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Trends of Global Agriculture and Prospects of China's Agriculture Toward 2050

Huang Jikun, Xie Wei, Sheng Yu, Wang Xiaobing, Wang Jinxia, Liu Chengfang, Hou Lingling

China Center for Agricultural Policy, School of Advanced Agricultural Sciences, Peking University, Beijing 100871, China

Abstract: Considering the implications of global agricultural development trends on China's agriculture, this article reviews China's agricultural development history and projects prospects for agricultural development by 2050. The transformations of the overall economic structure and rural economy should be integrated to enhance agricultural labor productivity and promote the rapid development of agriculture. By 2050, the share of agricultural Gross Domestic Product in China's total economy and the share of agricultural employment in China's total employment will gradually converge. China's food self-sufficiency rate will drop from 95% to approximately 90% by 2035, and even lower by 2050. High-value agricultural products and multifunctional agriculture are major driving forces for farmers' future agricultural growth and income rise. The strategic priorities for realizing China's agricultural modernization by 2050 include: (1) improving agricultural productivity and ensuring national food security, (2) maximizing the comparative advantages of agricultural products, (3) promoting green, high-efficiency, and high-value agriculture, (4) guaranteeing the sustainable utilization of agricultural water and soil resources, and (5) guiding modern agricultural development through institutional, policy, and investment reforms. Salient policy recommendations include: (1) increasing investment in technology and infrastructure to improve agricultural productivity, (2) enhancing the development of advantageous agriculture and agriculture with potential large demand, (3) improving the market environment and rectifying market failures to support the development of high-value agriculture, (4) maintaining the sustainable development of agriculture, and (5) optimizing the allocation of land, labor, capital, and other agricultural production factors.

Keywords: global agricultural development; China's agricultural outlook; rural transformation; food supply and demand forecast; agricultural modernization

1 Introduction

The 19th National Congress of the Communist Party of China (CPC) proposed the realization of socialist modernization by 2035, and the construction of a prosperous, democratic, civilized, harmonious, and beautiful modern socialist country by 2050. Simultaneously, it proposed the promotion of the simultaneous development of a new type of industrialization, informatization, urbanization, and agricultural modernization. As agricultural development has yet to undertake multiple tasks, such as ensuring national food security, ecological security, and agricultural sustainability, agricultural modernization is the weakest link in the simultaneous development of the four modernizations. In response to these challenges, China established numerous strategies, including revitalizing rural areas and prioritizing tackling issues related to agriculture, rural areas, and rural residents, to promote agricultural modernization. Given this background, analyzing the development trends and prospects of agricultural development in China by 2050 to accelerate agricultural modernization is an urgent research task.

Based on a summary of the implications of global agricultural development trends, this article reviews China's agricultural development history, projects the trend of China's agricultural development up to 2035 and further till

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Corresponding author: Huang Jikun, professor of China Center for Agricultural Policy, School of Advanced Agricultural Sciences , Peking University. Major research field is agricultural policies. E-mail: jkhuang.ccap@pku.edu.cn

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2050, and proposes policy recommendations to accelerate the realization of agricultural modernization. Specifically, it sets the following tasks: elaborating on the development course and characteristics of China's agriculture in the past, summarizing the trend of global agricultural development and its implications for China's agricultural development, projecting the development direction of China's agriculture toward 2035 and 2050, and proposing policy options for accelerated agricultural modernization and the national agricultural policy support system.

2 Review of the development of China's agriculture

2.1 Evolution of the production, consumption, and trade of China's agricultural commodities

Since the reform and opening-up in 1978, China's agricultural production has maintained rapid growth to meet rising domestic consumption demand. The average annual growth in agricultural gross domestic product (GDP) in China accounted for 4.6% from 1978 to 2020. With fundamental food security being ensured, cash crops have rapidly developed. China's livestock and poultry production growth exceeded that of crops by a large margin, while the increased rate of fishery output remarkably outpaced other agricultural products. China's food consumption structure has changed tremendously owing to economic growth and market reform since 1978, revealing prominent characteristics at different stages. The period from 1980 to 1990 was marked by replacing whole grains with refined grains, and the gradual increase in consumption of non-staple foods. Since 1990, food consumption per capita in China has primarily been characterized by "the substitution of grains or staple food with high-value agricultural commodities". China's food trade has expanded rapidly since 1978, with continuous improvement in traded goods and regional structures. The food trade has become a significant means of adjusting the balance of food supply and demand, raising farmers' incomes, boosting agricultural employment, and promoting the development of the rural economy in China.

2.2 Major driving forces for the development of China's agriculture

Since 1978, the development of China's agriculture has been driven primarily by institutional innovation, technological advancements, market reform, and agricultural investment [1]. (1) Institutional innovation in rural areas: The household contract responsibility system (HCRS) remarkably improved total factor productivity in agriculture, and it was an important driving force for agricultural growth in the early stages of reform and opening-up (1978–1984). Based on stabilizing the farmland system, China has promoted the household system reform in an effort to support and encourage non-agricultural employment and inter-regional mobility of rural labor, which has propelled the comprehensive reform of villages and townships. China also created the institutional innovation to transform grassroots governments. Meanwhile, efforts have been made to innovate the farmer cooperative economy and reform the rural credit system. (2) Technological advancements in agriculture: Over the past four decades, the advancement of agricultural science and technology has significantly contributed to supporting the growth of China's agriculture. The large-scale agricultural research system established in China's public sector, with a full set of disciplines, secures the accelerated innovation of agricultural science and technology from a technical perspective. The national system aimed at promoting agricultural technologies covering all villages and towns across China provides a systematic guarantee that fundamental technical services will serve the expedited application of agricultural technologies. The improvement of the operation mechanism for agricultural technologies, especially the pivotal effort to reform the salary system and performance evaluation, has incentivized research and development (R&D) personnel and raised their incomes. Increasing government investment has provided financial guarantees for the advancement of agricultural technologies. Meanwhile, over the last decade or so, a large number of enterprises have been drawn to invest in agricultural technologies, thereby injecting new vitality into scientific and technological innovation. (3) Market reform for agricultural commodities: This has affected agricultural development and farmers' income from the following three aspects: (I) It has improved the allocation efficiency of agricultural resources, promoted the adjustment and optimization of the agricultural production structure, and improved the competitiveness of the agricultural commodity market; (II) It has further lowered farmers' purchase price of agricultural inputs, which has promoted farmers' investment in agricultural production and raised their income; (III) It has also cut into market transaction costs and increased the price of farmers' agricultural products, thereby triggering farmers' enthusiasm for expanding production and elevating farmers' income. (4) Increased agricultural investment: The diversion of more investment in agricultural production by the government and farmers is another critical driving force for the sustained high growth rate of China's agriculture. Among government investments, the construction of agricultural infrastructure was the most critical because it raised the total factor productivity of agriculture.

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2.3 Major challenges and policy options for future agricultural development

Ensuring an increase in farmers' income, food security, and agricultural sustainability has been the primary challenge for the development of China's agriculture since the beginning of the 21st century [2]. Successful experience in reforming and developing agriculture in the past four decades, except for some detours during some periods, will be invaluable for China's agricultural reform and development in the future. It is important to remember these successful cases and experiences drawn from the development and reform of China's agriculture in the past 40 years, namely the four key aspects: rural institutional innovation, agricultural technological advancement, market reform for agricultural commodities, and increased agricultural investment.

3 Global trends for agricultural development

3.1 Distribution characteristics and changing trends of global arable land and water resources

Although global arable land resources are mainly concentrated in Asia and the Americas, the per capita arable land is higher in Oceania and North America and lower in Asia, especially South Asia and East Asia. In 2017, the global per capita arable land was 0.18 hm^2, whereas Oceania, which has the smallest total arable land, had a per capita arable land as high as 0.78 hm^2. Furthermore, North America also had relatively high arable land per capita (0.54 hm^2). On the contrary, Asia (0.11 hm^2), especially East Asia (0.08 hm^2), has smaller arable land per capita [3]. Globally, available freshwater resources are relatively limited and unevenly distributed. In the context of climate change, followed by an increase in industrialization and ecological water use, the imbalance between global water supply and demand will be further exacerbated. Although the total surface water supply will remain relatively stable, the spatial imbalance will increase further. Global groundwater resource exploitation will continue increasing, resulting in regions suffering from intensified overexploitation [4].

The mismatch between global arable land and population distribution underlines the importance of the differences in agricultural production structures and trade. For example, China supports 20% of the global population with only 8% of farmland; therefore, China's land-intensive agricultural commodities are less competitive in the international market. International trade in agricultural products and food is critical for addressing food security both globally and in many countries. For example, China and other countries, where the arable land per capita is less than 0.12 hm^2, are major importers of agricultural commodities. In contrast, the import and export of agricultural commodities in Germany and other similar countries, where arable land per capita is between 0.12 hm^2 to 0.26 hm^2, is balanced. The third category of countries, including the Uninted States, with over 0.26 hm^2 of per capita arable land, are major exporters of agricultural commodities.

The analysis of the distribution characteristics and trends of global arable land and water resources emphasizes the significant role played by the food trade. China's full self-sufficiency in food would compromise its sustainable development of resources and the environment. The transformation of modern agriculture and food security needs to "take full advantage of the resources and markets in China and the world."

3.2 The trends and distribution of global food productivity

Although global land for cereal cultivation shows a downward trend, the total output of cereals continues to increase, mainly because of the higher crop yield. Previous studies show two factors contributing to increased crop yield: an increase in production inputs (e.g., fertilizer, pesticide, and machinery) and technological advancement. Despite facing numerous new problems arising from higher inputs into production, China is still applying more fertilizer and pesticides, while European countries have been reducing it since the 1980s. The enormous regional differences in grain productivity present massive potential for the global growth of grain production. Half of the global cereal production originates from countries where productivity is lower than 5 tons per hm^2, while countries whose per unit yield surpasses 6 tons per hm^2 contribute only 20% (Fig. 1). This also implies that global cereal production could increase significantly if productivity in lower-yielding countries increases significantly [5].

Trends and distribution of global food productivity show that there is still high potential for growth in global food production. If the productivity of countries with lower yields can be significantly increased, global food production will improve significantly. The future agricultural growth in China and many other countries will mainly depend on productivity growth.

3.3 Trend of global agricultural technologies

Advancements in agricultural technologies significantly contribute to the development of agriculture. Globally,

investment in public agricultural R&D has gradually increased, with high-income countries consistently holding the dominant position (accounting for over 50% of agricultural R&D investment globally) [6]. Certainly, in recent years, the average annual growth rate of the overall public agricultural R&D investment in developing countries has been similar to that in developed countries and higher than the global average [7]. A new round of technological and industrial revolutions has injected vitality into agricultural transformation. Agriculture is gradually entering a modern agricultural development stage with information-led, bio-engineered, intelligent production, and sustainable development. The agricultural technology revolution has effected comprehensive and profound changes in agriculture, and completely changed the production and trade patterns of world agriculture.

From the development trends of global agricultural technologies, China must focus on investing in sustainable agricultural development and systematically solving agricultural and related issues. Particularly, China should consider relying on modern science and technology and management systems such as modern biology, information communication technologies, equipment technology, and resource management to solve the issues surrounding agricultural development, facilitate the systematic view of balancing foods, water, land, and energy, better manage challenges in agricultural development from the perspective of "Food System"; and thereby promote and facilitate the development of smart agriculture.

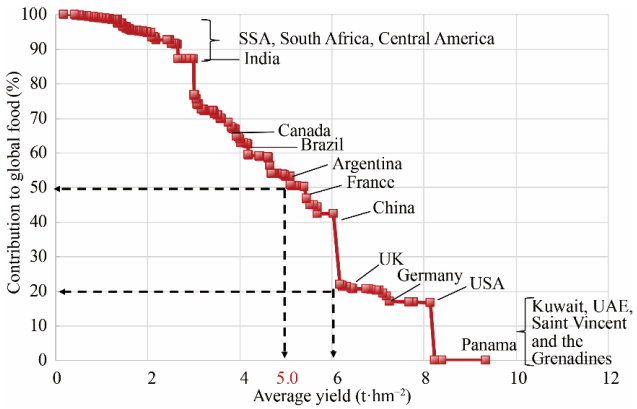

Fig.1. Cumulative contribution of major countries and regions with different grain yield to world's total grain production (2016). *Note*: Data from the Food and Agricultural Organization of the United Nations, FAOSTAT, 2017.

3.4 Changes in agricultural support policies in major developed countries

Agricultural support and protection rates in developed countries have changed significantly, and policies have gradually become more market-oriented to improve agricultural competitiveness. Influenced by the Uruguay Round of Trade Negotiations and constrained by the rules of the World Trade Organization, to promote the adjustment of domestic production structure and improve the market competitiveness of major agricultural commodities, the average producer support (PSE) in the Organization for Economic Cooperation and Development (OECD) countries has shown a slow decline in the proportion of agricultural output value (Fig. 2). It is worth noting that this trend is exactly opposite of that in China, as China's PSE share in agricultural production value has exceeded the OECD average in recent years. Simultaneously, the agricultural protection rate in China (the percentage difference between domestic and international prices) has also exceeded that in the United States and the average among the European Union since 2009.

In the future, agricultural support policies will shift from market intervention to improving agricultural productivity, the competitiveness of agricultural commodities, and agriculture's sustainability. Although developed countries often offer generous agricultural subsidies, the support policies in all countries are gradually reducing direct intervention in agricultural commodities prices and shifting to improve the competitiveness of domestic agricultural commodities.

3.5 Trend of global agricultural structure and rural transformation

International experience in rural development indicates that the transformation of the rural economy (rural transformation), with productivity improvement as the primary driving force, promotes the structural transformation of the national economy (structural transformation). Meanwhile, structural transformation driven mainly by industrialization and urbanization accelerates rural transformation and development. Structural and rural transformations complement each other, eventually converging urban and rural labor income [7]. The declining

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proportion of rural populations in developed countries is in alignment with the speed of structural transformation. When the structural transformation is completed, the ratio of the rural population in developed countries approaches approximately 20%. However, some countries and regions have experienced a significant decline during the post-industrial period (Fig. 3).

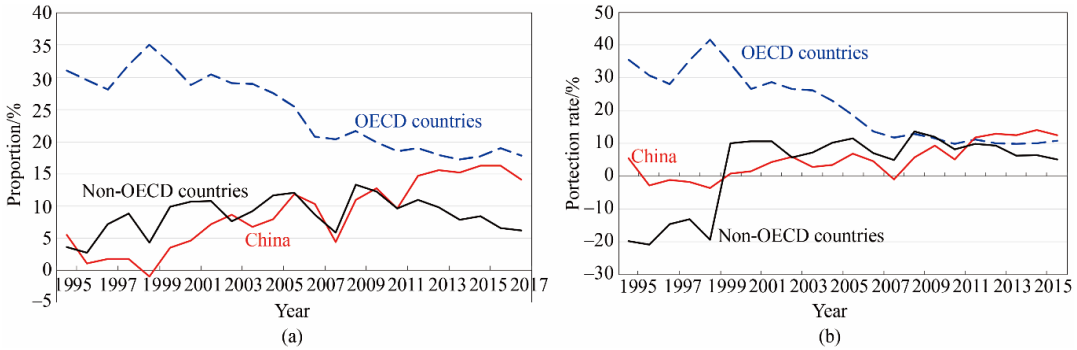

Fig. 2. Share of PSE in agricultural product output (a) and rate of nominal protection over producers (b) for China and other major countries.

Note: Data for the figure on the left from the OECD database, 2018 https://data.oecd.org/agrpolicy/producer-protection.htm; data for the figure on the right from the OECD database, 2018, http://www.oecd.org/tad/agricultural-policies/producerandconsumersupportestimatesdatabase.htm.

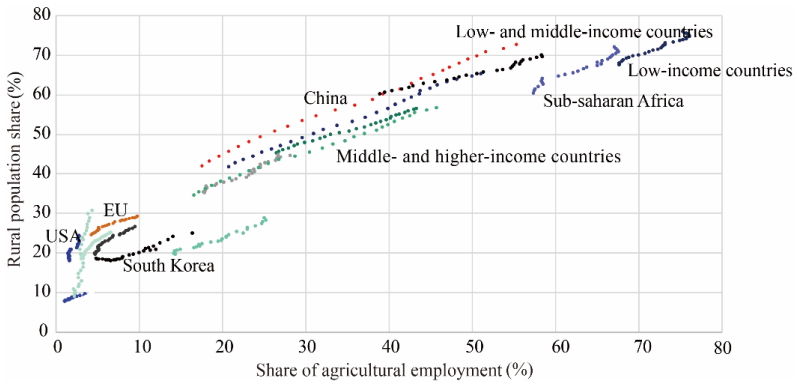

Fig. 3. Changes in share of agricultural employment and share of rural population in major countries and regions (1991—2017).

Note: Data from the Food and Agricultural Organization of the United Nations, FAOSTAT, 1992—2018.

In the future, China's agricultural development should conform to the global trend of rural and structural transformation, and promote structural transformation by enhancing rural transformation driven by agricultural productivity. China should promote rural transformation by creating more employment in the process of structural transformation. Meanwhile, agricultural labor productivity needs to be significantly improved, thereby further narrowing the productivity gap for the labor force in the agricultural and non-agricultural sectors.

4 Trends and prospects for China's agriculture development toward 2050

The review of agricultural development in China since 1978 and the analysis of the implications of global agriculture trends helps us project the development trend of China's agriculture toward 2050.

4.1 Role of China's agriculture in the national economy by 2050

Rapid economic growth is accompanied by major structural economic changes. Since the reform and opening-up, China's agricultural output has grown at an average annual rate of 4–5%. However, the industrial and service sectors and the overall economy have grown faster. Especially, since 1985, industry and services have grown nearly three times faster than agriculture. Agriculture's share in GDP declined from 40% in 1970 to 8% in 2020, against the rising share of the industry and services sector that grew from 60% in 1970 to 92% in 2020 (Table. 1). These indicators underline the convergence of agricultural development trends in China and developed countries: the

greater the role of agricultural transformation, the faster it develops; concurrently, the share of agriculture in the economy decreases gradually.

Table 1. China's economy, employment, and population structure during 1970–2020 and 2030–2050. (Unit:%)

		1970	1980	1990	2000	2010	2020	2035	2050
GDP Share	Agriculture	40	30	27	15	10	8	5	3.6
	Secondary&Tertiary Ind.	60	70	73	85	90	92	95	96.4
Employment	Agriculture	81	69	60	50	37	24	10	4.0
Share	Secondary&Tertiary Ind.	19	31	40	50	63	76	90	96.0
	Rural Population	83	81	74	64	50	36	25	20.0

Note: Historical data from *China Statistical Yearbook* and data for the future from model analysis run by China Center for Agricultural Policy, School of Advanced Agricultural Sciences, Peking University.

The employment structure also reflects changes in the economy. In 1970, the share of the labor force in China's agriculture accounted for 81% but later fell to 24% in 2020. In contrast, the share of employment in the industry and services sector in the national economy improved significantly, from 19% in 1970 to 76% in 2020 (Table 1). In fact, by 1995, over 150 million rural laborers worked in non-agricultural sectors [8], which grew to 280 million in 2017 [9].

It is expected that future changes in the status of agriculture in the national economy will be closely consistent with the modernization transformation of China's economy. From agriculture to industries and services, the agricultural sector's share in total GDP will continue declining, to 5% in 2035 and 3.6% in 2050, while the industrial and service sector's share in total GDP will rise to 95% in 2035 and 96.4% in 2050. From rural to urban areas, the share of agricultural employment is expected to fall to 10% in 2035 and 4% in 2050. The rural population is expected to fall to 25% in 2035 and 20% in 2050. The change in the industry's structure, labor force mobility, and the reduction of the rural population all show that China is rapidly advancing the urbanization process (Table 1).

4.2 Trend of China's food production, consumption, and trade toward 2050

China's agricultural policy simulation and projection model (CAPSiM) was applied to project and analyze the supply and demand of China's agricultural commodities (Table 2). The general trends for China's supply and demand of agricultural products are as follows: (1) the increased imports of agricultural products are mainly soil- and water-intensive agricultural products, such as soybeans, corn, and sugar; (2) as demand for grains decreases, China will be self-sufficient in rice and wheat by 2035 and 2050, but feed demand will continue to exceed domestic production capacity, and imports will continue growing. Increasing the import of feed crops is conducive to developing domestic animal husbandry and supply security for livestock and poultry products. (3) Consumer demand for animal products, aquatic products, vegetables, and fruits and the requirement for food quality and safety will increase significantly. Society's multifunctional needs from agriculture (such as ecology, landscape, tourism, and culture) will also result in new growth in agriculture. The development of high-value agricultural commodities and multifunctional agriculture will comprise the main sources of future agricultural growth and farmers' income.

The increase in demand for feed crops in China will notably surpass domestic production by 2050 and the self-sufficiency rate of feed crops will continue declining. The import demand for corn and soybeans will continue increasing. If the corn tariff quota system is not adopted, corn imports in 2035 and 2050 will reach 5.6×10^7 t (83% self-sufficiency rate) and 6.6×10^7 t (82% self-sufficiency rate), respectively. By 2035, soybean imports will exceed 100 million tons and this trend will continue. If corn's import tariff quota system is implemented (tariff of 1% under a quota of 7.2 million tons and 65% beyond the quota), the import of livestock products will increase significantly.

In addition to vegetables and fruits, the gap between the supply and demand for agricultural products will expand further. Self-sufficiency for sugar will be lowered to 58% by 2035 and will continue decreasing toward 2050; the cotton self-sufficiency rate will drop to 66% and 54% by 2035 and 2050, respectively.

The demand and supply gap for animal commodities mainly relies on trade policies for feed crops and the development of grass-based husbandry. By 2050, the supply and demand for aquatic products will be balanced; however, the supply and demand balance for animal products will remain uncertain. Under the circumstances of restricted imports of corn and lack of attention to the development of grass-based husbandry, the import of pork, poultry, beef, mutton, and dairy products will expand and become highly dependent on unreliable international market supply. If the feed crop market is liberalized, the supply and demand of pork and poultry can be balanced. More beef, mutton, and dairy products will be imported, and the self-sufficiency rate will decline by 10% to 20% in

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2050 compared with the current level.

Table 2. Projection on supply and demand of China's major agricultural commodities in 2019, 2035, and 2050.

		Rice	Wheat	Corn	Soybean	Cotton	Sugar	Pork	Beef	Mutton	Eggs	Milk	Aquatic
2019	Output/×10^4t	14673①	13360	26078	1810	589	1460②	4255	667	488	3309	3201	6480
	Import/×10^4t	255	349	479	8851	194	339	313	176	39	0	1629	624
	Export/×10^4t	275	31	3	12	5	18	21	2	0	10	0	417
	Total demand/×10^4t	14653	13678	26554	10649	778	1781	4547	841	527	3299	4830	6687
	Direct consumption/×10^4t	10765	9654	835	10406	0	1084	4547	841	527	3299	4830	6687
	Feed grain/×10^4t	947	1363	15383	70	0	0	0	0	0	0	0	0
	Others/×10^4t	2941	2660	10337	173	778	697	0	0	0	0	0	0
	Self-sufficiency/%	100	98	98	17	76	82	94	79	93	100	66	97
2035	Output/×10^4t	13137①	12316	27610	1904	511	961②	6415	827	576	3444	3984	7878
	Import/×10^4t	271	331	5609	10444	270	697	132	489	103	0	2636	770
	Export/×10^4t	36	33	0	10	4	9	16	1	0	8	0	338
	Total demand/×10^4t	13372	12614	33219	12338	777	1649	6531	1315	679	3436	6619	8310
	Direct consumption/×10^4t	9504	8436	497	12066	0	959	6531	1315	679	3436	6619	8310
	Feed grain/×10^4t	607	1228	19572	69	0	0	0	0	0	0	0	0
	Others/×10^4t	3261	2950	13151	203	777	690	0	0	0	0	0	0
	Self-sufficiency/%	98	98	83	15	66	58	98	63	85	100	60	95
2050	Output/×10^4t	11413①	10976	30490	1881	422	568②	6933	918	618	3238	4172	8716
	Import/×10^4t	220	283	6624	10470	365	1005	167	988	202	0	3959	827
	Export/×10^4t	44	39	0	10	3	6	13	0	0	7	0	314
	Total demand/×10^4t	11589	11220	37114	12340	784	1567	7087	1905	821	3231	8132	9229
	Direct consumption/×10^4t	7609	6834	261	12034	0	856	7087	1905	821	3231	8132	9229
	Feed grain/×10^4t	355	1056	22558	64	0	0	0	0	0	0	0	0
	Others/×10^4t	3625	3331	14295	243	784	711	0	0	0	0	0	0
	Self-sufficiency/%	98	98	82	15	54	36	98	48	75	100	51	94

Note: ① Counted at the milled rice rate of 70%; ② Counted at the sugar rate of 12%. Data from CAPSiM simulation.

4.3 Long-term food security and sustainability

Along with population growth, income increases, and the evolution of food consumption, food consumption in China continues increase but maintains relatively high self-sufficiency. Food security in China is backed by the exhaustion of water and land resources as well as unsustainable environmental development. Food imports in China have increased and surpassed the total exports in 2003. Food imports have relatively alleviated resource pressure and addressed environmental challenges in China. This study evaluates and quantifies the amount of water and land resources saved by food imports and their significance in global agricultural development. Forecasting this trend also helps clarify how best to balance food and resource security and promote the transformation of modern agriculture.

Based on the projection of future food trade, this research considers resource and environmental consumption statistics from existing references [10] to predict the effect of food trade on water and land resources. The projection show that China and the world will uphold the virtual water and land saving trend through the food trade. Following the changing food supply and demand structure in 2035 and 2050, the amount of imported food is expected to change significantly. The net import of virtual water and land resources will help China save vast quantities of these two resources.

In the baseline scenario, the net import of virtual water would help China save 3.3×10^{11} m^3 of water resources by 2050 (Table 3), and the saved land resource conserved by food trade is expected to reach 6.62×10^7 hm^2. If these agricultural commodities were all produced in China, the sowing area would account for 49% of the national arable land in 2015. Our projection suggests that as China is a country with high usage intensity of water and land resources, while most export nations have low usage intensity, trade in foods in China saved 9.5×10^{10} m^3 of virtual water and 1.5×10^7 hm^2 of virtual land to the benefit of the world in 2015. Moreover, increased net import of foods in China will save the world approximately 1.3×10^{11} m^3 of fresh water and 1.437×10^7 hm^2 of arable land by 2050. Food imports in China will not only secure China's water and land resources but also significantly contribute to global agricultural sustainability.

Enhanced irrigation efficiency will change the effect of China's food trade on the conservation of virtual water resources in both China and worldwide. If China can improve its irrigation efficiency by 0.5% annually (S1), the virtual water conservation in China will reach 3.1×10^{11} m^3, or 4.6% lower than the baseline scenario, with the irrigation rate remaining the same. Higher irrigation efficiency directly impacts the global conservation of water resources (down by 10%) (from 1.3×10^{11} m^3 to 1.2×10^{11} m^3) (Table 3). In S2, if China can improve its irrigation efficiency by 1% annually by 2050, virtual water conservation for China and the world will decline by 7.6% and 16.2%, respectively. Meanwhile, a higher irrigation efficiency significantly reduces the irrigation water required for China's domestic agricultural production.

Table 3. Projection of resources conserved by China's food import toward 2035 and 2050.

Year	Scenario	Water conservation ($\times 10^{11}m^3$)		Land conservation ($\times 10^7hm^2$)	
		China	World	China	World
2035	Baseline	3.0	1.4	6.6	1.7
	S1	2.9	1.3	–	–
	S2	2.8	1.2	–	–
2050	Baseline	3.3	1.3	6.1	1.4
	S1	3.1	1.2	–	–
	S2	3.0	1.1	–	–

Note: Date from the simulation of CAPSiM

5 Policy implicationsfor China to realize agricultural modernization toward 2050

5.1 Main targets and priority areas

The targets of agriculture development toward 2035 are as follows: (1) The total food self-sufficiency rate reaches 88%. It will be higher than 90% for cereals, among which rice and wheat will ensure absolute security with a self-sufficiency rate as high as at least 98%; the rate for corn will be above 80%; pork higher than 98%, beef and mutton higher than 70%, poultry and eggs will be mostly self-sufficient, dairy products will be at least 70%, and vegetables and fruits will be moderately exported. (2) Green, highly efficient, and multifunctional agriculture with high value will be expanded more rapidly. With an output value of more than 90%, it will become a major source of income for farmers. (3) Agricultural production will enter the sustainable development phase.

The targets of agriculture development toward 2050 are as follows: (1) the total food self-sufficiency rate will reach at least 85% as that for cereals will be more than 85% and that for rice and wheat will be more than 95%. (2) Green, highly efficient, and sustainable agriculture of high value will be achieved on all fronts.

Priority areas: (1) Improving agricultural productivity and ensuring national food security. A significant increase in total factor productivity of agriculture will guarantee national food security. (2) Maximizing the comparative advantages of agricultural products. The market shall allocate resources to agricultural products with comparative advantages. (3) Promoting green, highly efficient, and high-value agriculture. More support will be provided for green, safe, environmentally friendly, highly efficient, and multifunctional agriculture. (4) Guaranteeing sustainable utilization of agricultural water and soil resources. (5) Guiding modern agricultural development through institutional, policy, and investment reforms, an innovative strategy will be implemented to lead the development of modern agriculture by innovating rural institutions, technologies, supportive policies, and investments.

5.2 Major policy guarantee

First, the input of technology and infrastructure to improve agricultural productivity should be increased. The government should enhance the investment intensity for agricultural R&D while rekindling businesses' passion for further investing in agricultural R&D by better protecting intellectual property rights. From the perspective of input mixture, the government is expected to adjust the orientation of investment in agricultural R&D. Regarding input into infrastructure facilities, it has to be made not only to build new infrastructure facilities but also to maintain and improve existing ones to improve the role played by technologies in agricultural development.

Second, the development of advantageous agriculture and agriculture with large demand potential should be enhanced to ensure food security. Limited water and land resources will be concentrated on food production. Moreover, breeding should be a top priority for agricultural development in the future. Advantageous agriculture, including vegetables/fruits and aquatic products, among others, together with agricultural sectors with high potential, including green and multifunctional agriculture, will experience a greater boost.

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Third, the market environment could be improved by rectifying market failures to support the development of high-value agriculture. New impetus will be unleashed for agricultural growth, and farmers' income will increase owing to a more favorable market environment in which the development strategy of green, highly efficient, and high-value agriculture would be executed. Different regions will seek new development paths for agriculture by considering high-value and green agricultural products to expand new areas of agricultural growth and raise farmers' incomes.

Fourth, the sustainable development of agriculture should be maintained. The productivity layout should be optimized based on the pattern of agricultural production and the endowment of water and land resources. The utilization of water and land resources should be coordinated in the short and long term. Crop rotation and land retirement should be expanded to better utilize water and land resources.

Fifth, land allocation, labor, capital, and other agricultural production factors should be optimized. More investment will be made to produce advantageous and green agricultural products, as well as public goods for multifunctional agriculture. The markets and services for these products should be shaped to improve China's agricultural productivity and market competitiveness.

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