

Strategic Study on Agricultural Structure Adjustment in China in the New Era

Luo Qiyou, Liu Yang, Tang Huajun, Zhou Zhenya, You Fei, Gao Mingjie

Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China

Abstract: The main contradiction in the agricultural sector of China has changed from gross shortage to structural ambiguity in the current circumstances. To adapt to the new normality of agricultural development in China, it is important for the current agricultural development to adjust and optimize the agricultural structure, speed up the transformation of the growth model, and promote supply-side structural reforms in agriculture. Here, we analyze the main problems existing in China's agricultural structure from five aspects, including planting, animal husbandry, industrial, product, and spatial structures. Furthermore, we elaborate the strategic conception of China's agricultural structure adjustment in the new era and put forward the adjustment and optimization plan for the planting, animal husbandry, and industrial structures, as well as the corresponding policy recommendations.

Keywords: structure adjustment; planting structure; animal husbandry structure; regional layout

1 Introduction

With China's economic development entering a "new norm" and agricultural development entering a new stage, the environment of agricultural development has undergone profound changes, and the advancement of agriculture faces complex situations and arduous tasks. The costs of capital goods in the agricultural sector, such as chemical fertilizers and labor, have risen rapidly, and meanwhile, the international prices of commodities have become lower than their domestic prices. Under the dual pressure of both "cost floor" and "price ceiling," the comparative advantage of agriculture has continued to decrease, and the contradiction between the supply and demand of agricultural products has become increasingly prominent. Specifically, difficulties in buying and selling agricultural products coexist, leading to an increase in the domestic inventory and import volume of the corresponding commodities. Since the country has become increasingly dependent on foreign supplies of certain agricultural products, the survival of the corresponding domestic industries is threatened. Moreover, problems related to agricultural resources and environment, such as decreasing arable land area and quality, the over-exploitation of groundwater, and agricultural non-point source pollution, have become increasingly serious, whereby it could be said that the "red light" of the agro-ecological environment is "flashing." Since a large number of farmers have chosen to engage in non-agricultural sectors and now consider farming to be a part-time profession, the aging of the farming population has become increasingly prominent, and the questions surrounding who will farm the land and the associated farming methods require urgent solutions [1–4]. Under the new circumstances, the main contradiction in agricultural sector has shifted from the lack of total output to structural contradiction. Therefore, it is greatly important for the development of national agriculture to adapt to the new norms of agricultural development; adjust and optimize the agricultural structure; accelerate the transformation of development models; promote supply-side structural reforms; establish a modern agricultural structure that coordinates the production of grain, cash, and forage

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Corresponding author: Liu Yang, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Associate Research Fellow. Major research field is agricultural distribution and regional development. E-mail: liuyang@caas.cn.

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crops; integrate the development of crop farming, animal husbandry, and agricultural product-processing industries; and combine agriculture, animal husbandry, and fisheries. The goal is to achieve modern agricultural development with an efficient, safety-oriented, resource-conservative, and environment-friendly output.

2 The main problems of agricultural structure in China

2.1 Crop structure: Surplus of corn; shortage of soybean as oil plants, and forage

(1) There is a periodic surplus of corn and its stock has increased substantially. During the 12 consecutive years of increase (2003–2015) in grain production, the accumulated increased production of all grain crops was 190 million tons, while that of corn was 100 million tons, accounting for 57% of the total increase in grain production. Rice and wheat maintained a balanced supply and demand. However, owing to a slowdown in the growth of domestic consumption and the impact of factors, such as the import of alternative products, the production of corn underwent a temporary surplus, with a significant increase in its inventory.

(2) The planting area and production of soybean are continuously declining, though foreign dependence is increasing. Since 2004, the planting area and production of soybean in China have decreased simultaneously by 32.15% and 32.28%, respectively, in 2015, thus leading to an over-dependence on foreign supply. Since the quality and price of domestically produced soybean appear to be unattractive to the domestic buyers, the import volume of soybean has grown rapidly, with a yearly increase in the dependence on foreign supply. In 2015, the total amount of imported soybean was 81.69 million tons, which was 6.8 times that of soybean produced domestically, accounting for 70% of the world's soybean trade and 87% of the total domestic consumption. The dependence on imported soybean was the highest among all agricultural products.

(3) There is a general lack of high-quality forage; the current capability of the industry does not match the demand for forage. In 2015, China's cattle production was 50.03 million heads, and the breed stock number of dairy cows was 15.07 million heads, which required approximately 75.96 million mu (1 ha = 15 mu) of silage corn. However, according to the statistics of the National Animal Husbandry Service, the planting area of silage corn in China was 40.73 million mu, 35.23 million mu less than the demand in 2015 (Table 1).

Table 1. Supply and demand of major agricultural products in China in 2015.

Category	Demand and supply ($\times 10^4$ t)			Self-sufficiency rate ^b (%)
	Output	Consumption	Gap ^a	
Three major grain products	56 304	46 928	-9 376	120.0
Rice	20 823	18 950	-1 873	109.9
Wheat	13 019	10 977	-2 042	118.6
Corn	22 463	17 001	-5 462	132.1
Soybean	1 179	8 775	7 597	13.4
Edible vegetable oil	1 126	3 280	2 154	34.3
Soybean oil	41	1 410	1 369	2.9
Rapeseed oil	462	630	168	73.3
Peanut oil	252	260	8	96.9
Palm oil	0	570	570	0.0
Cotton	522	716	194	72.9
Sugar	1 160	1 560	400	74.4

Source: Data from *China Agriculture Statistical Report* and *Food Development Report of China* over the years, the China National Grain and Oils Information Center, the National Cotton Market Monitoring System, and the China Sugar Association.

^aGap = Consumption - Output.

^bSelf-sufficiency rate = Output/Consumption.

2.2 Structure of animal husbandry: Unfit for the carrying capacity of resources

(1) The structure of the animal husbandry industry does not match the carrying capacity of the environment and is not spatially in line with the processing ability of animal waste. Specifically, the animal husbandry and crop farming industries are not well balanced regionally; as a result, the comprehensive utilization rate of animal waste is less than 50%. In some areas, the numbers of livestock and poultry exceed the carrying capacity of the environment,

leading to severe pollution problems. Specifically, Northeast China has abundant feed grain and a strong ability to absorb animal waste. However, given the small population in the region, the market for animal products is small, and the husbandry industry is underdeveloped. The southeast coastal areas, on the other hand, lack feed grain. Owing to their dense population, they have a large market for animal products and well-developed animal husbandry industry; however, the environmental carrying capacity is limited.

(2) The majority of the bred animals are grain-feeding animals, such as pigs and poultry, and the proportion of herbivores is small. Pork and poultry meat production accounts for more than 85% of the total meat production, while the proportion of herbivores (cattle, goats, sheep, and rabbits) is approximately 14%.

2.3 Industrial structure: Insufficient processing and service capacity

(1) A huge gap in the overall capacity of the agricultural product-processing industry exists between China and other countries. At present, the agricultural product-processing rate in China is only 60%, which is lower than that in developed countries (80%). The processing rate of fruit in China is only 10%, while the average global fruit-processing rate is 30%. The processing rate of meat in China is only 17%, while that in developed countries is 60%. In addition, the ratio between processing and agricultural output in China is 2.2:1, much lower than that in developed countries (3:1 to 4:1); the ideal theoretical ratio is 8:1 to 9:1 [5].

(2) The agricultural product-processing industry mainly produces primary processed products. The industrial chain is short, and the value-added capacity of processing requires improvement. The majority of the enterprises that process edible agricultural products have a low comprehensive utilization of by-products. Specifically, 5.7% of the enterprises treat by-products entirely as waste, and 25.3% of the enterprises believe that the value of by-products is not fully utilized [6].

(3) The quality and efficiency of the agricultural service industry are low. At present, the circulation mode of agricultural products is still mostly in the primary stage of distribution. Specifically, the products are first acquired from the origin of production by local dealers, who then trade with the dealers at sales destination, who finally supply the products to retailers. Modern circulation methods, such as contract farming, chain operations, and direct sales, are rarely applied.

2.4 Product structure: Many average-quality and few high-quality, safe, and specialized agricultural products; ill-matching supply and demand

As the quality of life for urban and rural residents in China has improved, from having only adequate food and clothing to leading a well-off life, the market requires more diverse and high-quality agricultural products. However, the domestic agricultural product market is mainly filled with average- or poor-quality products, and the total amount of high-quality agricultural products is low. The number of pollution-free, green, and organic agricultural products and products with specific geographical indications accounts for less than 20% of the total agricultural products available, leading to a contradiction between the limited supply from small-scale agricultural production and huge demand from the market. This problem has restricted the development of high-quality agricultural products in China.

2.5 Spatial structure: Inconsistent distribution of crop farming and water resources and spatially uncoordinated distribution of animal husbandry and crop farming

(1) The distribution of crop farming is inconsistent with the distribution of water resources. In China, the southern regions occupy 38% of the total land resources and 81% of the total water resources in the country, while the northern regions occupy 62% of the total land resources and 19% of the total water resources of the country. In recent years, the grain production center of China has shifted northward to regions with relatively less water, further intensifying the problem of a lack of water resources for land irrigation (Fig. 1).

(2) The distributions of animal husbandry and crop farming units are not spatially coordinated. In recent years, owing to the northward shift of the production center of corn, which is an important feed resource, the availability of the feed resources around large- and medium-sized cities in the southern regions is extremely limited; some areas often have no available feed resources. However, the southern regions have accelerated the breeding of pigs and intensified the density of aquaculture. Owing to the unreasonable local distribution of corresponding resources, the development of crop farming and animal husbandry is often poorly coordinated. In addition, the comprehensive utilization of animal waste is low, the contradiction between pig breeding and water environment protection has grown in prominence, and the uncoordinated spatial distribution of crop farming and animal husbandry units has

become increasingly severe.

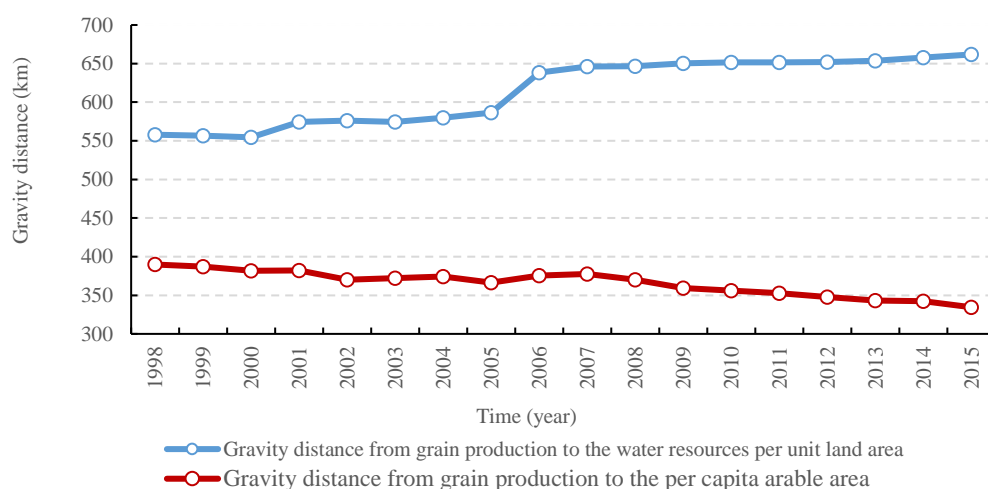


Fig. 2. Gravity distance from grain production to water resources per unit land area and per capita arable area.

3 Structural reform strategies of China's agriculture in the new era

3.1 General guidelines

The general ideas of the structural reform are as follows: respect the food security strategy and green development initiative proposed by the central government in the new era, and focus on the assurance of supply, protection of ecology, and security of income. The structural reform should include the study and design of more detailed policies to support green agricultural production; guiding the adjustment of development scales and spatial distribution of key crops, such as edible grains; and assisting with the adjustment of crop structures in areas with dominant products and environmental problems. The reform should actively prioritize the development of new business entities, such as family farms and large family-farming businesses, and optimize the variety and industrial and spatial structures of agriculture with the assistance of advanced science and technology. The reform should include the vigorous expansion of the forage feed industry, as well as of the corresponding processing and service industries. It is also necessary to accelerate the construction of a modern agricultural structure that is compatible with the resources and environment, adapts to market demand, and ensures coordinated development among the crop farming, animal husbandry, processing, and service industries.

3.2 Focus of the reform

(1) Optimizing variety structure by focusing on improving specialization, quality, and professionalism: Under the condition of guaranteeing a certain level of self-sufficiency, each region is required to steadily reduce and eliminate the products with limited sales, and vigorously develop the production of high-quality, specialized, and characteristic products that suit the market demand. In terms of food crops, the focus is to improve the proportion of high-quality and special-purpose grains and accelerate the construction of production bases for food crops, forage crops, and crops that are specifically used for further processing. The focus on cash crops is based on developing specialized products and expanding the construction of characteristic industrial bases for products such as Chinese herbal medicines and vegetables.

(2) Optimizing crop structure by focusing on developing the modern forage feed industry: The reform should promote the production of forage crops; transformation of food-crop land to forage-crop land; combined development of the crop farming and animal husbandry industries; and coordinated development of the ternary structure of food, cash, and forage crops. Guided by the requirement of "the determination of the crops to be planted based on the animal husbandry needs of the area," farmers in the major food-crop-producing areas are encouraged to cultivate forage and silage corn and plant high-quality forage such as alfalfa. Each region should expand the development space for high-quality forage by fully utilizing uncultivated hills, valleys, mounds, and bottomlands, as well as rehabilitated land, grasslands, and winter fallow fields in Southern China. In addition, regions are required to accelerate the construction of artificial grasslands and development of forage-harvesting, processing, and silage

machinery suitable for mountainous and hilly areas in Southern China.

(3) Optimizing the structure of the crop farming, animal husbandry, processing, and service industries by focusing on the secondary and tertiary industries: Each region should accelerate the development of agricultural product-processing industry, build industrial clusters, actively develop methods for the primary processing of agricultural products, and build a batch of specialized, large-scale, standardized raw material-production bases. Each region is encouraged to develop socialized services for the entire agricultural production process and to promote large-scale agricultural operations. Furthermore, it is suggested that regions accelerate the integration between the market circulation system and distribution of storage, transportation, and processing industries; transform and advance the local market at the origin of the agricultural products; and develop “Internet Plus” agriculture. Furthermore, the regions are encouraged to explore cultural resources in rural areas, expand the versatility of the agriculture industry, and develop modern and leisure urban agriculture practices to improve the overall efficiency of agriculture.

(4) Optimizing spatial structure by focusing on improving the carrying capacity of resources and the environment: Based on the comprehensive consideration of factors, such as natural conditions, economic development, and market demand, each region should optimize the spatial distribution of crop farming and animal husbandry units; properly arrange the location of intensive farms according to the carrying capacity of the environment and agricultural resources of the local areas; and improve the compatibility of agricultural production, resources, and the environment. The goal is to facilitate the agglomeration of agricultural production towards advantageous areas and achieve a favorable regional and professional distribution of agricultural production units.

4 Structural reform plan for agriculture in China

4.1 Structural reform plan for crop farming

4.1.1 General plan

With the consideration of the allocation and production of various food, industrial, seed, and cash crops, the structural reform intends to promote a shift in the crop farming industry from a dual structure (food and cash crops) to a ternary structure (food, cash, and forage crops), and implement a system that ensures the safe supply of food crops, stabilizes the supply of cash crops, and increases the supply of forage crops.

The goals are to adjust the proportions of the planting areas of food, cash, and forage crops from 52.1:30.7:17.2 in 2015 to 47.3:30.0:22.7 and 44.8:29.6:25.7 by 2025 and 2030, respectively (Table 2), and to increase the planting areas of silage corn and alfalfa to 60 and 97 million mu and 90 and 110 million mu by 2025 and 2030, respectively.

Table 2. Structural reform plan for crop farming.

Category		2015	2025	2030
Crops planting area ($\times 10^4$ mu)		249 561	269 225	279 630
Structure of food, cash, and forage crops	Food crops ^a (%)	52.1	47.3	44.8
	Cash crops ^b (%)	30.7	30.0	29.6
	Forage crops ^c (%)	17.2	22.7	25.7
Percentage of main crops	Rice (%)	18.2	16.0	14.8
	Wheat (%)	14.5	12.9	12.0
	Corn (%)	22.9	27.2	29.5
	#Silage corn (%)	1.6	2.2	2.5
	Cotton (%)	2.3	2.2	1.8
	Sugar crops (%)	1.0	1.0	1.0
	Oil plants (%)	8.4	9.3	9.9
	Alfalfa (%)	2.8	3.6	4.0

^aFood crops include edible grains and grains for industrial use, such as rice, wheat, corn, soybean, tubers, and coarse grains.

^bCash crops include cotton, oil plants, sugar crops, and vegetables.

^cForage crops include feed corn, fodder rice, forage tubers, feed grains, and green fodder.

4.1.2 Optimizing the regional distribution of crops

Restoring rice production in the south and stabilizing it in the north: The planting area of rice in the well-irrigated

areas of Northeast China has gradually decreased; therefore, the focus for rice production is to improve the intensification and product quality in river- and lake-irrigation areas and reduce rice planting in the northwest regions. Future focus should be cast on the construction of superior production areas along the middle and lower reaches of the Yangtze River and restoration of rice planting in Southern China with sufficient hydrothermal resources.

Stabilizing wheat production in the north and reducing it in the south: The future focus for wheat production is to stabilize the capacity of the main wheat-producing areas alongside the Yellow River, Huaihai River, and Haihe River basins, to increase the yield of wheat-growing areas under rice stubble in the middle and lower reaches of the Yangtze River, moderately restore the production capacity of strong-gluten spring wheat area in the northeast, and to appropriately reduce wheat production along the Yellow River, Huaihai River, and Haihe River basins, which suffer from the over-exploitation of groundwater.

Stabilizing corn production in advantageous areas and controlling it in non-advantageous areas: The focus for corn production is to stabilize the corn-production capacity of advantageous areas in the northeast and along the Yellow River, Huaihai River, and Haihe River basins, and to reduce the planting areas of corn in non-advantageous regions, such as the agro-pastoral zone in the north, the wind-sand and arid zones in the northwest, and the rock desertification zone in the southwest. In addition, the regions are expected to expand the planting of silage corn as fodder supply for the animal husbandry industry and reduce the production of sweet corn, especially in non-advantageous areas.

Applying crop rotation between soybean and grains: Corresponding regions are encouraged to apply crop rotation between soybean and grains to gradually restore and improve the productivity of soybean. The northeast regions are expected to expand the planting area of high-quality edible soybean varieties and stabilize the area of soybean varieties produced for oil. The areas along the Yellow River, Huaihai River, and Haihe River basins are expected to focus on producing high-quality, high-protein edible soybean varieties by appropriately restoring the planting areas. The southern regions are expected to apply the intercropping technique to improve both the cultivation and maintenance of the land.

Stabilizing the production of oilseed rape and increasing the production of peanut: The focus for production of plants used for oil is to strengthen the construction of the superior rapeseed production areas along the Yangtze River Basin, increase the planting of “double low” (low erucic acid and low glucosinolate) rapeseed in the winter fallow fields and tidal flats alongside rivers and lakes in the south, and expand the planting areas of spring rape in the northern regions. In addition, corresponding regions are expected to expand the planting area of peanut, with a focus on peanut planted for oil extraction along the Yellow River, Huaihai River, and Haihe River basins, as well as crop rotation implemented between peanut and grains.

Stabilizing and improving the efficiency of cotton production in the north: The focus for cotton production is to stabilize the cotton-growing area in Xinjiang, promote the planting of high-yield cotton varieties that are strongly resistant to salt and alkaline conditions and allow for convenient machine harvesting, and promote the application of mechanized production techniques. In addition, it is necessary to consolidate cotton production in the saline-alkali and tidal flats alongside the seas, rivers, and lakeside areas of Yanhuang.

Increasing the production of sugar cane and stabilizing the production of sugar beet: The production of sugar cane should focus on the two advantageous areas of the southern central Guangxi Autonomous Region and southwestern Yunnan Province. In addition, it is necessary to stabilize the production of sugar beet in the major production areas, such as the Xinjiang Autonomous Region, Inner Mongolia Autonomous Region, and Heilongjiang Province, and reduce its production in the south and along the Yellow River, Huaihai River, and Haihe River basins.

Ensuring balanced development of vegetable production: The focus for vegetable production is to reduce the production of protected vegetables along the Yellow River, Huaihai River, and Haihe River basins; reduce both the intensity of non-point source pollution and the planting area and scale of production of the vegetables that are planted in the southern regions for supplying to the northern regions; and reinforce the development of production bases for winter and spring vegetables in the southwest and summer and autumn vegetables in the Loess Plateau, Gansu Province, and Xinjiang Autonomous Region.

Actively cultivating forage crops: The focus for forage-crop production is to guide the production of forage crops to be in accordance with animal husbandry. Specifically, the northern regions are expected to develop alfalfa, silage corn, forage oats, and forage barley, and implement a crop rotation between food and forage crops; the southern regions are expected to develop a large variety of forage crops, such as ryegrass, clover, Chinese pennisetum, and forage rapeseed, as well as grasslands in the mountain areas.

4.1.3 Adjusting the regional structure of crops

Regions in Northeast China are expected to stabilize the production of rice; expand the production of soybean, coarse grains, tubers, and forage crops; and establish a crop rotation system. Specifically, the focus for the adjustment plan is to stabilize the advantageous rice-planting areas, such as the Sanjiang and Songnen plains; reduce the planting areas of corn in Northern Heilongjiang Province, Hulunbeier (Inner Mongolia Autonomous Region), and the transition zone between cropping and nomadic areas; expand the production of soybean, coarse grains, tubers, and forage crops; adopt planting methods, such as crop rotations, between grains and soybean or grains and forage; and establish a healthy balance between crop farming and animal husbandry practices to thereby gradually establish an actionable rotation system.

Regions in Northern China are expected to focus on stabilizing the existing crop structure, applying a moderate reduction, and ensuring the coordinated development of food, cash, and forage crops. Specifically, the regions should stabilize the planting area of wheat; improve the methods of yielding two crops a year, such as wheat with corn, soybean, or peanut; and stabilize the planting areas of vegetables. In addition, on the premise of steadily increasing the grain production capacity, the regions in Northern China should moderately reduce the wheat-planting area in areas with a severe over-exploitation of groundwater; expand the planting area of silage corn; and appropriately expand the planting areas of peanut, soybean, and forage.

Regions in the middle and lower reaches of the Yangtze River are expected to stabilize the planting area of double-cropping rice and rapeseed and improve the quality of these products. The regions should stabilize the planting area of double-cropping rice, focusing on the promotion of centralized sprout cultivation and machine transplanting methods; stabilize the planting area of rapeseed, speeding up the selection and promotion of rapeseed varieties that have short growth periods and are suitable for machine harvesting; improve the quality of products, selecting and promoting the non-glutinous rice and japonica rice varieties that have moderate growth periods, high yields, and good quality; and incorporate special varieties of weak (low-gluten) wheat. In addition, these regions are expected to develop forage crops, such as ryegrass, for growing in winter fallow fields.

Regions in Southern China are expected to stabilize the planting areas of rice and sugar crops and expand those of winter crops. Specifically, the regions should stabilize the planting area of double-cropping rice, select and promote high-quality non-glutinous rice, and develop ratoon rice according to the local conditions; stabilize the planting areas of sugar crops; promote the application of virus-free seedlings; strengthen the construction of infrastructure in the fields of high-yield and high-sugar varieties of sugar cane; accelerate the pace of machine-harvesting techniques; and promote sugar crops that are planted in autumn and winter. In addition, the regions should fully utilize the light and temperature resources in winter to expand the planting areas of winter potato, corn, silk pea, green manure crops, and forage crops.

Regions in Southwest China are expected to determine the types of crops based on the characteristics of the land, stabilize the planting areas of cash crops, increase the planting areas of forage crops, and facilitate animal husbandry through the growth of forage crops. The regions should stabilize rice and wheat production, develop the production of ratoon rice, stabilize the planting area of highland barley in the Tibetan areas, and expand the planting areas of potato and coarse grains; promote technologies, such as rapeseed seedling transplanting and machine planting, to expand the production of high-quality rapeseed; reduce the planting area of corn in the non-advantageous areas in the Yunnan–Guizhou Plateau; and plant high-quality forage to develop herbivorous animal husbandry.

Regions in the Loess Plateau should cultivate the potential of agricultural production based on the precipitation in the region and establish a highly efficient agricultural structure with dry-farming products. The regions are also expected to stabilize summer crops (wheat) and actively develop potatoes, spring wheat, coarse grains, legumes, and forage crops (silage corn, alfalfa, forage rape, and forage oats) according to the requirements of the local area. Particularly, the regions should develop specialized cereal grains and legumes, expand the planting of special oil plants, and strengthen the construction of the seed production bases for corn, vegetables, virus-free potatoes, and alfalfa.

Regions in Northwest China are expected to allocate farmland based on the availability of water resources and determine the crops to be grown based on the availability of land type, to establish a water-conserving agricultural production system. Specifically, the regions should actively promote the machine harvesting of cotton and stabilize the corresponding planting area, as well as develop forage production, promote ley farming, protect mountain pastures, and promote animal husbandry.

Regions in the central part of Inner Mongolia should determine the livestock breeding amount based on the availability of forage, accelerate the development of high-quality artificial forage materials, expand vegetation cover,

and improve the ecological environment. The regions should also expand drought-tolerant food crops, such as potatoes, millet, sorghum, and artificial forage, and encourage fallow and crop rotation.

Regions in the Qinghai–Tibet Plateau are expected to develop an agricultural system that integrates food crops, forage crops, and grasslands and facilitates the integration of crop farming and animal husbandry. Specially, the region should guarantee the self-sufficiency of grains (highland barley), while casting attention on the integration of crop farming, animal husbandry, and pasture planting in agricultural areas to develop the characteristics of plateau-specific agriculture based on the development of animal husbandry and ecological security.

4.2 Structural reform plan for animal husbandry

The government should comprehensively consider the production efficiency of various livestock and poultry animals, the likelihood of trade substitution, and the development space for herbivores when designing the product structure of the animal husbandry industry. Specifically, the corresponding regions should stabilize the production of live pigs, expand the production of broiler chickens, and vigorously develop beef cattle, dairy cows, meat sheep, and other herbivores. The goal is to increase the production of pork, poultry, cattle, mutton, poultry eggs, and dairy products to 60.95, 23.13, 9.72, 6.53, 33.57, and 47 million tons, respectively, by 2030. In addition, during the period between 2015 and 2030, the proportion of pork will be reduced by 4.1%, whereas that of beef and mutton will be increased by 2.7% and that of poultry meat will be increased by 1.5% (Table 3).

Table 3. Structural reform plan for animal products.

Category	2015		2025		2030	
	Production ($\times 10^4$ t)	Scale (%)	Production ($\times 10^4$ t)	Scale (%)	Production ($\times 10^4$ t)	Scale (%)
Meat products	8 454	100.0	9 606	100.0	10 033	100.0
Pork	5 487	64.9	5 962	62.1	6 095	60.8
Beef	700	8.3	892	9.3	972	9.7
Mutton	441	5.2	590	6.1	653	6.5
Poultry	1 826	21.6	2 162	22.5	2 313	23.1
Dairy products	3 870	100.0	4 500	100.0	4 700	100.0
Poultry eggs	2 999	100.0	3 291	100.0	3 357	100.0

The basic idea of the overall distribution of animal husbandry is to reduce the scale of livestock and poultry farming around the water-network area in the south and in areas surrounding large cities (such as Beijing, Tianjin, and Shanghai); develop the animal husbandry industry in the northeast, along the Yellow River, Huaihai River, and Haihe River basins and transition zones between cropping and nomadic areas; and optimize the distribution of animal husbandry units within the areas along the Yellow River, Huaihai River, and Haihe River basins. From the perspective of industrial distribution, the pig-farming areas should be categorized into key development zones (areas along the Yellow River, Huaihai River, and Haihe River basins and Southwest China), constrained development zones (areas surrounding Beijing, Tianjin, and Shanghai and water network in Southern China), potential growth zones (Northeast China), and moderate development zones (Northwest China). In addition, each region should promote the coordinated development of pig production and resources, the environment, and market. The production of beef cattle should focus on consolidating the development of the producing areas in Central China, steadily improving them in Northeast China, optimizing their development in Western China, actively developing them in Southern China, and protecting the development of the pastoral areas in Northern China, to improve the quality of beef gradually. The production of mutton sheep should focus on consolidating the production areas in Central China and the agro-pastoral zone in Eastern Central China, optimizing their development in Western China, actively developing them in Southern China, and protecting the development of pastoral areas in Northern China. The production of dairy cows should focus on consolidating the development of production areas in Northern China, Inner Mongolia, and Northern China, steadily improving them in Western China, actively developing them in Southern China, and fully utilizing the grassland resources in the winter fallow fields and mountain areas of Southern China. The production of poultry should focus on the vigorous development of production areas in Northern China and in the middle and lower reaches of the Yangtze River, as well as the moderate development of areas surrounding cities.

4.3 Reform plan for industrial structure

4.3.1 Vigorously developing the agricultural product-processing industry

The corresponding regions are expected to expand the scale of the agricultural product-processing industry; enhance the technological focus; extend the industrial chain; and meet the needs of urban and rural residents in terms of healthiness, safety, and quality of food. The goal is to achieve a ratio of 2.7 between the output of the agricultural product-processing industry and total agricultural output by 2025 and a ratio of 3.0 by 2030. In order to achieve this goal, the corresponding regions should adopt the following measures: first, the regions should actively introduce the concepts of “Internet Plus” and “Industry 4.0” to innovate the processing methods and business models of agricultural products; second, the corresponding regions should increase the research on modern processing technologies; third, the local governments should encourage the intensive processing of by-products so as to improve their comprehensive utilization rate; fourth, the regions should strengthen the research and development of specialized agricultural products and construction of agricultural bases; fifth, the regions should improve the processing standards of agricultural products so as to improve their quality.

4.3.2 Promoting the development of protected agriculture

The general development trend of protected agriculture is toward the direction of increasing intelligence, industrialization, energy conservation, and efficiency. To accelerate the development of protected agriculture in China, the government should enhance their support for scientific and technological innovations in protected agriculture, focusing on breakthroughs in key technologies. Such breakthroughs could include the simulation of the photothermal dynamic processes in facilities and response mechanisms of crops towards the environment and nutrients, environmental biological mechanisms, and regulation mechanisms of animal husbandry; mechanization of the entire process; smart vertical planting technology, mechanized feeding management; and animal waste treatment technology. In addition, the government should reinforce the training of professionals in protected agriculture. Most of the employees in protected agriculture in China are part-time farmers who have received little education and lack management experience; hence, it is difficult to guarantee production volume and efficiency. Therefore, from a strategic perspective, the government should focus on training professional farmers for protected agriculture, innovating talent with an international vision, and developing talent for the development of international business.

4.3.3 Orderly development of leisure agriculture

As a new industry and business, leisure agriculture has gradually shown its industrial advantages and development potential in promoting agricultural efficiency, increasing farmers' income, and increasing “green areas” in rural areas. It is an effective way to promote the supply-side structural reform of agriculture. In order to promote an orderly development of leisure agriculture, the local government and corresponding parties should develop the agriculture industry to fully embody all essential characteristics of agriculture, consider the local market environment and allow farmers to fully exert their dominant position in the market, extend the industrial chain and broaden the development space of the leisure agriculture industry; and generate and characterize a development model involving diverse consumer groups.

5 Measures to promote the optimization of agricultural structure in China

(1) Constructing high-standard farmland

To ensure the absolute safety of grain rations, basic self-sufficiency of grain products, and a certain level of self-sufficiency of commodities, the government should increase the construction of high-standard farmland to ensure the best use of farmland for agricultural production. It is recommended that the government increase their financial investments in the construction of high-standard farmland and water conservation facilities dedicated to these farmlands. In addition, following the completion of high-standard farmland, the corresponding land should be classified as “permanent basic farmland” included in red-line areas for farmland protection, and its use should be protected through legislation. The ownership and administration of high-standard farmland should be registered with the government. Following the completion of the project, corresponding photos of the farmland should be taken and submitted to the management database. The government should have detailed information in terms of the accurate location and the farmers in charge of the land to ensure that the use of the land will not change, the quality keeps improving, and the person responsible can always be found whenever problems occur. Furthermore, it is recommended to prioritize the construction of high-standard farmland in areas classified as major crop-growing

regions and protected areas for agricultural production.

(2) Recuperating the farmland

The corresponding parties should implement recuperation projects that balance the use and maintenance, as well as cultivation and recuperation, of land to establish the crop rotation systems (such as between grains and soybean or forage) that suit production development, match resource endowments, and meet market demand. Low-yielding corn areas along the “sickle bay” area and the Yellow River, Huaihai River, and Haihe River basins should be transformed from food-crop land to forage-crop land. Forage crops, such as silage corn, alfalfa, oats, and barley, should be developed according to the local conditions to assist the development needs of the herbivore animal husbandry. Regions in Northeast China should replace the continuous cropping of corn with crop rotations between corn and soybean. Regions along the Yellow River, Huaihai River, and Haihe River basins should replace the annual double cropping of wheat and corn with that of wheat and soybean or intercropping between corn and soybean. Regions in Northern China that over-exploit groundwater should reduce the planting area of wheat and replace wheat with drought-tolerant crops, such as cotton, sunflower, potato, and alfalfa.

(3) Rebalancing food-crop production regions

Currently, an increasing number of problems exist in terms of the distribution of production areas. The majority of food crops in the south are supplied by regions in the north. In addition, the number of main sales areas continues to increase. Therefore, it has become necessary to implement a rebalancing project that restores production in the south and reduces it in the north. Thus, the southern regions can fully utilize their natural advantages, such as high annual accumulated temperatures, long crop-growth periods, and high recultivation potential to improve the proportion of grain production. Moreover, it is necessary to appropriately adjust the production area of food crops in the north to reduce the agriculture-induced stress on the land and water resources. Specifically, restoring production in the south refers to the stabilization of production areas. It is necessary to control arable land and its use in the main sales areas, such as Shanghai, Zhejiang, and Guangdong, as well as in the major production areas of the Jiangnan Plain and Sichuan Basin, which are undergoing rapid urbanization. In addition, according to local conditions in the south, the corresponding parties should develop winter food crops, such as double-cropping rice and potato; promote production and cultivation techniques that are cost-saving and efficient; and gradually increase the supply capacity of major grain products. “Reducing production in the north” refers to the reduction of food-crop production in the resource-limited and non-main production areas. The focus should be cast on reducing the planting area of corn in the fourth and fifth accumulated temperature zones in Northeast China and the agro-pastoral zone in Northern China, as well as reducing the planting area for wheat in the northern areas that face a severe over-utilization of groundwater.

(4) Promoting featured minor crops

The production of minor crops, such as soybean, potato, forage feed, coarse grains, and legumes, has been lacking sufficient attention in recent times. However, such crops play a significant role in establishing a rational rotation system, promoting the green development of agriculture, and enhancing benefits to farmers. Therefore, it is recommended to strengthen the development of minor crops, focusing on providing political support for their collection and storage, production (such as providing subsidies), market circulation, and processing and transformation, as well as for the scientific innovation of the production and processing of minor crops and forage. This will help to stimulate potential technological breakthroughs in terms of improving varieties, cultivation quality, and standard development.

(5) Implementing a pilot project of the subsidy reform for green agriculture

The current agricultural production subsidy system, which lacks suitability for the new agricultural situation in China, needs reform. Specifically, the subject and coverage of subsidies do not fit the demand, objectively hindering the improvement of agricultural productivity, resources, and environment. To that end, it has become essential to push forward a reform of the three major subsidies in agricultural production (comprehensive subsidies for means of agricultural production, direct subsidies for food crop farmers, and subsidies for improved crop varieties), link the agricultural subsidy reform with green agricultural restructuring and agricultural transformation and upgrades, and expand the subsidies that support ecological production. The goals of this are to relieve the contradiction between ecology and high-efficiency agriculture, and promote the establishment of an agricultural system that balances the use and maintenance of land, saves resources, and is environmentally friendly. Therefore, the principles of the green agricultural subsidy reform are as follows: the key subject of subsidies should be food crops; the subsidies should be orientated towards the main production areas that have good conditions, a large production scale, and a noticeable comparative advantage; the subsidies should be granted to the farmers themselves so as to protect their benefits and

secure their income; and the subsidies should meet the requirements of green agriculture development.

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