

# Strategies for China's Agricultural Development Toward 2050

## The Comprehensive Research Team for Research on Agricultural Development Strategy in China by 2050

**Abstract:** In the era of global change, it is essential to analyze the future trend of agricultural development in China and forecast the direction and path of China's agricultural modernization towards 2050 to assist policymaking. In this study, we first investigate agricultural development in China over the past four decades and then analyze the opportunities and challenges that China's agricultural development is facing. Lastly, we forecast future agricultural development in China. Our study shows that China's agriculture has experienced rapid growth over the past four decades; institutional innovation, technological progress, marketization reform, and public investment are the four major driving forces. However, agricultural development in China still encounters many challenges, including a slowdown in productivity growth, degradation of soil and water, and uncertainty of the global supply chain. This implies that, towards 2050, China should adhere to the principles of innovation, green, high efficiency, and sustainability, and accelerate agricultural modernization by efficiently producing more high-valued and green products to maintain food security and self-sustained grain supply. To achieve this long-term goal, the government should deploy seven major strategies focusing on biological technology, seedling innovation and among others, and initiate a series of agriculture-supportive policies.

**Keywords:** agricultural development; 2050; food security; high-valued agriculture; modern breeding technology based on bioengineering techniques

## 1 Introduction

To realize China's two-stage goals—socialist modernization by 2035 and a new type of industrialization, informationization, urbanization, and agricultural modernization by 2050 (“four modernizations”)—China should uphold the development philosophy of innovation, coordination, green, openness, and sharing, and advance the four modernizations synchronously. In due course, the country faces a series of challenges in ensuring national food security, ecological security, sustainable development, and intensified market competition, among others, in terms of agricultural modernization. These challenges include resource misallocation and differences in technology innovation between urban and rural areas, among others. Therefore, new ideas for future agricultural development in China are required.

Currently, a large variety of research has been conducted to analyze future trend of agricultural development in China; however, most of these studies are limited to trend prediction [1,2], with insufficient macro research and their impact analyses. The research is dominated by future food security issues, with no discussion on the overall situation of agricultural development [3,4]. It only forecasts the supply and demand of main agricultural products in the short term (to 2030) [5,6], without reflecting long-term changes toward 2050. Given this, this study has, based on the past experience in China's agricultural development as well as opportunities and challenges ahead, pursued to clarify the phased development goals for 2035 and 2050, and carried out forward-looking and strategic research focusing on modernization of cropping and livestock industries, production mode and industrial value chain, resources, environment and sustainable development, and other key directions, in a bid to provide a basic reference for research

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and macroscopic decision-making in the related field.

## 2 China's agricultural development: achievements and evolution across regions

### 2.1 Agricultural development: reforms and achievements

The past four decades have seen rapid growth in China's agriculture. The country uses 5% of the world's freshwater resources and 8% of the world's arable land to provide 95% of the food for 18% of the world's population. Between 1978 and 2020, the agricultural GDP grew at an average rate of 4.5% per year. While the outputs of rice, wheat, and corn increased annually at average rates of 1.1%, 2.3%, and 3.9%, respectively, the growth rates of cotton (4%), oil (6.1%), sugar (5.2%), and fruit (11.1%) output, as well as vegetable cropping areas (5.1%) were more pronounced, and the outputs of meat and aquatic products grew annually at average rates of 5.7% and 7%, respectively [7]. Agricultural growth and structural optimization have not only improved food security for both urban and rural residents but also met the demands for food consumption and nutrition improvement. Agricultural development has also contributed to non-agricultural employment growth in rural areas, promoting rural economic transformation and improving farmers' income [8,9].

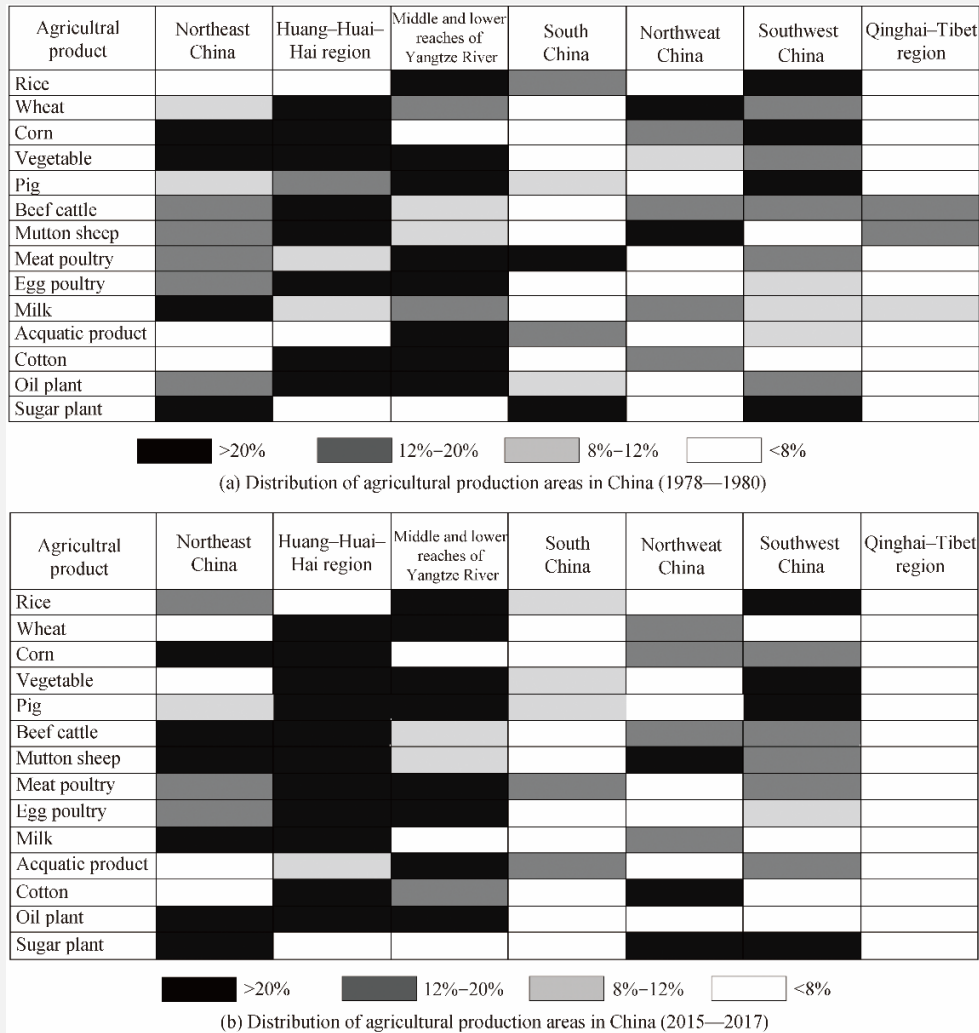
Advances in science and technology, institutional innovation, market reform, and public agricultural investment are the four main driving forces of China's agricultural growth. These forces are selected sequentially to achieve phased development goals, which are also essential for the successful transformation of food systems. The implementation of the household responsibility system marked the start of the 40-year reform process in rural areas, which helped improve land and labor productivity. At the middle and later stages of the reform, many new rural institutional innovations have played a crucial role in improving agricultural productivity and increasing farmers' income [10]. The reform of the agricultural innovation system has promoted agricultural technology progress and agricultural total factor productivity growth, which has grown annually at an average rate of nearly 3% in the past four decades. More than half of this growth has been driven by technological progress [5,6]. Market reform and opening-up have improved the efficiency of resource allocation, fueled the adjustment of agricultural production structure, and increased farmers' income [11]. As investment in rural infrastructure construction has increased steadily, the conditions for agricultural production have been significantly improved and the foundation for agricultural production has been cemented [12,13]. Although agricultural development and reform in China have experienced a few detours in particular periods, the result is remarkable [14].

### 2.2 Regional layout evolution of agriculture and its determinants

Over the past 40 years, the cropping and livestock production, the way of agricultural production and management patterns have changed along with the changes in regional resource endowment, comprehensive advantages, and social and economic conditions (Fig. 1). Overall, China's agricultural production has gradually shifted toward the north and stabilized. While maintaining an increase in grain production, the geographical distribution of agriculture has transformed from the "shipment of grain from the south to the north" mode to the "shipment of grain from the north to the south". Cash crops are growing rapidly, and the production layout is subject to remarkable changes. Regional comparative advantages of vegetables gradually emerge in neighbors of large urban areas; after the rapid growth of livestock products, regional production layout tends to be stable, but subject to recent fluctuations. The shift of agricultural production toward North China made the sustainable development of agriculture in the north of Huaihe River a critical issue as the Huang-Huai-Hai Region, short of water, has become the main production area for more than 10 kinds of main agricultural products. Regarding the impact of factor endowment on the regional distribution of agricultural production, a marked trend has emerged; that is, land-intensive agricultural products are moving northward, while capital-intensive agricultural products are moving to developed regions. For example, the production of land-intensive agricultural products such as grain and cotton is gradually moving to the north. Limited by capital investment and infrastructure construction, the production of vegetables, aquaculture, and other high-value agricultural products is gradually moving in with the improvement of infrastructure in southern China, especially in developed coastal areas.

The evolution of the regional distribution of agricultural production depends mainly on five factors: (1) Regional comparative advantages are the main factor leading to changes in the regional distribution of agricultural production; (2) although national water conservancy developments and policy interventions boost agricultural production in North China, the water shortage has started to restrict the expansion of agricultural production distribution in the north; (3) technological progress and improved transportation conditions have helped optimize the regional

distribution of agricultural production; (4) social and economic factors such as population and income growth have driven the expansion of agricultural production, and then affected the distribution of agricultural production; (5) and with openness to the outside world, the pressure of water and soil resources in China has been alleviated and the regional distribution of local agricultural production has been optimized.



**Fig. 1.** Evolution of agricultural production across regions in China (1978–2017).

Source: *China Statistical Yearbook*.

### 3 Opportunities and challenges facing future agricultural development in China

#### 3.1 Opportunities for future agricultural development

Implementing rural revitalization has provided policy priorities for agricultural and rural development. To satisfy the general requirements of “thriving business, ecology and livability, rural civilization, effective governance, and life in plenty,” numerous plans and policies have been successively developed to facilitate rural revitalization. For example, the *Strategic Plan for Rural Revitalization (2018–2022)* proposed guidelines and specific requirements for implementing a rural revitalization strategy and made overall arrangements for agricultural and rural development at the present stage.

Thanks to innovation in agricultural technology, especially the application and re-innovation of digital, genetic, and equipment, and cross-border technologies in agriculture, agricultural modernization will be expedited. With the advent of the 4th Industrial Revolution, technological progress will lead agriculture into a modern agriculture stage featuring sustainable development; emerging technologies related to agriculture, such as Internet Plus, big data, and robots, will also be applied gradually. Relying on computers, network communications, genetic engineering, and other technologies, the 4th Industrial Revolution renders all-round and profound changes in global agriculture through revolutionizing agricultural and non-agricultural technologies. It will completely reverse the pattern of

global agricultural production and trade and empower the development of modern intelligent agriculture.

Changes in the international market environment and China's international status also provide great opportunities for agricultural development. In the past 20 years, China's international status has been constantly lifted, creating favorable conditions for supplementing domestic demand through agricultural trade in the future. Today, China is in need of importing a large number of feed and oil products to relieve the pressure on domestic agricultural production due to constrained supplies of water and soil resources. For example, in 2020, soybean imports exceeded  $1.2 \times 10^8$  t (Fig. 2); as personal income continues to rise, a firm foundation will be laid for food security through agricultural trade [15]. In recent years, through the Belt and Road Initiative, China has developed good trade and investment relations with countries in Asia, Eastern Europe, Africa, South America, and other regions. This provides a foundation for these countries to conduct an international division of labor with China based on comparative advantages and thus creates favorable conditions for China to ensure domestic food security by utilizing international arable land and irrigation water resources in the international market in the future.

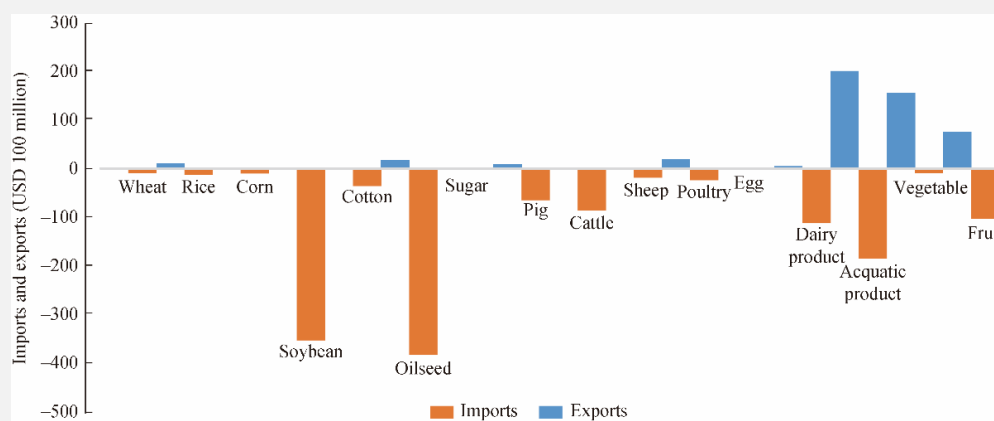


Fig. 2. China's imports and exports of major agricultural commodities in 2020.

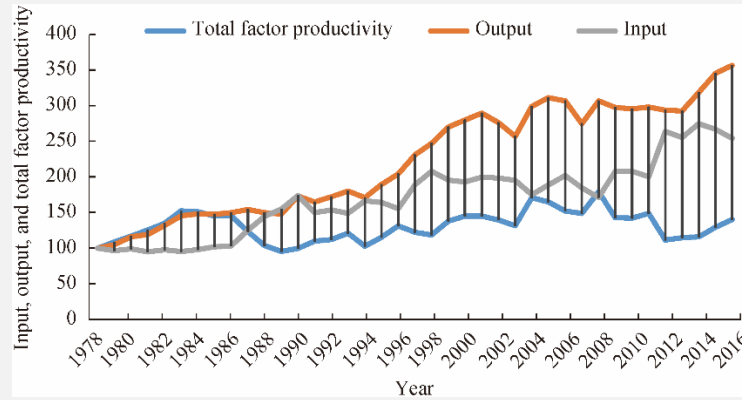
Source: Ministry of Agriculture and Rural Affairs of the People's Republic of China.

### 3.2 Challenges for future agricultural development

Owing to factors such as meeting the growing demand for food and the challenge of declining comparative advantages of main agricultural commodities, the demand for livestock products and feed grains (corn and soybean) is increasing. The limited supply of labor, water, and soil resources also makes it difficult for the country to reverse the rising trend of agricultural production costs. In recent years, growing food demands have posed challenges to food security in China [16]. There are signs that the total quantity and structure of food supply and demand are not easy to be balanced. For example, China's total food self-sufficiency rate dropped from 100% before 2008 to approximately 95% by 2020. Such a decline is expected to continue over the next decade. Among the self-sufficiency rates of all kinds of food, the self-sufficiency rate of grain has reached 98% by 2020 and is expected to fall to 88% by 2030.

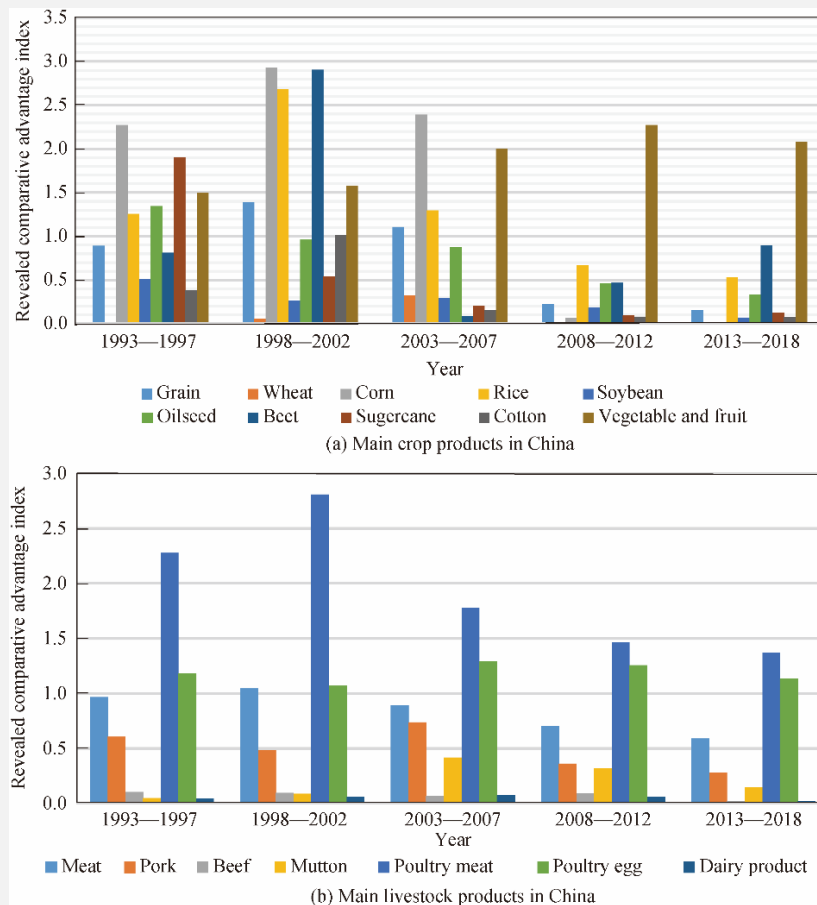
Relevant systems and mechanisms are required to tackle the challenges in the course of agricultural technology innovation and development. Currently, public research and development (R&D) institutions perform mixed functions of basic research and applied research, which negatively affects enterprises to become the main body of technological innovation. The lack of incentive mechanisms erodes researchers' innovation capacity. Specifically, the inaccurate orientation of agricultural scientific research reform makes it difficult to deepen the reform of the agricultural technology systems; public institutions monopolize almost all directions of agricultural research, restricting the enthusiasm of enterprises to engage in agricultural R&D; and the market competitiveness of innovative technologies of government-led agricultural R&D systems remains low.

Labor productivity in agriculture has long been lower than that in industrial and service sectors, and agricultural total factor productivity is growing at a lower speed with increasing cross-regional disparity, which reduces agricultural vitality (Fig. 3). The scale economy of production and degree of mechanization popularization are still limited by the current method of agricultural production. Factors such as an insufficient extension of agricultural industry chains, unreasonable cross-link allocation of value-added agricultural products, and factor-market distortion result in the misallocation of land and labor resources, seriously restrict the potential to improve agricultural labor productivity in the future.



**Fig. 3.** Input, output, and total factor productivity index of agriculture in China (1978–2016) (1978=100).

Agricultural policy support systems dominated by grain, cotton, oil, and sugar are unable to support the development of high-value and sustainable agriculture in the future. Restricted by trade agreements of the World Trade Organization and other international agencies, the scope for the implementation of some subsidies is unsustainable. Underpinned by market-oriented reforms, the agricultural product market has developed rapidly in China. However, many subsidy policies aimed at ensuring domestic food security and farmers' income have led to market distortions and affected the distribution of production factors and their utilization efficiency. For example, in recent years, China has implemented policies for the purchase and sale of agricultural products and price interventions, stimulating short-term domestic production. However, while playing their expected roles, these policies have also distorted the market and affected the allocation of resources, aggravating the imbalance of agricultural production structure. Supported by domestic policies, China's comparative advantages in main agricultural products (except vegetables and fruits) have declined significantly in recent years (Fig. 4).



**Fig. 4.** Changing trend of comparative advantages of main agricultural commodities in China (1993–2018).

Source: Statistics of the Food and Agriculture Organization of the United Nations.

We are facing great challenges in terms of resources and the environment for agricultural production. Currently, 393 million *mu* ( $1 \text{ mu} \approx 666.7 \text{ m}^2$ ) of arable land in China is exposed to pollution to various degrees, with the arable layer becoming generally shallower. These phenomena, including soil compaction and soil erosion in North China, black land degradation in Northeast China, soil consolidation and acidification in East and Central China, heavy metal pollution of land in Southwest and South China, and soil alkalization and soil erosion in Northwest China, have not been effectively alleviated. Amid the increasing shortage of water resources, the proportion of agricultural water use dropped from 88% in 1978 to 60% in 2020, which is likely to continue to decline in the future, and serious overexploitation of groundwater (the amount of underground water for agricultural use in North China exceeded  $6.9 \times 10^{10}$  tons in 2020, an increase of 43% from 1998) and the intensification of extreme climate changes may exacerbate the water crisis.

Adjustments to global supply chains in response to the ongoing COVID-19 pandemic will pose greater uncertainty to the international market for agricultural products in the future. Although it is safe to say that a global food crisis is unlikely, the continuing pandemic will markedly increase market risks for food supply and distribution, and some countries that rely on food imports face great challenges. Meanwhile, as the global economy and financial markets are further impacted by the pandemic, the complexity of financial markets is growing, and potential market fluctuations are bound to gradually shift to crude oil, minerals, grain, and other commodity markets, which may lead to substantial turbulence in the prices of relevant products.

#### 4 Judgment on agricultural development trend toward 2050

By 2050, the level and structure of food consumption are expected to be exposed to significant changes. The demand for grain will continue to decline gradually; the demand for feed and animal products will increase and peak around 2035; and the demand for green, safe, and high-value agricultural products will continue to grow. From now to 2035 is a key transitional period for China's sustainable and modern agricultural development, whereas that from 2035 to 2050 is the period of steady improvement in China's sustainable and modern agricultural development. Innovation in agricultural technology, reform of rural systems, and increase in agricultural input will become the main driving forces of agricultural total factor productivity and for further promoting the development of green, ecological, efficient, and multi-functional high-value agriculture in the medium and long term. Regional adjustments in agriculture will be accelerated and develop sustainably under the constraints of resources and the environment. Despite mounting uncertainties in the international environment in the short term, international trade will still play an important role in regulating the balance between supply and demand for domestic agricultural products.

First, the demand for food rations continues to fall; the demand for fruits, edible oil, sugar, livestock products, aquatic products, and other foods continues to grow, but at a slower pace and stabilizes after peaking around 2035, with the consumption structure to be further improved and safe, healthy, and nutritious food gaining dominance.

Second, rice and wheat are self-sufficient; soybean imports continue to grow; certain comparative advantages are maintained in vegetables, fruits, and aquatic products that are self-sufficient; the comparative advantage of oil and sugar crop production as well as the self-sufficiency rate of edible oil and sugar continue to decline. For basic self-sufficiency of pork and poultry, corn and soybean imports need to be increased; the self-sufficiency rate of beef and mutton will continue to decline, and this decline can be significantly alleviated by accelerating the development of grass husbandry (Fig. 5).

Third, changing food demand of urban and rural residents and their demand for multi-functional agriculture urge us to develop safe, green, efficient, and multi-functional high-value agriculture. The demand for high-quality rice, wheat, vegetables and fruits, livestock products, aquatic products, as well as high-value agricultural products and services such as agritainment and folk tourism continues to increase.

Fourth, the key to supporting future agricultural development is to maintain sustained and steady growth (2%–3%) of agricultural total factor productivity, which calls for multiple measures in terms of reform of the agricultural technology innovation system, rural institutional innovation, the transformation of production patterns, and the development of high-value agriculture.

Fifth, regional agricultural growth and resource, ecological, and environmental protection gradually tend to be balanced, and the sustainable and efficient agricultural development mode suitable for regional resource endowment gradually takes shape and develops steadily.

Sixth, there is great potential for growth in world food production. Improvements in agricultural productivity and inputs in other developing countries, and the steady development of international agricultural trade, can provide a stronger guarantee for China's food security supply.



Seventh, despite recent challenges to economic globalization and increasing risks in the international market, the main grain importers and exporters will all appeal to promote international trade, as the spatial distribution of water and soil resources and population in the world is uneven. The trend of trade growth in grain and other agricultural commodities will continue.

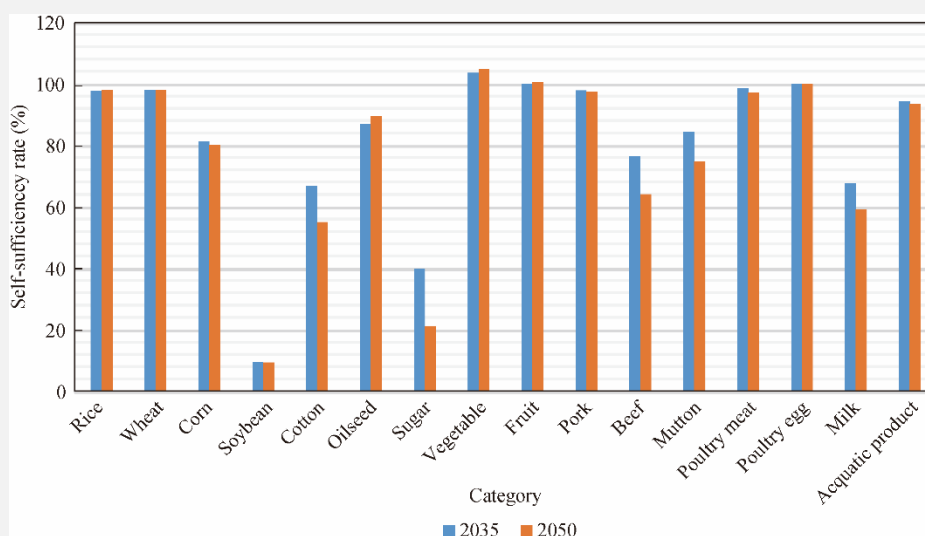


Fig. 5. Self-sufficiency rate of main agricultural products by 2035 and 2050 (%).

## 5 Strategies for China's agricultural development toward 2050

### 5.1 Development philosophies and strategical plans

China will uphold the innovative, green, efficient, and sustainable development concept, power the development of high-value and sustainable agriculture by stage, and finally realize agricultural modernization in an all-round way to ensure absolute grain security through maintaining independent and controllable domestic grain supply. By 2025, China needs to make institutional and technological innovations with increased R&D investment, advance the supply-side structural reform in the agricultural value chain, and significantly increase the total factor productivity of agriculture. By 2035, China will prioritize the development of modern intelligent agriculture, advance agricultural modernization, and optimize the regional distribution of the development path based on their comparative advantages and carrying capacity of water and soil resources. By 2050, priority will be given to consolidating and upgrading sustainable development and modernization of agriculture.

On the basis of ensuring absolute grain security, efforts will be made to boost the all-round development of green, efficient, and multi-functional high-value agriculture and achieve sustainable development and modernization of agriculture. By 2035 and 2050, the self-sufficiency rates of rice and wheat will reach at least 96% and 95%, respectively, and the overall self-sufficiency rates of grains will reach at least 88% and 85%, respectively. The self-sufficiency rates of pork will reach at least 96% and 95%, respectively; the self-sufficiency rates of beef and mutton will reach at least 70% and 60%, respectively. China will be self-sufficient in poultry, meat, and eggs, and moderately export vegetables, fruits, and aquatic products; the agricultural total factor productivity will grow annually at an average rate of 2%–2.5%. China will adhere to the red lines of arable land and agricultural water consumption, and fully implement modern agriculture with high value and sustainable development by 2025, 2035 (partial implementation), and 2050 (full implementation).

To practice the above development ideas and realize the development goals in stages, the following five strategies are recommended.

#### 5.1.1 Adhering to the bottom line of ensuring the absolute grain security and the independent and controllable domestic food supply

With only 7% of the world's freshwater resources and 9% of the world's arable land, China needs to feed 18% of the world's population. Although the proportion of China's population in the world is expected to decrease to 17% by 2035 and 14% by 2050 [1], the proportion of its arable land in the world is also decreasing. In pursuit of sustainable agricultural development when facing limited land supply per capita, China should ensure that total food is independent and controllable on the premise of ensuring absolute security of grain rations related to the national

economy and people's livelihood [17,18]. The absolute security of grain rations means that the self-sufficiency rates of rice and wheat should meet the goals for 2035 and 2050. Adhering to the red line of arable land and maintaining a moderate strategic reserve of grain rations at the state level is an important guarantee for absolute food security; efforts to deepen "the reserve of grain rations on land and based on technology" and launch "the reserve of grain rations through political measures" (including the system and mechanism, mode of production, and risk control) are also the key to achieving the goal of independent and controllable food supply.

#### 5.1.2 Innovative development of agricultural total factor productivity

We will establish a system for nurturing technological innovation in the new era and a system and mechanism for ensuring the supply of agricultural inputs, raise the total factor productivity of agriculture from the perspective of productivity, and build an agriculture-promoting system and management system suitable for the development pattern in the new era to significantly increase the total factor productivity in terms of production relations. On one hand, we will build more robust systems and mechanisms for technological innovation and ensure the supply of agricultural inputs in the field of agricultural technology and infrastructure, and raise the total factor productivity directly from the perspective of productivity, which is also a concrete reflection of the strategies of "reserve of grain rations on land and based on technology". Currently, intensifying efforts should be made to speed up the reform of the agricultural technology system to enhance technological innovation capacity while rationally increasing investment in agricultural infrastructure. On the other hand, we will build sound innovative systems and mechanisms for agricultural productivity improvements, and raise the total factor productivity of agriculture through reforming production relations, ways of production, agricultural production structures, integration of industrial chains and industries, and regional production layouts, among others.

#### 5.1.3 Regional agricultural sustainable development based on comparative advantage and resource carrying capacity

We will strengthen the division of agricultural production across regions and confine the main food producing regions based on the carrying capacity of resources and environments and comparative advantages. Sustainable development patterns suitable for local conditions will be explored for Northeast China (e.g., large-scale modern agriculture), the Huang-Huai-Hai region (e.g., ecological, water-saving, and high-value agriculture), the Huang-Huai-Hai region in the middle and lower reaches of the Yangtze River (e.g., ecological high-value agriculture with multiple functions), the Huang-Huai-Hai region in southeastern coastal areas (e.g., ecologically efficient and export-oriented high-value agriculture), the northwest Huang-Huai-Hai region (e.g., water-saving and efficient modern agriculture), the southwest Huang-Huai-Hai region (e.g., ecological and multi-functional characteristic agriculture), and southern hilly and mountain areas (e.g., the combination of planting and breeding and ley-farming).

#### 5.1.4 Actively participating into international cooperation to improve national food supply capacity

We will alleviate the constraints of soil and water and the pressure of resources and the environment for China's agricultural production by active use of domestic and international resources and markets; give full play to the comparative advantage of agricultural products, enhance the international competitiveness of China's high-value agricultural products; take accurate measures to tackle changes in the international situation, contribute to the management system of trade in bulk agricultural products and build systems and mechanisms for responding to and making pre-plans for international emergencies; support Africa and developing countries in South America in enhancing agricultural production capacity, and meet China's import demands in addition to enhancing agricultural supply capacity worldwide.

#### 5.1.5 Modern agricultural innovation led by system, policy, and investment innovations

China's agricultural development over the past four decades demonstrates that institutional innovation, policy reform (such as technological innovation and market reform), and public input are the main forces driving agricultural growth, which is also the key to the success of agricultural development and reform. To realize the goal of agricultural development for 2050, we will highlight the development concept of reform and innovation; promote institutional improvements in land, water resources, labor, capital, and business organizations in the new era; put in place a modern agricultural policy support system covering agricultural technology, agricultural finance, market reform, and agricultural trade; and foster a complementary and symbiotic agricultural investment model between government public investment (such as farmland irrigation and water conservancy, rural roads, information and communication infrastructure, market infrastructure, and public goods) and social investment (such as peasant household investment and market-oriented investment of agricultural enterprises).



## 5.2 Key projects for agricultural development

A key task in the near future is to promote the transformational development of green, efficient, and multi-functional high-value agriculture, as well as the leapfrog development of smart and ecological modern agriculture. From multiple aspects such as variety, quality, safety, characteristics, efficiency and multi functions such as ecology, culture, and leisure, we will deepen the supply-side structural reform of agriculture and create a good production and market environment for the development of high-value agriculture through institutional and technological innovation and policy support in the fields of production and circulation. We will develop modern, intelligent, and ecological agriculture supported by modern biotechnology, digital technology, and equipment technology, with ecology as the main line and intelligence as the means to lay a solid foundation for leapfrog development of agriculture. Further, we will expand the application of information technologies such as the Internet of Things and cloud computing, boost the development of modern and intelligent agriculture, explore a development model, technical support, and policy guarantee system of ecological agriculture suitable for different regions, industries, and scales, and advance the ecological process of modern agriculture.

While centering on strategic priorities for agricultural development and key links in urgent need, we will implement the following key projects across the board in the near future: (1) Modern biological breeding and seed industry innovation projects to enhance the contribution of germplasm resources to agricultural production and the production capacity of the “reserve of grain rations based on technology”; (2) Project of all-round farmland fertility improvement to increase the production potential for the “reserve of grain rations on land”; (3) farmland irrigation efficiency improvement project to promote the sustainable use of water resources; (4) agricultural ecological environment protection projects to comprehensively improve the quality of agricultural development and the capacity for sustainable development; and (5) technological innovation and personnel training projects to enhance the capacity for innovation in agricultural technology. Next, the following key projects will be implemented across the board: (1) Recycling agriculture projects of integrated planting and breeding; (2) standardized development project of modern agriculture; and (3) modern and intelligent agriculture projects.

## 6 Countermeasures and policy recommendations

### 6.1 Building a sound institutional guarantee system for prioritizing agricultural development

To ensure that agricultural modernization will be partially realized by 2035 and fully by 2050, we should advance the progress of agricultural modernization and intensify the implementation of agricultural development strategies from 2020 to 2035. It is suggested that a system and mechanism for prioritizing agricultural development be established in the near future to provide key guarantees for completely eliminating the dual structure between urban and rural areas and prioritizing agricultural development.

### 6.2 Fostering innovation in rural land transferring system and in agricultural production patterns

By 2025, we will implement the policy of extending the second round of land contracts for another 30 years upon maturity and build a sound system of “separating three rights of contracted rural land”; boost the development of farmland transfer markets; promote orderly annexation of farmland and expand agricultural land operations; foster new types of agribusiness entities full of market vitality such as family farms, cooperatives, agricultural enterprises, and agribusiness consortiums. We will also support the development of social service organizations such as the extension and integration of agricultural, industrial chains and high-quality agricultural mechanization throughout the process, and transform the mode of agricultural production to the development of green, ecological, and multi-functional high-value agriculture. After 2025, we will embrace an all-round improvement stage in all aspects.

### 6.3 Reforming the agricultural technology and innovation system

Before 2025, a new round of agricultural technology system reforms will be launched to strengthen the positioning of basic applied research in the public agricultural sector, build an innovation system for the agricultural technology at a faster pace with enterprises as the main body, and intensify efforts to reform the promotion system for the agricultural technology. After 2025, the innovation system for the agricultural technology will be perfected and innovation capacity will be enhanced in an all-round manner. On one hand, we will encourage enterprises to play a primary role in technological application and industrialization research and define the function of R&D spending in the public sector; on the other hand, we will speed up the establishment of a collaborative and efficient agricultural

technology innovation system and create a favorable investment and market environment for agricultural R&D.

#### **6.4 Implementing education and training programs for improving rural human capital accumulation**

Before 2025, we will set a national agricultural technology innovation talent fund for educating and training talent and increase the number of leading talents in various fields related to agriculture, as well as the size of world-class technological innovation teams, issue special laws and regulations related to farmer education and training, establish a multi-channel mechanism for joint investment from the government, society, and farmers, and develop a multi-layered education and training system for farmers. After 2025, we will optimize and adjust the relevant systems and mechanisms in due time, continue to enhance our capacity to guarantee intellectual resources for agricultural technology innovation, and give full play to the fundamental role of the education and training system for farmers.

#### **6.5 Improving agricultural productivity, developing high-value agriculture, and fueling sustainable development**

Before 2025, China will maintain inputs in agricultural R&D, technology adoption, high-standard farmland, and rural infrastructure construction to meet actual needs; advance reforms in the minimum purchase price model for rice and wheat; accelerate the destocking of rice and wheat and branding agricultural products; and make the supply-side structural reform in agriculture to improve its efficiency in all aspects. Further, it will remediate the agricultural environment and control non-point source pollution. We will pursue steady progress in crop rotation and fallow, as well as manage and replace the arable land contaminated by heavy metals; build a robust ecological compensation mechanism; and initiate reforms in agricultural water rights and prices. After 2025, we will continue to provide necessary policy support in a way that drives a comprehensive shift to a model of agricultural productivity improvement, as well as high-quality and sustainable development.

#### **6.6 Engaging in global value-chain to ensure food security and building global trade governance systems**

Before 2025, we will set special funds to improve agricultural productivity in developing countries in Africa, systematically enhance the ability to address international market fluctuations through China's agricultural trade, step up participation in and promotion of multilateral and bilateral trade agreements, and construct a management system for international trade in staple products, such as soybean and corn. After 2025, we will maintain and intensify input management and achieve the fundamental goal of independent and controllable grain supply in China while providing Chinese solutions to world agricultural development and improving the global agricultural trade governance system.

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