Research on the Evolution of Innovation Policy in China Agricultural Science and Technology Park

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Abstract

China's national agricultural science and technology parks have experienced the stages of pilot construction, overall promotion and innovative development. K-means clustering analysis, Python language and multi-dimensional cross-view were used to analyze the evolution of innovation policy of national agricultural science and technology parks from 2000 to 2020. The results show that the evolution of innovation policy of parks can be divided into three stages: system construction stage, innovation development stage and quality improvement stage. The proportion of different types of policies in each stage is not same. The proportion of guiding policies is always increasing, and the policy structure system is becoming reasonable. Problems such as insufficient policy supply and improper supply and demand adaptation exist in each stage. Therefore, under the new environment of supply-side reform, it is necessary to further improve the policy supply system of agricultural science and technology parks and meet the diversified demands of innovation practice under the new era background. It is necessary to strengthen the linkage mechanism of departments to solve the policy imbalance and the insufficiency of efficiency. To strengthen the integration of industrial innovation resources in the park and improve and coordinate the industrial innovation chain.

Key words: Agricultural science and technology park; Policy evolution; Text mining

INTRODUCTION

In 2001, China officially started the construction of the first batch of national agricultural science and technology parks. After 20 years of development, China's agricultural science and technology park has gone through three stages of pilot construction (2001 to 2005), comprehensive promotion (2006 to 2011), and innovative development (2012 to the present). In December 2020, the ninth batch of national agricultural science and technology parks were announced, so far China has approved the construction of 303 national agricultural science and technology parks. In different stages of the development of China's agricultural science and technology parks, their positioning and function have been adjusted, and different park innovation policies have also been introduced to guide the construction and development of the park. The Suggestions of the CPC Central Committee on Formulating the 14th Five-Year Plan for National Economic and Social Development and the Long-term Target for 235 clearly points out that we should "improve the quality, efficiency and competitiveness of agriculture, strengthen green guidance, standard guidance and quality and safety supervision, and build demonstration zones for agricultural modernization". This points out the direction for the strategic adjustment of the function and positioning of the national agricultural science and technology parks in building a new development pattern in the new period. To this end, it is necessary to study the evolution of the innovation policies of the national agricultural science and technology park since 2000, and put forward relevant suggestions combined with the requirements of the new era and the new development pattern for the further improvement of its innovation policies.

1. RELEVANT LITERATURE REVIEW

Corresponding to the three stages of development of China's agricultural science and technology park, Liu Ran Ran and other domestic scholars divided the research on

national agricultural science and technology into three stages: preliminary exploration, rapid development and deepening consolidation, and discussed the themes and key of the research institute at different stages (Liu & Wang, 2019). The changes in the internal and external environment of rural agricultural development have led to the different functional positioning and functions of national agricultural science and technology parks in different stages of development, and the innovation policies of the park have changed accordingly. In the national agricultural science and technology park function role positioning and research, early research mainly believes that the national agricultural science and technology park in the integration of agricultural technology, the transformation and promotion of agricultural science and technology achievements, cultivating internationally competitive agricultural industry group and promoting the new agricultural science and technology revolution plays an important function and role (Sun & Lu, 2002; Wu, 2001; Jiang, 2000). With "mass entrepreneurship, innovation", innovation-driven development and national rural revitalization strategy, national agricultural science and technology park was given more functions and role, some research that the national agricultural science and technology park for agricultural enterprise incubation, agricultural industry integration and agricultural new forms provides environmental conditions, provides a new path for farmers' income, is an important base of rural agricultural innovation entrepreneurship, is agricultural and rural industry and farmers income growth of the important carrier and platform (Wu, 2014; Zhou, et al, 2018; Xie, Lü, Xia, 2019). Based on this, the innovation policy research on the national agricultural science and technology park also reflects the difference of this stage. In the early research, in view of agricultural natural weakness, agricultural high risk and the lack of agricultural science and technology innovation ability, the researchers put forward the land preferential, tax preferential, financial support, financial credit preferential, tariff preferential innovation support policy, policy research focus is to incentive park enterprises to gather more factor resources, improve the agricultural technological progress rate, promote the transformation of agricultural development mode (Jiang & Sun, 2004; Long & Su, 2007). In recent research, it has become the focus of attention to improve the comprehensive innovation ability support policy, including organizational system innovation ability and market innovation ability, attract the agglomeration of high-level factor resources of rural agricultural industry, and form the rural revitalization strategy and the policy superposition effect in the innovation and development of science and technology parks (Xie & Mao, 2018; Xia, 2018; Wu & Wu, 2020). The 20-year development of the National Agricultural Science and Technology Park fully shows the important role of innovation policies,

but as some studies have pointed out, the sustainable development of the national agricultural science and technology park needs to give full play to the main role of innovation of enterprises in the park and form an innovation system of the park (Wang, et al, 2015). With the change of the functional orientation and role of the national agricultural science and technology parks in the new era and the new development pattern, the policies of the park should also be adjusted accordingly. However, most of the studies have discussed the adjustment of policies from the problems existing in the development of agricultural science and technology parks in a specific period, and they lack to study the policy adjustment of national agricultural science and technology parks in the new period and the new pattern from the perspective of the internal evolution logic of the policy. To this end, K-means cluster analysis and python language are used below to divide the policy evolution of national agricultural science and technology park since 2000, analyze the implementation effect of science and technology park policies in different stages from a multi-dimensional cross perspective, and put forward the adjustment suggestions of national agricultural science and technology park policies under the new period and the new development pattern.

2. IN-DEPTH EXCAVATION BASED ON THE POLICY TEXT OF THE NATIONAL AGRICULTURAL SCIENCE AND TECHNOLOGY PARK

Policy text is one of the core components of policy content (Zhang, Geng, & Wang, 2015). Deep excavation of the content of policy text and further evaluation and judgment are not only helpful to organize the distribution and evolution development trajectory of policy themes, but also to analyze the many problems existing between policy formulation and implementation according to the policy practice response (Zhang, et al, 2019). In view of this, 21 representative relevant policy texts of agricultural science and technology parks from 2000-2020 were selected as research samples.

2.1 Word Extraction and Word Frequency Statistics

First, 21 agricultural science and technology park park related policies establishment document set. The policy text of the agricultural science and technology park is imported, and the edit Python language uses the jieba module. Some of the word frequency statistical results are shown in Table 1. Refer to Li Chenguang (Li & Zhang, 2012). For the classification of innovative policies, this paper extracts verbs as an important basis for the clustering of policy texts. Among them, the frequency of vocabulary is proportional to its importance in the policy text of the park.

Table 1
Some vocabulary and word frequency statistics

Serial number vocabulary	Serial number vocabulary	Serial number vocabulary
1 Development	6 Innovation	11 Improve the following
2 Construction	7 Agricultural Products	12 Service
3 Technology	8 Support for	13 Policy
4 Advance	9 Country	14 Technology
5 Farmers	10 Speed up the speed	15 Implementation

On the basis of the above, in order to further judge the degree of correlation between the policy text and the extracted keywords, the vocabulary-document relationship matrix was constructed to observe the correlation degree of each policy text. Then, the K-means clustering algorithm is used to determine the final number of categories of 3, that is, the clustering results show that the relevant policy text of the agricultural science and technology park can be divided into three themes.

2.2 Results of the Cluster Analysis

Cluster analysis divided the policy text of agricultural science and technology parks into three categories, including 5 incentive policies, 6 mandatory policies and 11 guiding policies. Among them, in the first type of text data, the incentive words such as "improvement", "cultivation", "service" and "promotion" account for a relatively high number, so it is summarized as "incentive policy", that is, the directional policy formulated to guide the park to carry out the construction work itself. In the second type of text data, mandatory words such as "management", "evaluation", "organization", "guidance", "acceptance and" acceptance "appear frequently and are divided into" compulsory policies ". In the third type of text data, there are more guidance words such as "improving", "increasing", "support" and "accelerating", which are summarized as "guidance policies", which mainly provides specific and detailed guidance for the practice of various agricultural science and technology parks. According to the development characteristics and time background of Chinese agricultural science and technology parks in different times and reference to sorghum (Huang, 2021). For the development process of China's agricultural science and technology park, the innovation policy evolution is divided into three stages: system construction (2000-2009), innovation development (2011-2016) and quality improvement (2017 to the present) (Table 2).

Table 2
Statistics of policy types for each stage

Policy type	Stage of System Construction (2000-2009)	Stage of Innovative Development (2011-2016)	Quality Improvement Phase (2017 to present)
Incentive-type policies	2	2	1
Compulsory class policies	3	2	1
Guiding class policies	1	5	5

From the perspective of the number of classified policies, incentive policies are the same as those of compulsory policies, both accounting for 24% of the total sample, reflecting the key role of incentive policies in driving the development of agricultural science and technology parks and promoting the progress of agricultural technology.Incentive policies can encourage the innovation and development of the main body of the park, inject innovation vitality into the park while encouraging innovation behavior, and create a good atmosphere for collaborative innovation in the agricultural industry. Guiding policies account for the most proportion (52%), showing a trend of fewer and more, and are dominant among the three types of policies.From the perspective of the total proportion of three types of policy statistics, incentive policy and mandatory policy gradually declined in recent years, guiding policy gradually occupy the mainstream, reflects the evolution of our agricultural science and technology park policy system gradually improved, but also shows that the country to agricultural science and technology park "light management, guidance" change, management mode gradually rationalization, diversification.

3. EVOLUTION ANALYSIS OF POLICY AND PRACTICE OF NATIONAL AGRICULTURAL SCIENCE AND TECHNOLOGY PARK AT DIFFERENT STAGES

3.1 System Construction Stage (2000-2009)

Since the 21st century, in order to catch up with a new round of scientific and technological revolution, the exploration of the development of agricultural science and technology parks has made practical preparations for the construction of a national agricultural science and technology park, and also laid a foundation for the policy system construction of the national agricultural science and technology parks. In the face of the low contribution rate of agricultural science and technology, in order to seize the historical opportunity of the new round of agricultural science and technology revolution, the national agricultural science and technology park has been given the function and goal of realizing agricultural leap-forward development and enhancing international competitiveness at the beginning of its construction. In this period, China's agricultural business subjects were restricted by various factors such as insufficient innovation consciousness, outdated innovative thinking mode and lack of innovation experience, and it is urgent for policies to provide incentive support and scientific management methods for the innovation practice of the park. In 2001, the State Council issued the Outline for

the Development of Agricultural Science and Technology (2001-2010) and put forward the idea of building a national agricultural science and technology park to promote the development of agricultural science and technology for the first time. Subsequently, the Ministry of Science and Technology successively formulated and promulgated the Guidelines for Agricultural Science and Technology Parks and the Measures for the Management of Agricultural Science and Technology Parks, which put forward the basic management system and management mode for the construction of early parks in China.In 2001, the Supplementary Notice on Strengthening the Work of "National Agricultural Science and Technology Park" further put forward more detailed goals and requirements for the principle direction, work focus and management mechanism of the park construction.Since 2007, the Comprehensive Evaluation Index System of National Agricultural Science and Technology Park and the Evaluation and Acceptance Code of National Agricultural Science and Technology Park have been issued successively. Since then, the park has officially concluded a dynamic evaluation and management system for the first time, and the policy structure has been further improved.

However, due to the construction of China's agricultural science and technology park in China is still in the early practice stage, many mismatch between innovative practice responses and policies. In the past ten years of this stage, compulsory policies occupy the lead and are more related to agricultural science and technology parks, supplemented by incentive policies. Although guiding policies are mentioned, there is no detailed guidance for the innovation and development of agricultural science and technology parks. Most of the mandatory policies are the specialized policy documents of agricultural science and technology parks, which provide rules and regulations and management requirements for the initial exploration of the construction of agricultural science and technology parks in China. Incentive policies aim to establish and improve the appropriate innovation incentive mechanism, mainly including enterprise innovation support subsidies, patent and intellectual property application and protection, to help strengthen the innovation awareness of the industry and society, create a good atmosphere for agricultural innovation, and give directional guidance to agricultural science and technology innovation. The two respectively provide a guarantee for the development of agricultural science and technology parks from the two aspects of overall control and direction guidance, but the "policy failure" phenomenon emerging in the practical response also seriously restricts the overall development of agricultural science and technology parks, and also restricts agricultural science and technology innovation to a certain extent. The alignment analysis between practice response and policy during this period is shown in Table 3.

Table 3
Analysis of the cross-evolution of policy and practice in the system construction stage

Policy orientation	Practice response	There are some deficiencies
We will build world-class key agricultural laboratories and science and technology parks.	Construction of science and technology parks and national laboratories in agriculture was accelerated. Science and Technology Park related policies were issued。	The quantity distribution of north-south development is uneven. The vast majority of are national macro policies, with few local response policies, mostly mandatory policies in the park, and the policy effectiveness structure is not perfect and unreasonable.
We will encourage all agricultural science and technology parks to actively introduce advanced technologies to form industrial characteristics.	The introduction of projects in the park increased significantly, and technology varieties and facilities gradually diversified.	scientific and technological innovation excessively pursues quantity and economic benefits, ignoring the quality of science and technology and social and ecological benefits. The conversion rate and contribution rate of scientific and technological achievements are relatively low.
We will increase investment in agricultural science and technology and raise the rate of agricultural science and technology progress.	agricultural machinery total power and fixed asset investment equipment costs continued to grow agricultural science and technology national budget funds continued to increase.	The construction of the agricultural innovation system is not perfect, and the efficiency of transforming scientific research achievements is still relatively low.
We will promote large-scale processing and technological modernization of agricultural products.	The total scale of China's agricultural and sideline food processing investment and construction has continued to rise.	However, the overall processing and transformation degree remains at the low level, and the creation of benefits are limited.
We will improve our ability for independent innovation in agricultural science and technology.	The number of agricultural patent applications and authorization (items) gradually increased; the number of agricultural science books published continued to increase.	The industrialization development of patents has poor quality and low benefit value patent loss, idle, cheap acquisition and related supporting facilities.
We will carry out actions to train scientific and technological personnel and establish high-quality scientific and technological personnel in the agricultural field.	A small number of agricultural technicians and undergraduate research and trials in related majors increased.	Institutions did not increase substantially, and the construction of high-quality agricultural science and technology team achieved little effect; the lack of quantity and quality of high-tech talents and unreasonable talent introduction mechanism hindered the high-quality development of the industry.
We will foster science and technology agricultural enterprises with international competitiveness.	Attracted a large number of agricultural enterprises to settle in, and created certain social benefits.	The innovation in agricultural science and technology still faces the problem of short and narrow industrial chain, and fails to simultaneously achieve the growth of the number of enterprises and the rate of scientific and technological progress.

3.2 Stage of Innovation and Development (2011-2016)

In 2010, China resumed the application of the third batch of national agricultural science and technology parks, and the development of the park entered a new stage of historical development. In 2011, the Ministry of Science and Technology issued the Development Plan for the National Agricultural Science and Technology Park during the Twelfth Five-Year Plan, and put forward the goals and requirements of improving the ability of industrial technology integration, and building an agricultural science and technology service platform. Since 2012, the agricultural science and technology park has been written in the No.1 document of the Central Committee for eight consecutive years, marking the official beginning of the stage of innovation and development. In 2012, the 12th Five-Year Plan for the Development of Agriculture and Rural Science and Technology proposed to strengthen the construction of industrial radiation and driving capacity in the park and promote the construction of development bases for emerging agricultural industries. At this stage, the accumulation of "quantitative change" in innovation in China's agricultural science and technology parks has gradually achieved achievements. Guiding policies gradually increased and began to take the lead, setting more precise development goals for the construction and development of agricultural science and technology parks, which became the focus of the innovation policies of the park at that time. Therefore, the guidance policies for the actual demand began to gradually occupy the lead. The guidance on the detailed innovation practice of agricultural science and technology parks mainly focuses on institutional reform and industrial clusters. However, there are still deficiencies exposed in practice, among which the unbalanced development of the park and the lack of support for supporting policies are particularly prominent (Table 4).

Table 4
Analysis of the cross-evolution of policies and practice in the Innovation and Development stage

Policy orientation	Practice response	There are some deficiencies
We will promote the capacity building of industrial technology integration and innovation in the park, and improve the implementation mechanism of advanced agricultural application technology innovation suitable for the development of modern agriculture.	The industrial types of the park are constantly enriched, the new service industries of modern agriculture are gradually emerging, and the modernization process of the park is accelerated.	Although the spatial distribution of agricultural science and technology parks with high innovation technology efficiency is uniform, there is still a big gap with the industrial parks in the same period, and the management level of the park is uneven.
We will improve our ability to transform scientific and technological achievements, strengthen the functions of technological demonstration and promotion, and give full play to the functions of transforming and incubating achievements.	The park represented by Wuhan has become the area with the ability of national innovation first.	There is a large gap in the innovation output level of the park, and there is still room for improvement in the innovation investment (talent team construction, research and development funds, land financing intensity, etc.).
Build emerging agricultural industry development bases, and enhance the industrial radiation scope and capacity of the park.	The construction of agricultural emerging industry development base was accelerated; the industrial radiation and driving capacity of agricultural science and technology park gradually emerged.	The overall level of technology promotion presents a strong and weak situation. The driving capacity and effectiveness of industry still needs to be optimized and coordinated.
We will give priority to investment in agricultural science and technology, and tilt preferential policies such as financial capital to the field of agricultural science and technology innovation.	National agricultural investment has been greatly increased; (2) Research and development investment in agricultural science and technology parks has continued to increase.	There are large differences in R & D investment between different regions, the R&D investment in central China is much higher than that in other regions, and the balance contradiction between various regions is large.
We will build China's collaborative innovation alliance for agricultural science and technology, and build a service platform for agricultural science and technology, information, brand and financial sharing.	The autonomy of the park is gradually showing, the dependence on government subsidies has been reduced, and the diversified financing methods such as its own funds and financial financing have begun to increase.	Land investment and financing have increased significantly, but the effect gap between the central and western parks is great, highlighting the contradiction of unbalanced development.

3.3 Quality Improvement Stage (2017 to present)

With the continuous improvement of people's income level, consumption demand for agricultural products has become the market focus and mainstream, agricultural supply side structural reform is imperative, the national agricultural science and technology park has been given a new historical mission and responsibility, the evolution of park innovation policy has therefore entered the stage of quality improvement. The 2018 National Development Plan for Agricultural Science and Technology Park put forward the tasks of improving the innovation service capacity, developing and gathering high-tech industries, and promoting the integrated development of "integrated park and city". At the same time, the "National Agricultural Science and Technology Park Management Measures" also ushered in a revision. Compared with the previous setting, the park is more accurate, the functions are clearer, the conditions of the park are more detailed, and the acceptance and evaluation are more perfect, emphasizing the basic principle of "government leading, market operation, enterprise subjects and farmers benefit". At this stage, the types of policies are still mainly guiding policies. Policy guidance for innovation practice is mainly reflected in green development, industrial integration, integration of government, industry, research, rural finance, and a new pattern of opening up. It will help enrich the vitality of agricultural science and technology innovation subjects, improve the supply

quality of scientific and technological agricultural products, and improve the efficiency of the transformation of agricultural scientific and technological achievements. However, with the uncertainty and complexity of the changes in the international economic environment, there are still problems such as the poor effect of some policies and the inconsistent with the actual development, such as the low enthusiasm for rural agricultural entrepreneurship and the unbalanced development of rural e-commerce (Table 5).

Table 5
Analysis of Cross evolution of Policy and Practice in Quality Improvement Stage

Policy orientation	Practice response	There are some deficiencies
We will improve the agricultural innovation and business environment, and improve the park's innovation and entrepreneurship capacity and social service capacity.	The number of entrepreneurs began to increase, the field of entrepreneurship gradually expanded, and the number of business incubators and other related business services increased.	People's willingness to start increases, but the entrepreneurial practice is still not high; the construction of service institutions such as business incubators is not perfect, and the survival rate is still at a low level.
Gather innovation elements and build a talent highland.	The policy and mechanism for the introduction of scientific and technological innovative talents has been gradually improved.	The number of high-tech innovation talents is still scarce; the talent introduction and incentive mechanism cannot meet the gap demand; the transformation rate of scientific and technological innovation achievements is low.
We will promote the development of rural e-commerce.	Rural e-commerce is developing rapidly.	Compared with other products, agricultural products brands have weak influence, lack of county e-commerce talents, limited supply chain guarantee ability, and low digital level of county level limit the high quality and balanced development of county e-commerce.
We will strengthen agricultural technology and science and development.	R&D investment continues to increase, the construction of supporting infrastructure related to technological innovation is accelerated; the cost of technological innovation gradually decreases.	There is still a gap in the demand for scientific and technological innovation; only the national financial support for scientific and technological innovation is limited, and the innovation atmosphere of the whole industry and the whole society still needs to be created.
We will improve financial and financial support policies for the parks, implement land use supervision, and optimize the management mode of the park.	Support for R & D and achievement transformation increased; rural financial forms continuously enriched; park investment and financing platforms developed rapidly and guarantee institutions gradually increased.	The integration degree of rural finance and science and technology innovation is low, and agricultural innovation subjects still have investment and financing difficulties; the financial environment of agricultural science and technology needs to be optimized.
We will build a platform base for scientific and technological innovation, promote the deep integration of industry, education and research, and build a modern agricultural technology system.	The construction of agricultural technology innovation platform and characteristic industrial base is progressing smoothly; agricultural science and technology innovation makes remarkable achievements.	Scientific and technological achievements and industrial application did not develop at once, and the efficiency of scientific and technological achievements is still low. The policy system for agricultural industrial integration needs to be further explored and improved.

4. CONCLUSIONS AND SUGGESTIONS

4.1 Main Conclusions

K-means cluster analysis and python language were used to divide the policy evolution of National Agricultural science and technology parks since 2000, and analyze the implementation effect of science and technology park policies in different stages from a multi-dimensional cross perspective. The main conclusions are as follows:

(1) Text mining analysis shows that the national agricultural science and technology park policies can be divided into guiding policies, incentive policies and compulsory policies. Since 2020, the increasing number of guiding policies has shown that the national policy on agricultural science and technology parks is gradually relaxed, no longer forcing government intervention, and gradually changing from the role of excessive management to service. At the same time, the policy system structure is gradually rationalized, reflecting the evolution of the national agricultural science and technology park policy from exploration to improvement.

(2) The multi-dimensional cross perspective analysis of the innovation policy of the park shows that the national agricultural science and technology park innovation policy has gone through the system construction stage, innovation development stage and quality improvement stage. At different stages, the innovation policy of the park is still facing problems such as insufficient policy supply, mismatch of supply and demand adaptation, and poor structural system.

4.2 Countermeasures and Suggestions

In the new period to build the new cycle of new development pattern, the national agricultural science and technology park needs to play a more prominent and key role in rural revitalization, it not only need to gather rural agricultural innovation entrepreneurship resources, promote the depth of integration of rural industries, also undertake the agricultural science and technology achievements, technology promotion and new agricultural business subject cultivation functions, the national agricultural science and technology park policy therefore need timely dynamic adjustment.

(1) Further improve the policy support system of agricultural science and technology parks, enhance the driving force for innovative development of agricultural science and technology parks, improve the policy innovation environment of agricultural science

and technology parks, and solve the problems such as insufficient policy supply and improper adaptation of policy supply and demand. First of all, while ensuring the integrity and feasibility of existing policies, matching policies such as financial support, entrepreneurship support and intellectual property protection should be gradually improved to solve the problem of insufficient policy supply in agricultural and rural innovation-driven development. Secondly, according to the differentiated characteristics of different regions in different periods, combined with the characteristics and characteristic functions of different regions and different types of parks, to improve the applicability and specialization of innovation policies, to meet the diversified development needs of different types of national agricultural science and technology parks.

(2) Strengthened the departmental linkage mechanism to solve the problem of innovation policy imbalance and insufficient efficiency play. Most of the policy release departments of the park are led by the Ministry of Science and Technology, and other relevant departments assist to coordinate and participate in the work of the park. However, the work of the park has certain complexity and systematicness, and the innovation activities themselves involve multi-subjects and departments. To this end, it is necessary to improve the level and coordination between innovation policies, strengthen the communication and coordination among various government departments, and realize the benign interaction between policy formulation, release, implementation and application.

(3) Strengthen the industrial innovation and integration in the park, and improve the coordinated industrial innovation chain. Innovate the distribution mechanism, rationally use equity investment, technology investment and government cooperation, explore the appointment of scientific and technological personnel, and attract professionals such as capital, technology and other innovative elements to gather in the park. We will establish and improve the mechanism for the coordinated development of agricultural and rural industrial innovation chains in the new era, accelerate the deep integration of industry, education and research, further improve the innovation coordination capacity of leading agricultural enterprises, agricultural research institutions, institutions of higher learning and other agricultural innovation entities, and continue to improve the efficiency of transforming agricultural scientific and technological achievements.

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