

Promoting the Competitiveness of China's Agricultural Industry in the New Development Stage: From an Industry Security Perspective

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Abstract: Promoting the competitiveness of China's agricultural industry is crucial for transforming China into a modern country. The aggravation of agricultural external risks and the basic national conditions—smallholder farmers, resource shortage, and tight balance of agricultural product supply and demand—propose new requirements and challenges in the competitiveness of China's agricultural industry. There is an urgent need to redefine the competitiveness of the agricultural industry and propose a corresponding strategic framework for the new development stage. In this study, we propose such a concept, labeled as safe and diversified, green and efficient, core control, and independent competition. Moreover, we established a competitiveness evaluation index system for the agricultural industry considering three core components: security assurance, industrial control, and market competitiveness, and evaluated the competitiveness of China's agricultural industry using this system to explore its weaknesses. Furthermore, we propose new competitiveness upgrade paths and countermeasures; specifically, China should ensure a stable supply of important agricultural products, expand the value-added space of its agricultural industry, promote the modernization of agricultural operation and services, encourage international co-operation, and prioritize the development of agricultural science and technologies.

Keywords: competitiveness of the agricultural industry; security assurance; industrial control; market competitiveness; industry security

1 Introduction

Enhancing the agricultural industry's competitiveness is crucial for transforming China into a powerful modern socialist country as it enters a new development stage (hereafter, also "new stage"). China has entered a new development stage of building a fully modern socialist country and marching toward the second-centenary goal. Under such circumstances, domestic and international situations and needs have undergone major changes, posing new challenges to the competitiveness of China's agricultural industry. On one hand, the world economy is in recession, the international geopolitical order is unstable, and trade protectionism is rising again. Higher external instability and uncertainty have a more complex and profound impact on the industry's competitiveness. Furthermore, the agricultural industry's strategic issues have gained unprecedented strategic importance. On the other hand, as China enters the new

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stage, the agricultural industry's high-quality development provides basic support and strong demand as well as forms an important driver for the domestic–international dual circulation. However, the basic national conditions regarding agriculture are not expected to change significantly for many years; agricultural resource constraints will become increasingly tight, the supply of grain and other agricultural products will be in tight balance, and agricultural operation models will be dominated by smallholder farmers. Consequently, the agricultural industry must be more competitive.

Most studies construct index systems and analyze the market competitiveness of China's agricultural industry using the traditional logic of competition, that is, leveraging low costs and differentiation [1]. Notably, these studies define the competitiveness of China's agricultural industry in a relatively narrow sense: that it remains impossible to (1) meet China's needs in its high-quality development stage, (2) transform its main social contradictions, and (3) fight the challenges arising from the intensification of external risks. Here, after re-examining the implications and characteristics of the agricultural industry's competitiveness, we propose a new competitiveness framework. We also construct an index system to evaluate this concept in China's new development stage. Furthermore, we explore the paths and major initiatives for upgrading the agricultural industry's competitiveness, which can provide theoretical references for increasing agricultural efficiency and farmers' income, fostering social stability, and inspiring high-quality industrial development.

2 Strategic vision for the agricultural industry's competitiveness at the new development stage

2.1 Necessity of reconstructing the agricultural industry's competitiveness

Competitiveness of the agricultural industry is essentially a relative concept. Its implications have been gradually extended and deepened over time. Traditional implications are either focused on the competitiveness of agricultural products [2], the competitiveness of the industry itself [2], or production costs [3]. Regarding the theoretical paradigm and analytical logic, studies on the traditional agricultural industry's competitiveness are mainly based on the complete market hypothesis within the theory of neoclassical economics, and adopt the analytical framework of factor endowment–comparative advantage–product competitiveness. These studies use the international market share of each country's product exports as the main evaluation criterion and advocate for the adoption of low-cost and differentiation strategies. However, due to China's special national conditions regarding agriculture, especially the multiple risks faced by agricultural trade, this traditional thinking of competitiveness has some problems. We need to urgently reshape the implications of the agricultural industry's competitiveness and expand and reconstruct it in the following aspects.

First, traditional implications should be reshaped, considering the current needs and environmental challenges. Today's world has undergone complex changes; furthermore, China has entered the stage of high-quality development and transformation of major social contradictions. Therefore, agriculture, as an industry with high natural dependence, weak output continuity, short product storage periods, and low demand controllability, is expected to face diverse risks and severe challenges. Therefore, we must thoroughly understand the new features, requirements, and contradictions brought about by changes in the development stage, environment, and conditions. Further, we must re-examine the way of using international and domestic resources and markets, and the logic of competing with low costs and differentiation. These approaches are prerequisites for constructing the concept of the agricultural industry competitiveness in the new stage.

Second, the theoretical premise of the agricultural industry's competitiveness should reflect its characteristics. The traditional theoretical paradigm follows the general industrial competitiveness theory, which mainly applies to the manufacturing sector. However, it ignores the significant differences between the agricultural and manufacturing sectors regarding market premise, market demand, resource allocation, production process, and product realization. Consequently, the theoretical premises and industrial reality diverge. Rather, the theoretical premise needs to be based on geographical and industrial heterogeneities and incomplete markets, subject to the import and export policies of various countries [4].

Third, the core foundation of industry competitiveness should be based on the concept of industrial security. Security assurance is a core feature of agriculture that is distinct from the manufacturing sector. Competitiveness and security of the agricultural industry are complementary and mutually reinforcing. An important premise and basis for the agricultural industry's implications of competitiveness is to withstand the risks and uncertainties of changes in the international trade environment and maintain stable domestic market supplies of major agricultural products and

sustainable livelihoods for farmers in China. With a large population and a majority of smallholder farmers, China must combine national industrial security with the agricultural industry's competitiveness, which should be built based on a new security perspective to achieve secure supplies, activate dynamic growth drivers, compete in actual situations, and mitigate risks.

Fourth, competition strategies should integrate returns and risks. China must strategically consider the profitability and risks of trade from the perspective of economic and political costs. Moreover, the international division of labor and domestic industrial integrity of supply should be considered from the perspective of comparative advantage and supply chains, respectively. Regarding the agricultural industry's competitive strategy in the new stage, the primary step is not to improve competitiveness, but to improve defense capability, not to consider profitability in a certain period or stage, but the long-term sustainability of its own capacity building, and not to pursue profit maximization, but to ensure risk minimization and security maximization [1].

2.2 Implications of competitiveness in the new stage

Considering the strategic needs and environmental changes in the new stage, the agricultural industry's characteristics and security, and the overall consideration of returns and risks, we suggest that the industry's competitiveness in the new stage refers to its ability to: (1) continuously and steadily meet the domestic demand for agricultural products for sustainable economic and social development, (2) effectively respond to various types of domestic and international risk shocks, and (3) resist damage or threats from unfavorable factors to maintain a certain level of market competitiveness and industrial control under an open economy. Specifically, it includes four aspects, which are outlined below.

First, security and diversification are the bases for the agricultural industry's competitiveness in the new development stage. The industry should guarantee the security of the required amount of food and other food supplies and meet the growing needs of residents for diversification, high quality, and nutritional security. Simultaneously, the security of farmers' livelihoods and rural social stability must be ensured.

Second, greenness and efficiency are the red lines for this competitiveness. Agricultural industry development cannot be advanced at the expense of the environment. However, ecological security is not necessarily cemented at the cost of agricultural production efficiency. New paths should be explored to achieve economical and intensive resource recycling, green and efficient output, and sustainable development of the ecological environment.

Third, core control is the source of competitiveness in the agricultural industry in the new stage. We need to strengthen and improve the industry's ability to prevent, control, and resist external risks, and have sufficient control over core technologies, capital, channels, and brands. Through this, the industry's independence, supply of agricultural products, and stability of economic and social development are protected from international market fluctuations and the impact of foreign competition.

Fourth, independent competition is the embodiment of the agricultural industry's competitiveness in the new stage. China can utilize domestic and international resources and markets more effectively with a "dual circulation" development model, where the domestic economic cycle plays a leading role, while the international economic cycle serves as an extension and supplement. For example, some agricultural products with comparative advantages and regional characteristics can take the initiative in international trade competition and gain corresponding market value.

2.3 Core elements of the agricultural industry's competitiveness in the new stage

2.3.1. Security assurance

Security assurance refers to the ability to ensure an effective, sufficient, and sustainable supply of food and major agricultural products at reasonable economic, political, and ecological costs in order to meet domestic consumption, strategic reserves, and resource and environmental demands. As a prerequisite and basis for the agricultural industry's competitiveness in the new stage, security assurance is the primary requirement for agriculture to maintain national security objectives and the most fundamental characteristic that distinguishes agriculture from other industries in terms of competitiveness (Fig. 1). Security assurance manifests itself in three aspects, the first of which is the security assurance of food quantity (or quantity security) and quality. The quantity security of the supply of major agricultural products, such as the absolute security of meals, basic self-sufficiency of grains, and the guarantee of live pigs, must be ensured. In terms of the quality of food supply, more attention should be paid to high quality, safety, nutrition, and health to meet the increasingly diverse consumption needs of residents in the new stage. Second, social security

assurance related to farmers' livelihoods is required. In China, agriculture provides many jobs and plays an important role as a social stabilizer. Therefore, the important bottom lines for the agricultural industry's competitiveness in the new stage are to ensure sustainable livelihoods and income growth for farmers and to maintain the stability of rural social order. Third, the security assurance of agricultural resources and the environment is important. Ecological security is a rigid constraint and a decisive factor that dynamically reflects the long-term development and potential competitiveness of the agricultural industry. The core of building long-term sustainability capacity is to promote high-quality and green development of agriculture.

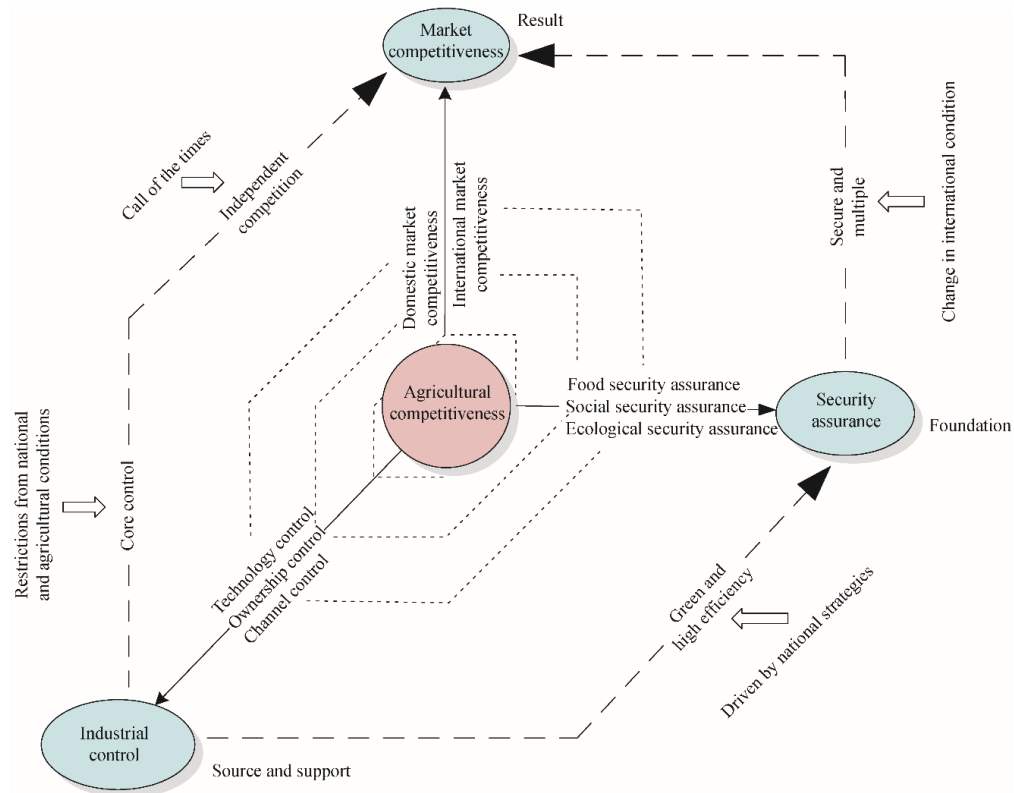


Fig.1. Three-dimensional conceptual model for agricultural competitiveness in the new stage.

2.3.2 Industrial control

Industrial control in agriculture means that a country has sufficient control or dominance over the core technology, capital, channels, and brands of its agricultural industry. With sufficient industrial control, the agricultural industry's independence will not be compromised by dependence on the agricultural products of other countries in open competition, and neither the supply of agricultural products nor the sustainable economic and social development will be affected by price fluctuations in international agricultural markets and the impact of foreign competition. As the source and support of the agricultural industry's competitiveness in the new stage, industrial control refers to the ability to effectively resist and counterbalance adverse external factors and risk shocks (Fig. 1). Industrial control is reflected in three ways. First, in terms of technological control, key core technologies, such as new varieties, equipment, and materials for important industries, should be independently developed. It is also necessary to possess capabilities for independently conducting research and development (R&D), design, and manufacturing of strategic products. The scope and number of international standards for advantageous and characteristic agricultural products should be expanded by giving prominence to the Chinese situation. Second, ownership control manifests itself mainly in the ownership or exclusive possession of valuable core assets, as well as in domestic enterprises' control of international companies via mergers and acquisitions to effectively control the entire internal control chains and the host country's agricultural industry groups. Third, channel control refers to the appropriate deployment of key links in the supply chain, such as acquisition, warehousing, and distribution, for agricultural products to achieve the ability to control the entire industry chain. Brand control is an important aspect of channel control.

2.3.3 Market competitiveness

Market competitiveness refers to the ability to provide domestic and international markets with more agricultural products that satisfy the demands of consumers (or buyers), occupy and use more productive resources than other countries, and continuously generate profits. It is the result of external competition in the domestic agricultural industry compared with the competitive agents of other countries in the open market and is reflected in two ways. First, in terms of international market competitiveness, China's agricultural industry relies on superior production capacity to obtain foreign exchange earnings and enhance export profits. Furthermore, overseas markets are used to compensate for the production capacity of resource-intensive varieties that do not have good resource endowments. Second, the advantages of China's large-scale market and potential domestic demand should be fully leveraged in terms of domestic market competitiveness. By meeting domestic demand as the starting point and ultimate goal of market competition, China needs to build a competitive agricultural industry system in which the domestic economic cycle plays a leading role. China must also build a food supply system that supports the health, nutrition, and high-quality needs of Chinese residents and retain the domestic market through differentiation, specialization, and brand development. Additionally, efforts should be made to develop the multifunctional value of agriculture; develop functional industries that are environmentally friendly; and integrate primary, secondary, and tertiary industries.

3 Current status and problems facing the competitiveness of China's agricultural industry

3.1 Construction of an evaluation index system

Most studies have only evaluated the competitiveness of China's agricultural industry from an international perspective. However, in this study, we constructed an index system for evaluating the competitiveness of China's agricultural industry based on its implications in the new stage. The primary indices include security assurance, industrial control, and market competitiveness. The secondary indices are mainly set according to the specific dimensions of the core composition of the agricultural industry's competitiveness in the new stage. The selection of tertiary indexes takes the authority of these indexes, the availability of index data, and prior literature into account to ensure the scientific rigor and operability of the selected indexes. The entropy method has been used to measure the index weights since 2000. Owing to space limitations, references for the selection of tertiary indexes and the measurement process of the entropy method are not reported here. The evaluation indices for the agricultural industry's competitiveness and their weights are presented in [Table 1](#).

Table 1. Evaluation indexes for the agricultural industry's competitiveness and their weights^{a, b}.

Primary index (weight)	Secondary index (weight)	Tertiary index (weight)	Measurement method and units	
Security assurance (0.393)	Food security (0.140)	Per capita food holdings (0.020)	Total agricultural production/Total population (kg/person)	
		Food self-sufficiency rate (0.038)	Production/(Production + Imports - Exports - Stocks)	
		Food production volatility index (0.022)	(Actual food yield in the current period - Trend food yield)/Trend food yield	
		Protein supply (0.029)	(kcal/person/day)	
		Energy supply (0.030)	(g/person/day)	
	Social security (0.124)	Rural labor structure (0.027)	Per capita net income of agricultural population (0.040)	Price index deflator using CPI ^c , with 1978 as the base period (CNY/person)
			Engel coefficient of rural residents (0.023)	—
			Income gap between urban and rural residents (0.035)	Per capita disposable income of urban residents/Per capita net income of rural residents
			Per capita area of cultivated land (0.028)	(hm ² /person)
	Ecological security (0.130)	Amount of chemical fertilizers applied per unit area (0.046)	Amount of chemical fertilizers applied per unit area (0.046)	Amount of agricultural chemical fertilizers applied/Planting area of agricultural products (kg/hm ²)
Water consumption per unit (0.015)			Agricultural water consumption/Agricultural production (m ³ /t)	
Consumption of land resources per unit (0.016)			Agricultural land use/Agricultural production (hm ² /t)	

Promoting the Competitiveness of China's Agricultural Industry in the New Development Stage: From an Industry Security Perspective

		Pesticide usage per unit output (0.026)	Pesticide usage/Agricultural production (kg/t)
Industrial control (0.234)	Technological control (0.048)	Technology innovation index for seed industries (0.026)	(Number of authorised new varieties of agricultural plants/Number of applications for new varieties of agricultural plants)/(Sown area of grain crops/Crop sown area)
		Technology dependency (0.012)	Contract value of agricultural technology import/Total value of agricultural technology import and export contracts
		Market share of foreign capital in chemical fertilizers (0.011)	Import volume of chemical fertilisers/Total use of chemical fertilisers in the current period
	Corporate control (0.064)	Openness of agricultural enterprises (0.005)	Number of foreign-funded enterprises/Number of agricultural enterprises
		Foreign equity control ratio (0.053)	Amount of equity investment by foreign investors in agricultural enterprises/Total registered capital of agricultural enterprises
		Foreign capital utilisation by enterprises (0.006)	Registered foreign capital of foreign-funded agricultural enterprises/Total registered capital of foreign-funded agricultural enterprises
Industrial chain control (0.121)	Capital dependence (0.019)	Proportion of agricultural FDI ^d in the total national FDI/Proportion of gross agricultural production in GDP	
	Foreign capital control rate in processing industry (0.037)	Gross product of foreign-funded agro-processing industry in China/Gross product of agro-processing industry in China	
	Logistics performance index (0.066)	—	
Market competitiveness (0.373)	Trade competitiveness (0.242)	International market share (0.031)	Total domestic agricultural exports/Global agricultural exports
		Revealed competitive advantage index (0.033)	((Export value of domestic agricultural products/Total export value of all domestic products)/(Total export value of agricultural products in the world/Total export value of all products in the world)) - ((Import value of domestic agricultural products/Import value of all domestic products)/(Total import value of agricultural products in the world/Total import value of all products in the world))
		Revealed comparative advantage index for net exports (0.028)	(Export value of domestic agricultural products/Export value of all domestic products) - (Import value of domestic agricultural products/Import value of all domestic products)
		Trade competitiveness index (0.045)	(Total export value of domestic agricultural products - Total import value of domestic agricultural products)/(Total export value of domestic agricultural products + Total import value of domestic agricultural products)
		Relative performance index for the global agricultural market (0.060)	(Export value of domestic agricultural products/Total export value of agricultural products in the world)/(Total export value of all domestic products/Total export value of all products in the world)
		Intra-industry trade index (0.045)	1 - (Export value of domestic agricultural products - Import value of domestic agricultural products)/(Export value of domestic agricultural products + Import value of domestic agricultural products)
	Product competitiveness (0.132)	Export orientation rate (0.076)	Export volume of agricultural products/Agricultural production
		Domestic-international price ratio (0.014)	—
		Import dependency (0.022)	Total agricultural import value in the current year/Gross domestic agricultural output in the current year
		Export dependency (0.019)	Total agricultural export value in the current year/Gross domestic agricultural output in the current year

Notes: a) Data on indexes are mainly collected from the *China Statistical Yearbook*, *China Rural Statistical Yearbook*, *China Agricultural Statistical Yearbook*, *China Statistical Yearbook on Science and Technology*, *China Basic Statistical Units Yearbook*, *China Agricultural Machinery Industry Yearbook*, *China Water Resources Bulletin*, World Development Indicators database, database of the Food and Agriculture Organization of the United Nations (FAO), World Trade Organization (WTO) database, statistical database of the Organization for Economic Co-operation and Development, Global Data Mapping Analysis Platform (Knoema), and relevant literature.

b) Index weights are rounded to three decimal places.

c) CPI: consumer price index

d) FDI: foreign direct investment

3.2 Competitiveness evaluation

3.2.1 Comprehensive competitive advantage of the agricultural industry is not obvious

Since 2000, the competitiveness of the agricultural industry initially declined and then slowly increased while generally fluctuating (Fig. 2). Competitiveness was the highest at 0.57 in 2000, the lowest at 0.25 in 2008, and then rebounded to 0.48 in 2018. Except for the three years before and after China joined the World Trade Organization (WTO), the overall competitiveness level was lower than 0.5. This result indicates that the competitive advantage of the agricultural industry is not obvious.

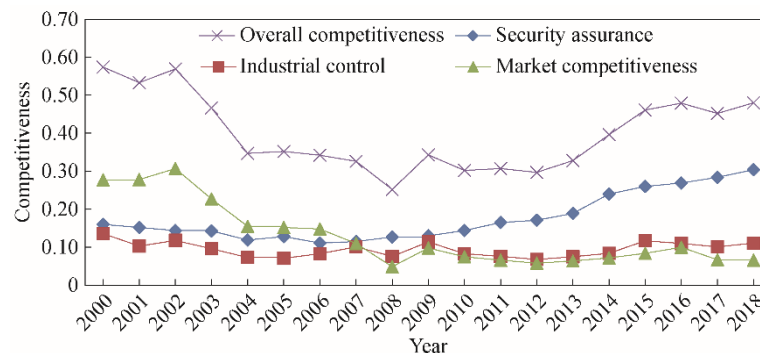


Fig. 2. Changes in dimension-specific competitiveness and overall competitiveness of agricultural industries (2000–2018).

3.2.2 Overall upward trend in security assurance

The agricultural industry remains competitive in terms of assuring domestic food supply and maintaining ecological and social security. In recent years, the agricultural industry's competitiveness has rebounded, mainly due to the continuous growth in security assurance (from 0.28 in 2006 to 0.77 in 2018). On one hand, the government's attention to food self-sufficiency capability and level and the long-term implementation of the food security strategy has ensured a stable level of basic competitiveness [5]. On the other hand, the promotion and implementation of rural revitalization and ecological conservation and green development strategies have effectively ensured the ecological security of the agricultural industry [6] and enabled sustainable improvement in the livelihoods of rural residents [7].

3.2.3 Fluctuating industrial control and its unclear trend of change

The control of the agricultural industry was at a moderate to low level, showing a W-shaped fluctuation. From 2000 to 2009, it fluctuated downwards and then increased. Since 2009, it has fluctuated with a similar trend between 0.3–0.6 and a mean value of 0.405. In the first decade after the WTO accession, China's industrial control over agriculture fluctuated downward, mainly because of the gradual removal of restrictions on the share of foreign-funded enterprises in China and the greater opening of the foreign investment sector [8]. The global financial crisis influenced the apparent fluctuations from 2008 to 2010 [9]. In recent years, industrial control over agriculture has rebounded slightly owing to the government's strong support for the agricultural industry, the increasing rise of large local agribusinesses, the acceleration of scientific and technological innovation, and the transformation of agribusinesses.

3.2.4 Weak and declining overall market competitiveness

Since China's WTO accession, the international market competitiveness of China's agricultural industry has greatly declined from 0.834 in 2002 to its lowest of 0.131 in 2008. In recent years, international competitiveness has steadily fluctuated, but remains weak (below 0.3) overall. The continuing rapid growth of agricultural imports, industrial protection strategies, restrictive import control, and rising production costs of agricultural products due to population and environmental constraints have constrained the relative position of China's agricultural products in international trade [10,11]. In addition, changes in agricultural resource endowments and the structure of the breeding industry, the inversion of internal and external prices, and especially the strong imports of food and oil crops, have led to a decline in the competitiveness of China's primary agricultural products.

3.3 Analysis of competitiveness shortcomings

3.3.1 Traditional production and business models make agricultural production costly and internationally uncompetitive

Small-scale decentralized operations are not conducive to reducing agricultural factor costs. The form of agricultural production organization has long been characterized by small plots, scattered distribution, part-time operation, and limited utilization of agricultural machinery and equipment, all of which inhibit the reduction of factor costs. Consequently, the international competitiveness of some products has almost been lost. According to our data, in China, labor costs accounted for 30%–40% of the total agricultural production cost in 2018, which was four to six times the cost incurred in the United States. Similarly, the labor costs for rice, wheat, corn, and soybeans in China were 3.9, 13.9, 12.1, and 7.8 times those in the United States, respectively. Meanwhile, the land costs for rice, wheat, corn, and soybeans were 1.4, 3.0, 1.3, and 1.6 times those in the United States, respectively. Even when compared to India, the cost of agricultural production in China has no advantage.

Moreover, the Chinese agricultural industry is loosely organized, and the industrial and supply chains are fragmented. Furthermore, transaction costs are high, making it difficult to obtain price advantages. Moreover, the development of the agricultural industry chain is not perfect. Primary processing remains the main processing method for agricultural products, and the comprehensive utilization rate of agricultural products is only approximately 40% versus 90% in developed countries. Finally, the supply and transport chains of agriculture are disconnected, and the socialized agricultural service system is imperfect, resulting in insignificant value-added benefits for agricultural products and large fluctuations in market prices.

3.3.2 Insufficient support for agricultural science and technology, and containments on key technologies

Since the 12th Five-Year Plan period, the average annual growth rate of national agricultural total factor productivity (TFP) declined from 3.77% in 1978–2005 to 2.20% in 2015–2018. This is due to a growth bottleneck in the contribution of technological progress to agricultural TFP. Specifically, support for agricultural science and technology remains inadequate for the sufficient development of the agricultural industry; moreover, the containment of key agricultural technologies is severe. For example, the R&D capability for crop breeding is relatively weak, and a technology innovation chain, including germplasm resources, genetic breeding, variety innovation, and integration of seed cultivation, breeding, and promotion, has not yet been formed. In addition, there is a lack of innovation in major products, as well as in new technologies for the rapid and intelligent cutting-edge diagnosis of important diseases and risk prevention and control technologies. Biological breeding technologies, such as animal molecular design and breeding, are still in the R&D stage.

Smart agricultural technologies have remained limited. The promotion and application of information technologies such as the mobile Internet in modern agriculture is insufficient. Data and information support systems integrating space, aerial, and ground remote sensing for human–machine collaboration, national agricultural and rural data centers, and related application and promotion systems have not been established.

3.3.3 Lack of large domestic agricultural enterprises with international influence and relatively weak control over the industrial chain

Since China joined the WTO, foreign dependence on Chinese agricultural enterprises has continued to decline. However, these enterprises are generally smaller in scale, less concentrated, and less well-managed. They are inferior to large multinational agricultural enterprises in terms of access to information, factor supply, and deep processing. Furthermore, Chinese agricultural enterprises are unable to obtain market opportunities of equal volume because of their weak competitiveness. The participation and control of large foreign multinational agribusinesses, from factor and information technology supplies pre-production to logistics and deep processing post-production, threatens the independent development of domestic enterprises to varying degrees. Moreover, the latter's over-dependence on several links in the foreign industrial chain may even affect domestic food and economic security. For example, large multinational seed enterprises use their technological advantages to seize the market. Further, international food and agriculture giants actively carry out technological R&D and application transformation in high-end biology and other frontier fields. This may threaten technological R&D and brand building for Chinese agriculture and indirectly hinder the technological control of domestic agricultural enterprises.

4 Paths to enhancing competitiveness

4.1 Strengthening the foundation of the agricultural industry's competitiveness on the premise of guaranteeing its security

Industrial security is an important basis and manifestation of industrial competitiveness; protecting industrial security is the greatest breakthrough. Considering international geopolitical instability, rising international trade protectionism, serious environmental disasters, and frequent infectious disease outbreaks, it is important to improve the agricultural industry's ability to withstand risks and safeguard national agricultural security. Crucially, the bottom line of agricultural industrial security should be consolidated. That is, while ensuring the quantity and quality of agricultural products, the sustainable use of agricultural resources and environmental sustainability are vital, taking ecological safety as the red line and adhering to green and ecological orientation. Furthermore, social safety is at the bottom line. The common development of new businesses and smallholder farmers should be considered to maintain the stability of the domestic agricultural market supply and sustainability of farmers' livelihoods. Finally, continuity and stability of the supply chain of imported agricultural products remain important.

4.2 Exploring strategies to enhance the competitiveness of different industries and products under industry- and product-specific policies

Industry- and product-specific policies should remain the basic principles for enhancing competitiveness in the agricultural industry. Different industries and products have different characteristics; hence, the methods of expressing their competitiveness and, consequently, strategies to enhance their competitiveness vary. Therefore, these policies should be implemented based on the importance, functional characteristics, urgency of industrial development, and actual needs of agricultural structural adjustment. First, for the main food industries (e.g., rice, wheat, corn, and soybeans) related to food security, the food supply should be stabilized. The strategy should focus on self-sufficiency based on domestic grain production, guaranteed food production capacity, moderate imports, and technological support to ensure the basic self-sufficiency of grains and absolute food security. Second, for industries of national importance (e.g., cotton, oilseed rape, sugar, and pigs), China should deepen the agricultural division of labor and extend the agricultural value chain to better fulfil the needs of domestic consumption upgrading. Third, for major industries with special features and certain advantages (e.g., citrus, apples, and tea), the country should seek trade opportunities and encourage globalization to gain higher international market share. Finally, for net imported agricultural products and key sensitive agricultural products (e.g., meat, dairy, and aquatic products), controlling risks and moderate protection are needed to improve competitiveness and prevent the impact of further opening up and massive imports.

4.3 Building a long-term mechanism for enhancing the agricultural industry's competitiveness with quality and efficiency improvement as the core

High-quality development, with quality and efficiency improvement at the core, can help China overcome the dilemma of the agricultural industry's development and offer a fundamental way to enhance its market competitiveness. Agricultural development in China faces several quality problems. For example, there are many varieties of agricultural products, but their quality is not excellent; agricultural brands are miscellaneous but not outstanding; and the industry is large but not strong. Consequently, the agricultural industry is unable to compete. High-quality agricultural product development is recommended to eliminate the past model of competition via large quantities and low prices to fundamentally solve the problem of weak agricultural competitiveness. China should promote the high quality of the production system, operation system, basic configuration, and sustainable agricultural development as the new starting point; adhere to the transformation from quantity to quality while forming new agricultural businesses; and promote agricultural industry innovation. Institutionalizing the monitoring of important inputs, standardizing production and management, long-term agricultural branding, the flexibility of demand-driven production, and popularizing third-party supervision and inspection should also be facilitated synthetically to truly enhance the agricultural industry's competitiveness.

4.4 Continuously unleashing the agricultural industry's competitive potential by building differentiated competitiveness

Differentiated competitiveness is an important path and future direction for improving competitiveness in the agricultural industry. Product-based competition, which relies on resource endowment and technological advantages, is constrained by China's realities, such as agricultural endowment conditions and the smallholder farmer economy. Therefore, product-based competition has limited room for further improvement; furthermore, it is vulnerable to changing the competitiveness of agricultural products in other countries. Therefore, China can avoid traditional competition, be unique, and enhance the competitiveness of its agricultural industry through differentiation. Differentiated competition reorients agricultural development toward product diversification, personalization, specialization, and branding to meet the needs of the future middle class to upgrade their consumption structure. Finally, primary, secondary, and tertiary industries should be integrated based on functional agricultural development and value chain expansion to better realize the multi-functionality of agriculture, match diversified consumer demands, and reconstruct agriculture's competitive advantages.

4.5 Providing lasting impetus for the agricultural industry's competitiveness through technological innovation and institutional mechanism reforms

Technological innovation and institutional mechanism reforms can help to continuously improve the agricultural industry's competitiveness and control. With the acceleration of industrialization and urbanization, agricultural production costs, including land and labor, have continued to rise, and the comparative advantages of major agricultural products have gradually weakened or vanished; the weakness of the agricultural industry's international competitiveness has been further highlighted. Therefore, first, we must urgently break the traditional ceiling of competitiveness gained using low costs and prices and promote sustainable improvements. To this end, scientific and technological support for the agricultural industry must be enhanced. Support should be provided for cutting-edge scientific and technological innovation, R&D of core technologies, and integration, research, and promotion of specific technologies based on the importance of industrial development and the urgency of enhancing competitiveness. This support should center on technological requirements in terms of cost saving and efficiency enhancement, quality safety, and ecological safety. Efforts are also needed to quickly develop a solid technological guaranteed capacity for steady food security, product quality and quality safety, and significant improvement in brand efficiency and comparative advantage, as well as promote technology models that conform to the improved competitiveness of various industries.

Second, China should realize the dividends of institutional reforms, deepen and improve the rural property rights system, accelerate the agricultural business system and mechanism innovations, expand and improve social service organizations and models for production, and innovate the interest linkage and distribution mechanisms between smallholder farmers and new businesses. Furthermore, China should promote new agricultural businesses and services' modernization, quickly establish a new agricultural support and protection policy system, deepen reforms regarding collection and storage systems, and establish the price formation mechanism regarding agricultural products.

4.6 Leveraging the agricultural import diversification strategy to improve the agricultural sector's capacity to control open risks

Agricultural import diversification strategy is an important means of ensuring China's food security and a reasonable manifestation of active access to global resources. Since 2011, China has been the world's largest importer of agricultural products of soybeans, edible vegetable oils, cotton, and sugar. However, highly concentrated sources, traders, and trade channels for imported products increase supply chain risks. China should ensure the sustainability of import supply chains to reduce risks, while improving the quality, efficiency, and competitiveness of domestic agricultural production. This strategy should actively seek to diversify import sources, channels, and varieties by clearly prioritizing import varieties and source countries, maintaining a gradual and slow increase in imports, and avoiding a short-term rise/decline in import quantities. Importantly, China should appropriately handle the relationship between the increase in imports and both domestic agricultural development and the realization of the production potential of exporting countries to build a sustainable, stable, and safe international agricultural import supply network. Thus, China can establish sustainable and stable strategic agricultural trade partnerships that avoid excessive and rapid shocks to domestic agricultural producers and international agricultural markets.

5 Recommendations for improving the agricultural industry's competitiveness in the new development stage

5.1 Ensuring a stable supply of important agricultural products

First, precise measures can be taken to accelerate the construction of the functional zones for grain production and protection zones to produce key agricultural products and lay a firm foundation for stable production and supply. Further, efforts can be made to improve the professional development and competitiveness of the two zones to facilitate the mutual integration of production, processing, logistics, R&D, demonstration, and services and boost the development of the entire industrial chain. Science and technology can serve as key supports for improving resource utilization and labor productivity.

Second, a regional coordination mechanism should be established to strengthen the capacity for linkage and protection. To stabilize production and marketing co-operation relationships, China should explore mechanisms for the joint construction of functional zones to produce grain and key agricultural products, and develop production and marketing models, such as purchase and sale trade, operations, and collection, storage, and sale, on behalf of the producers via joint ventures, co-operation, and equity participation. Policy and funding incentives, and operator benefit compensation should be maintained at appropriate levels for major cities and counties that produce important agricultural products. China should also explore third-party assessment mechanisms for the main marketing areas to effectively shoulder the responsibility of food security.

Third, logistics infrastructure should be developed further to establish an efficient agricultural supply chain system. For agricultural products with special advantages, the shortcomings and weak links of this system should focus on improving the warehousing and logistics. Furthermore, China should encourage the construction and renovation of facilities with post-production commercialization and processing functions, such as distribution centers, cold storage, and warehouses closer to the origin. Other important needs include building an information management platform for the supply chain of key agricultural products, accelerating the construction of an e-commerce platform for distinctive agricultural products, and improving information feedback and regulation mechanisms within the supply chain.

5.2 Expanding the agricultural industry's value-added offerings

First, the agricultural product processing industry should be expanded and strengthened. On one hand, efforts can include expanding primary processing, enhancing the deep processing of agricultural products, and promoting comprehensive utilization and processing to realize multiple value addition. On the other hand, the layouts of processing and production areas, sales areas, and parks for agricultural products can be optimized in a coordinated manner so that large agricultural enterprises can shift their agricultural processing to production areas. Consequently, agricultural processing areas can be connected to sales areas and agglomerate into agricultural processing parks.

Second, long-term development of agricultural branding should be encouraged. China should establish a unified and orderly, multi-layered linked agricultural branding system and the rules and mechanisms for agricultural brand certification, promotion, identification, extension, evaluation, and release to form a full brand management system. Furthermore, China should create an agricultural brand standard system, establish an agricultural brand catalogue system, promote regional brands, and moderately prioritize the construction of agricultural brands with high market potential and competitive export advantages.

Third, new industries and new forms of Agriculture Plus should be developed. The multiple functions of agriculture should be extended by vigorously developing leisure agriculture, rural tourism, forest recreation, and other industries. Furthermore, several creative agricultural products with high cultural tastes, intellectualization, profitability, and added value should be cultivated. Moreover, new forms of business and models of Internet + Agriculture models should be innovated. For example, e-commerce platforms for agricultural products should be strengthened to link online and offline marketing channels for agricultural products, thereby forming a diversified, multilevel, and full network marketing system.

5.3 Promoting the modernization of new business and service subjects in agriculture

First, we recommend advancing the modernization of new agricultural businesses. Trustee service organizations for agricultural production should be developed to increase smallholder farmers' production efficiency and effectiveness. Efforts are needed to improve the policy ecosystem for family farm development, encourage all regions to organize

family farm associations and alliances, and improve family farms' management and demonstration capacity. Furthermore, China should foster the standardized development of cooperatives and support them in expanding their scope of services and enhancing their service capacity.

Second, the high-quality development of agricultural production services should be promoted. Specifically, professional and comprehensive service subjects' development for agricultural production should be accelerated while encouraging new service subjects to form service consortia and alliances. Furthermore, the scope of agricultural production services should be extended throughout the pre-production, production, and post-production stages. In addition, information service platforms and integrated service systems should be established to improve service quality. Finally, more financial and credit support should be offered to agricultural production service subjects and the implementation of land-use policies for facilities should be promoted.

5.4 Strengthening the discourse on international agricultural co-operation

First, China should increase the number of agricultural entities for foreign co-operation. These entities will be responsible for managing the basic international agricultural data, market development, policy formulation, and guidance of multinational agricultural enterprises. The country should also focus on key industries and fields, and cultivate three to five large multinational agricultural enterprises that are comparable to the 'ABCD' world food giants (i.e., ADM, Bunge, Cargill, and Louis Dreyfus). Further, chambers of commerce, associations, and other supporting bodies should be supported and strengthened to create a favorable environment for enterprises to engage in agricultural foreign direct investment (FDI).

Second, key links in the supply chain should be controlled domestically. Strategic logistics channels should be strengthened, especially logistics systems such as warehousing, ports, and shipping in Belt and Road countries. Further, agricultural enterprises should be encouraged to strengthen overseas co-operation and expand their quality based on platforms such as overseas agricultural co-operation demonstration zones and industrial alliances, which can help control the entire agricultural industry chain.

Third, the layout of foreign trade and economic co-operation in agriculture should be expanded. China should deepen the economic and trade layout of key regions, such as those along the Belt and Road, to diversify its agricultural import sources. Additionally, China should construct globalized spot and futures markets for agricultural products to enhance international pricing power.

Fourth, support initiatives for agricultural globalization should be optimized. China should innovate and improve support policies for agricultural globalization, encourage long-term and balanced foreign investments, and establish a special fund for leading enterprises. China should also improve global agricultural co-operation and development data platforms, actively participate in multilateral co-operation frameworks, and strengthen coordination and consultation on data sharing, market monitoring, and economic and trade policies [12].

5.5 Prioritizing the development of agricultural science and technology

First, a stable growth mechanism for investments in agricultural science and technology should be established. China should establish a mechanism that links agricultural science and technology investment to fiscal revenue growth through legislation; then, investments in agricultural science and technology R&D can receive sustained and stable support. The structure of agricultural funding should be optimized by increasing the proportion of non-competitive funding. Furthermore, agricultural enterprises can be urged to invest more in R&D through tax incentives and post-subsidies. Finally, a "one cent" fund for agricultural science and technology innovation should be established. Under this fund, one cent is collected at each sale of 1/2 kilogram of grain, vegetables, or meat to provide targeted support for agricultural science and technology innovation.

Second, the layout of agricultural science and technology innovation should be optimized, with the cultivation of industrial security and core competitiveness at the forefront. To make breakthroughs in core technologies subject to constraints by other countries, China can focus on strengthening innovative research in basic frontier areas, such as analyzing genetic mechanisms of important traits in agricultural organisms, agricultural biosynthesis technologies and applications, stem cell utilization in farm animals, agricultural equipment sensing and control, and agricultural robots, which will enable breakthroughs in core key technologies subject to constraints by other countries.

Third, the agricultural science and technology system reforms should be accelerated. China should improve the corporate governance mechanism of modern research institutions and expand their autonomy in establishing research

projects; managing personnel, funds, and equipment; selecting research directions and technical routes; and international exchanges. China should also establish a classification and evaluation mechanism for agricultural research institutions and technological personnel and highlight the degree of innovation of scientific research results and technological R&D, relevance to industrial needs, and contribution to industrial development. Finally, the basic remuneration and innovation incentives for scientific researchers should be guaranteed and improved.

Compliance with ethics guidelines

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