automation and thus saving considerable time and labor costs associated with data processing. On the other hand, AI, by analyzing big data related to soil, climate, and crop growth, provides farmers with precise recommendations for irrigation and fertilization, reducing resource waste and increasing yield. In terms of market forecasting, the combination of AI and big data technologies allows farmers and agricultural practitioners to clearly understand consumption trends and market demands, thereby enabling more precise market positioning and product sales, reducing the imbalance between supply and demand. Concurrently, the fusion of blockchain and AI has a significant impact on the rural economy. Firstly, the combination of these two technologies helps to tackle challenges related to data security. Blockchain, as a distributed data storage and sharing platform, ensures the security, transparency, and traceability of data. When AI utilizes blockchain data for analysis and prediction, the ownership and usage of data can be clearly recorded, allowing users to better control the scope and manner of data sharing, preventing data misuse, and protecting privacy. Secondly, the integration of blockchain and AI is beneficial for enhancing the sharing of agricultural information in the Southwest region. Blockchain can standardize data formats and standards, while AI transforms data from different sources and structures into a processable format, integrating agricultural information, breaking data silos, and achieving comprehensive sharing.

In summary, the convergence of these three technologies is beneficial for data sharing. Big data analytics can collect and preprocess multi-source and heterogeneous agricultural data. On this basis, artificial intelligence further processes and analyzes the data using machine learning algorithms to uncover valuable information. Blockchain, with its distributed ledger technology, ensures the secure sharing and credible transmission of data among all participants, maintaining data consistency and integrity. This convergence also supports decision-making. Big data analysis provides a basis for precision agriculture by analyzing data on soil, meteorology, and crop growth. Artificial intelligence constructs predictive models and decision support systems based on these data and analysis results, offering precise decision-making recommendations for agricultural production. Blockchain records and traces various data and decisions in the agricultural production process, ensuring transparency and traceability. Furthermore, it is advantageous for protecting the privacy of farmers. Blockchain's encryption technology provides security for agricultural data, ensuring privacy and integrity, preventing data tampering and leakage. Artificial intelligence analyzes and processes encrypted data, and big data analytics, under the premise of data security, mines and analyzes massive data to provide decision-making basis for agricultural production and management. Only by fully unleashing the potential of these three technologies and achieving effective technological integration can we better promote the transformation and development of the rural economic structure in Southwest China.

4.2 Suggestions and Prospects for Policy Makers

In order to promote the vigorous development of rural economy in southwest China, policymakers should be forward-looking and take multiple measures at the same time. The primary task is to build a sound technical standard system, enhance the adaptability and interoperability of artificial intelligence, blockchain and big data technologies, and lay a solid foundation for rural digital transformation. At the same time, strengthen technical education and training, improve farmers' technology application ability and information literacy, so that advanced technology is truly integrated into agricultural production practice, and release the huge potential of science and technology to rejuvenate agriculture.

In order to stimulate innovation, special funds and incentive mechanisms should be set up to attract scientific research institutions and enterprises to actively participate in the research and development and application of rural science and technology, and form a good ecology of deep integration of production, university and research. In addition, improve the system of laws and regulations, strict data supervision, to ensure that data security and privacy are effectively protected in the process of technology application, and escort the healthy development of rural economy. Through these comprehensive policies, the southwest rural economy will be inserted into the wings of science and technology to achieve leap-forward development [16-19].

5   CONCLUSION AND DISCUSSION

This paper deeply studies the far-reaching impact of the combination of artificial intelligence, blockchain and big data on the rural economy of southwest China, and clearly points out the application potential and challenges of these three technologies in the rural economy. Through a detailed analysis of specific application scenarios, such as the role of artificial intelligence in agricultural production, the practice of blockchain in agricultural product traceability, and the role of big data in targeted poverty alleviation, we see how these three technologies are changing and driving the development of rural economies, especially in southwest China. However, we also see that the popularity and application of these three technologies has also brought some challenges and problems, such as the formulation of technical standards, adaptability and security issues, which have caused certain challenges for policy makers in guiding and managing the development direction of science and technology, promoting rural economic development, and ensuring the smooth transition of rural society. Therefore, this requires us to study and think more deeply, how to guide and manage the development of these three technologies scientifically and reasonably according to the actual situation of the rural economy, grasp the opportunities and challenges, in order to better serve the development of the rural economy. At the same time, it is also expected that more research can go into the countryside to understand the actual needs and conditions of the countryside, so as to put forward more scientific suggestions and opinions to promote the scientific and technological innovation and transformation of the rural economy. In addition, we also look forward to more policies to support the application and popularization of these three technologies in rural areas, such as strengthening infrastructure construction, improving the scientific and technological quality of farmers, and establishing a sound technical service system, so as to promote the high-quality development of the rural economy driven by science and technology.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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