Postprint: Recommendations for Overall Layout Adjustment of China's Agricultural Regions During the 15th Five-Year Plan Period

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Abstract

To implement the guiding spirit of the central government's directives on adhering to the "Greater Food" concept and building a strong agricultural nation in the new era of China's agricultural development, this article addresses the theme of overall layout adjustment for China's agricultural regions during the 15th Five-Year Plan period. Building upon a review of existing issues concerning the designation of major agricultural product production zones and the evolving layout of grain production bases, and integrating the central government's new requirements, the study undertakes refined classification, functional positioning, and strategic formulation for agricultural regional layout adjustments. It proposes an overall layout scheme for agricultural regions encompassing 8 major agricultural product production zones, 3 secondary agricultural product production zones, and 6 advantageous agricultural product production zones (the "8+3+6" framework). Subsequently, specific recommendations are advanced for functional upgrading of agricultural regions and suitable major construction projects to be implemented.

Full Text

Preamble

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Title: Suggestions for Layout Adjustment of China's Agricultural Regions During the Fifteenth Five-Year Plan Period

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Abstract

To implement the central government's directives on adhering to the "Greater Food" approach and building a strong agricultural sector in the new era, this paper addresses the overall layout adjustment of China's agricultural regions during the Fifteenth Five-Year Plan period. Based on a review of existing problems in the designation of major agricultural production regions and changes in the layout of grain production bases, we refine the classification of agricultural regions, clarify their functional positioning, and formulate adjustment strategies in accordance with new national requirements. We propose an overall layout scheme comprising eight major agricultural production regions, three sub-production regions, and six agricultural advantage regions (the "8+3+6" framework). Furthermore, we provide specific recommendations for enhancing the functions of agricultural regions and implementing major construction projects.

Keywords: agricultural regions, major agricultural production regions, Greater Food approach, food security, grain production bases, integrated layout

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1. Problems in Agricultural Region Layout and New Requirements

1.1 Existing Problems

Agriculture can be understood in both broad and narrow senses. Broadly defined, agriculture encompasses all economic activities related to crop cultivation, forestry, animal husbandry, and fishery production, as well as their processing, distribution, and services. In its narrow sense, agriculture generally refers to crop cultivation, including grain crops, tubers, beans, oil crops, cotton, hemp, sugar crops, tobacco, vegetables, fruits, nuts, medicinal herbs, and forage grass. As early as the 1930s, the renowned geographer Hu Huanyong first attempted to divide China into nine agricultural zones based on natural geographical conditions such as topography and climate, providing an important theoretical foundation for subsequent research on agricultural productivity layout and agricul-

tural regionalization. Between the 1950s and 1980s, China successively carried out comprehensive physical regionalization and comprehensive agricultural regionalization to better guide agricultural production, which played a crucial role in adjusting agricultural industrial structure and overall productivity layout. After the 1990s, national and local governments designated a number of national and provincial commercial grain production base counties, basically forming a spatial pattern of China's nine major commercial grain production bases composed of the Northeast Plain, the middle and lower reaches of the Yangtze River Plain, and the Pearl River Delta region. After 2000, the Ministry of Agriculture identified 268 counties in pastoral and semi-agricultural/semi-pastoral areas, covering 13 central and western provinces including Inner Mongolia, Sichuan, Tibet, Qinghai, and Xinjiang, establishing the development pattern of China's animal husbandry industry.

In 2010, the State Council issued the *Major Function Oriented Zoning Plan of China*, which systematically and comprehensively laid out China's agricultural regions for the first time by designating major agricultural production regions and supporting them with corresponding fiscal, industrial, land, and population policies. This formed the "Seven Regions and Twenty-Three Belts" agricultural strategic pattern, primarily comprising the Northeast Plain, Huang-Huai-Hai Plain, Yangtze River Basin, Fen-Wei Plain, Hetao Irrigation District, South China, and Gansu-Xinjiang major production regions. The *National Territorial Space Planning Outline (2021-2035)* subsequently optimized and adjusted the spatial pattern of national agricultural regions. However, the adjustment methodology essentially continued the framework of the Major Function Oriented Zoning Plan for designating major agricultural production regions. Notably, the number of county-level units designated as major agricultural production regions decreased rather than increased, failing to effectively mitigate the "south-decrease, north-increase" trend in China's agricultural production over the past 30 years. Instead, it solidified and amplified the "inverse resource endowment" problem in agricultural production conditions.

The 2015 Central Rural Work Conference emphasized "taking national food security as the primary task," while the 2016 No. 1 Central Document first identified "adopting a Greater Food approach" as an important component for optimizing agricultural production structure and regional layout. However, China's current agricultural region strategic layout struggles to effectively support the establishment of a comprehensive food supply guarantee system under the Greater Food approach, urgently requiring adjustments to the overall layout for the coming period. This necessitates expanding the scope of agricultural production regions, consolidating grain production safety bases, optimizing the layout of agricultural product production, and gradually achieving a rational spatial-temporal allocation of grain production, a combination of near and distant grain supply, and a robust agricultural security pattern with strong guarantees for diverse food supplies.

The early designation of major agricultural production regions had three main

deficiencies. First, these regions were primarily selected from areas outside the priority development zones, key development zones, and key ecological function zones, making it difficult to fully reflect the actual pattern of China's agricultural space. Notably, substantial important agricultural production areas existed within these priority function zones, especially around cities with high-quality cultivated land resources and good agricultural development foundations, which were often designated as urbanization areas based on urban development considerations. Second, the designation failed to address the "Greater Food" guarantee issue, focusing mainly on grain production areas and only incidentally mentioning animal husbandry in agricultural areas and freshwater aquaculture. Third, traditional pastoral areas on the Inner Mongolia Plateau, the Tianshan Mountains in Xinjiang, and the eastern Qinghai-Tibet Plateau are important livestock product production regions but were designated as key ecological function zones without separate listing.

The newly designated major agricultural production regions exhibit an "inverse resource endowment" problem. The *Major Function Oriented Zoning Plan* designated 793 county-level units as major agricultural production regions, accounting for 27.71% of all county-level administrative units nationwide, covering an area of 2.4413 million km^2 (approximately 25.43% of China's total land area) and involving a total population of 402 million (about 30.94% of the national population). The *National Territorial Space Planning Outline (2021-2035)* adjusted the number of county-level units in major agricultural production regions to 725, adding 38 counties in the Huang-Huai-Hai Plain and along the Yellow River in Gansu and Ningxia, while removing 106 counties from the middle and lower Yangtze River region, South China, Yunnan-Guizhou Plateau, and Qinghai-Tibet Plateau. The adjusted regions cover a total area of 2.1006 million km^2 (about 25.43% of national territory) with a total population of 343 million. Compared with the earlier designation, the number of county-level units decreased by 68, with increases in water-scarce northern regions and substantial decreases in southern regions with better production conditions.

The "south-decrease, north-increase" trend in grain production has not been effectively curbed. From the founding of the People's Republic of China to the early reform and opening-up period, China's grain production center was consistently located in the southern region. Between 1949 and 1989, grain production in southern China accounted for about 60% of the national total. Beginning in 1990, the proportion of grain production in the south declined continuously, and by 2005, northern China's grain production exceeded that of the south for the first time, with the gap continuing to widen. By 2022, northern China's grain production accounted for 59.80% of the national total, while the southern region contributed only about 40%, completely reversing the north-south grain production pattern [Figure 1: see original paper].

1.2 New Requirements

The Greater Food approach requires comprehensive and multi-channel development of food resources to ensure effective supply of various foods including meat, vegetables, fruits, aquatic products, eggs, and milk while guaranteeing grain supply, thereby achieving a diversified food supply system. Currently, China is transitioning from a large agricultural country to a strong agricultural power. The Greater Food approach broadens the traditional boundaries of food security, shifting the food security strategy toward food security under the Greater Food perspective, and imposes new requirements on the comprehensive supply guarantee capacity of important agricultural products. Building a strong agricultural sector based on the Greater Food approach must highlight both grain security and guarantee effective supply of various foods. Given the time-sensitive nature and unsuitability for long-distance transportation of most agricultural products, agricultural region layout must reflect both resource endowment suitability and the spatial dispersion of agricultural production regions and regional differences among different categories. Although existing major agricultural production regions focus primarily on grain production, they all possess the characteristics of agricultural regional complexes suitable for multiple varieties. Adding sub-production regions or characteristic advantage regions can compensate for deficiencies in spatial dispersion and category differences.

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2. Classification and Functional Positioning of Agricultural Regions

Agricultural regions refer to areas with favorable agricultural development conditions that provide agricultural products such as planting products, livestock products, aquatic products, and under-forest products as their primary function, meeting the comprehensive supply guarantee capacity under the Greater Food approach. Agricultural regions represent an extension of the connotation and spatial improvement of major agricultural production regions in the Major Function Oriented Zoning Plan. Although they belong to the "Three Zones" that are mutually exclusive with urbanization areas and ecological areas in territorial space planning, agricultural regions in the broad sense also include agricultural production areas within urbanization and ecological areas. Agricultural regions exhibit significant regional differences in resource endowment, development conditions, types of agricultural products provided, and supply capacity. Based on primary functions and functional levels, agricultural regions can be divided into three types: major agricultural production regions, sub-production regions, and agricultural advantage regions [Figure 2: see original paper].

Major Agricultural Production Regions: These regions have abundant cultivated land and basic farmland, favorable agricultural development conditions, and serve as national important grain production bases. Their primary function is to provide grain and various agricultural products including livestock

and aquatic products, with at least one product having national-level guarantee significance. Other functions include providing ecological products, service products, and industrial products.

Sub-production Regions: These regions have essentially the same primary functions as major agricultural production regions but differ in their relatively smaller spatial scope. They serve as regional grain production bases, with their supply capacity of grain, livestock products, and aquatic products having regional value. Other functions include providing ecological products, service products, and industrial products. Sub-production regions can appear within urbanization areas.

Agricultural Advantage Regions: These regions possess unique resource endowments for livestock or aquatic product production with conditions for large-scale development. Their primary function is to provide a single type of agricultural product with regional or national significance. Other functions include providing ecological products and service products. Agricultural advantage regions mostly appear in ecological areas and represent a composite function of ecological areas.

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3. Indicator Basis and Adjustment Ideas

3.2 Adjustment Ideas

(1) **Optimize the spatial structure of major agricultural production regions** by constructing a "major production region + sub-production region" spatial layout system to ensure that each province (autonomous region) has at least one major or sub-production region. Based on the major agricultural production region scheme designated in the *Major Function Oriented Zoning Plan* and using per capita grain production as the core indicator—with total grain production, grain surplus, total cultivated land area, and per capita cultivated land area as auxiliary indicators—we screen counties (districts) with per capita grain production exceeding the 400 kg food security threshold, substantial grain export potential, large cultivated land reserves, and significant grain production scale as candidates for major agricultural production regions. We then adjust these candidates considering regional water-soil-light-heat resource matching conditions, major regional development strategies, modern agricultural development requirements, and the designation results of grain production functional zones and important agricultural product production protection zones. Areas that do not meet the scale and constraint indicators for major agricultural production regions but have important regional agricultural product self-sufficiency status are designated as sub-production regions.

(2) **Practice the Greater Food approach** by adding advantage regions for livestock products, aquatic products, vegetables, fruits, and other agri-

cultural products to ensure effective supply of important non-grain agricultural products. Areas outside major and sub-production regions with significant advantages in producing important non-grain agricultural products such as livestock and aquatic products are designated as advantage regions. These hold equal status with sub-production regions but differ in their comprehensive versus specialized nature.

(3) **Expand the scale of traditional grain production areas in southern regions**, increase the number of major agricultural production regions, and improve southern grain self-sufficiency levels. Southern regions face increasingly severe food security challenges due to declining cultivated land area and grain production. For traditional southern grain production areas such as the Jianghan Plain, Dongting Lake Plain, Poyang Lake Plain, Taihu Lake Plain, Zhejiang-Fujian Hills, and Guangdong-Guangxi Hills, we recommend screening counties (districts) with relatively high cultivated land reserves and grain production for addition as major agricultural production regions.

(4) **Consider the agricultural production functions of urbanization and ecological areas** by developing modern urban agriculture and important agricultural product supply guarantee zones. County-level units with relatively high grain supply guarantee capabilities from urbanization and ecological areas should be selected and adjusted to supplement major and sub-production regions, strengthening the layout of modern urban agriculture in key urbanization areas. For ecological areas such as the Greater and Lesser Khingan Mountains in Northeast China, Tianshan Mountains in Xinjiang, Qinling-Daba Mountains, Yunnan-Guizhou Plateau, and Qinghai-Tibet Plateau, advantage regions for livestock and forest products should be designated.

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4. Strategic Pattern of Agricultural Regions

During the Fifteenth Five-Year Plan period, China's agricultural region strategic layout will consist of an "8+3+6" structure: "8" refers to eight major agricultural production regions including the Northeast Plain, Huang-Huai-Hai Plain, Loess Plateau Rim, Middle-Lower Yangtze River Plain, Sichuan Basin, Yunnan-Guizhou Plateau, South China, and Xinjiang; "3" refers to three sub-production regions including the Hexi Corridor, Huangshui River Valley, and Tibet's "Two Rivers and Four Tributaries" (Yarlung Tsangpo River, Nyang River, Lhasa River, Nianchu River, Yalong River, and Shiquan River) areas; "6" refers to six agricultural advantage regions, comprising three livestock product advantage regions in Inner Mongolia, Xinjiang, and the Qinghai-Tibet Plateau, and three aquatic product advantage regions in the Bohai-Yellow Sea, East China Sea, and South China Sea [Figure 5: see original paper].

4.1 Major Agricultural Production Regions

Major agricultural production regions consist of eight large areas, mainly distributed in the Northeast Plain, Huang-Huai-Hai Plain, Loess Plateau Rim, Middle-Lower Yangtze River Plain, Sichuan Basin, Yunnan-Guizhou Plateau, South China, and the northern and southern slopes of the Tianshan Mountains in Xinjiang. These regions involve 821 county-level units, covering a total area of approximately 2.4155 million km^2 with a total population of about 398 million. They retain 1.083 billion mu of cultivated land (56.48% of the national total), produce 412 million tons of grain (61.53% of national grain output), and have a grain surplus of 253 million tons .

(1) Northern Production Regions include the Northeast Plain, Huang-Huai-Hai Plain, Loess Plateau Rim, and Xinjiang major production regions. The Northeast Plain and Huang-Huai-Hai Plain are China's largest regions in terms of area, agricultural production scale, production efficiency, and grain supply capacity, with cultivated land areas of 442 million mu and 242 million mu respectively, and grain outputs of 136 million tons and 145 million tons respectively. Their cultivated land and grain production capacity account for 63.16% and 68.32% of the total for all major production regions. The Loess Plateau Rim production region includes the Hetao area, Fen-Wei Valley, Xinzhou-Dingxiang Basin and Datong Basin in northern Shanxi, and the Longzhong wide-valley hilly area in central-eastern Gansu, forming a ring-shaped agricultural production region surrounding the Loess Plateau core area. The Xinjiang production region is mainly distributed on the northern and southern slopes of the Tianshan Mountains and serves as an important production base for non-grain agricultural products such as cotton, fruits, and vegetables.

(2) Southern Production Regions include the Middle-Lower Yangtze River Plain, Sichuan Basin, Yunnan-Guizhou Plateau, and South China major production regions. The Middle-Lower Yangtze River Plain is one of China's most important commercial grain production bases and the core region for grain, livestock, and aquatic product production in southern China, including the Jianghan Plain, Dongting Lake Plain, Poyang Lake Plain, Jianghuai region, and Taihu Lake Plain. Its cultivated land area and grain output are 102 million mu and 52.96 million tons respectively, accounting for 9.42% and 12.85% of the major production region totals, and playing a vital role in maintaining southern grain security. The South China production region mainly includes the Zhejiang-Fujian hilly area, Guangdong-Guangxi hilly area, Leizhou Peninsula, and Hainan Island in Fujian, Guangdong, Guangxi, and Hainan provinces, with grain, livestock, and aquatic products as dominant products. This region faces severe challenges of cultivated land abandonment and has the smallest cultivated land area and grain output among all major production regions, with a grain deficit of 3 million tons.

4.2 Sub-production Regions

Sub-production regions include three areas: the Hexi Corridor, Huangshui River Valley, and Tibet's "Two Rivers and Four Tributaries" region, involving 44 county-level units in Gansu, Qinghai, and Tibet with a total area of approximately 221,200 km^2, a total population of 5.63 million, 8.17 million mu of cultivated land, a grain output of 3.84 million tons, and a grain surplus of 1.43 million tons .

The Hexi Corridor area in northwestern arid regions has abundant sunlight, dry climate, and large diurnal temperature differences, serving as a major commercial grain base and cash crop concentration area in northwestern China. Water shortage is the main constraint on agricultural development in this region, and its development direction is large-scale, intensive, and industrialized characteristic agriculture in arid areas. The Huangshui River Valley and Tibet's "Two Rivers and Four Tributaries" area are major production regions for highland barley, wheat, potatoes, summer vegetables, and livestock products including Tibetan sheep, dairy cows, cashmere goats, and Tibetan chickens in the Qinghai-Tibet Plateau. Although their agricultural production scale is relatively small, they are crucial for ensuring grain self-sufficiency and food security in the Qinghai-Tibet Plateau.

4.3 Agricultural Advantage Regions

Compared with the *Major Function Oriented Zoning Plan*, this scheme adds characteristic agricultural regions reflecting livestock and aquatic product production to meet the optimization requirements of China's agricultural strategic pattern from the Greater Food perspective.

(1) Livestock Product Advantage Regions mainly include the Inner Mongolia grassland, Xinjiang Tianshan grassland, and Qinghai-Tibet Plateau alpine grassland pastoral areas. The Xinjiang livestock product advantage region includes the Ili River Valley, Irtysh River Basin, and Ta-E Basin grassland pastoral areas, with meat sheep, beef cattle, horses, and camels as dominant products. The Inner Mongolia livestock product advantage region includes the Xilingol and Hulunbuir grassland pastoral areas, with dairy products, beef cattle, meat sheep, pigs, poultry, and horses, donkeys, and camels as characteristic products. The Qinghai-Tibet Plateau livestock product advantage region includes the northern Tibet Plateau, southern Qinghai Plateau, and western Sichuan Plateau grassland pastoral areas, with yak and Tibetan sheep meat as dominant products.

(2) Aquatic Product Advantage Regions mainly include the Bohai-Yellow Sea, East China Sea, and South China Sea nearshore and deep-sea areas. The Bohai-Yellow Sea region includes the Yantai-Weihai fishing ground, Shidong Southeast fishing ground, and northern Jiangsu fishing ground. The East China Sea region includes the Zhoushan fishing ground, Diaoyu Islands fishing ground, and East Fujian fishing ground. The South China Sea region includes the Tai-

wan Shoal fishing ground, western Guangdong fishing ground, Beibu Gulf fishing ground, and deep-sea fishing grounds in the Xisha, Zhongsha, and Nansha Islands.

4.4 Comparison with the *Major Function Oriented Zoning Plan*

Compared with the agricultural strategic pattern determined by the *Major Function Oriented Zoning Plan*, this proposal expands the scope of major production regions in the Sichuan Basin, Middle-Lower Yangtze River Plain, Yunnan-Guizhou Plateau, and South China regions (Fujian, Guangdong, Guangxi) with favorable water-soil-light-heat conditions. It optimizes major production regions in the Northeast Plain, Huang-Huai-Hai Plain, and Tianshan Mountains in Xinjiang. It integrates the Fen-Wei Valley and Hetao area with the Longzhong Loess wide-valley hilly area, Xinzhou-Dingxiang Basin, and Datong Basin into the Loess Plateau Rim production region. It splits the Yangtze River Basin production region into the Middle-Lower Yangtze River Plain and Sichuan Basin production regions, and treats the Yunnan-Guizhou Plateau area from the South China production region as an independent Yunnan-Guizhou Plateau production region. Additionally, it adds three sub-production regions, three livestock product advantage regions, and three aquatic product advantage regions. Compared with the *Major Function Oriented Zoning Plan*, the new scheme involves 72 more county-level units, with an 8.4% increase in area, 8.2% increase in covered population, 28.62% increase in total cultivated land, 23.03% increase in total grain output, and 34.77% increase in grain surplus.

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5. Function Enhancement of Agricultural Regions

(1) **Consolidate northern and expand southern grain production bases.** Consolidate the commodity grain production bases for rice, corn, and soybeans in the Northeast Plain, the large-scale production advantage areas for wheat, specialized corn, and high-protein soybeans in the Huang-Huai-Hai Plain, and enhance the value-added benefits and market competitiveness of high-quality wheat, corn, and potatoes in the Fen-Wei Plain, Hetao Irrigation District, and oasis areas in arid regions to further consolidate northern grain production bases. Curb the trend of cultivated land abandonment and "non-grain conversion" in southern regions, moderately expand the core area for double-cropping rice and high-quality specialized wheat production in the Middle-Lower Yangtze River Plain, and increase the planting scale of double-cropping rice, wheat, corn, and potatoes in southwestern, southern, and southeastern coastal areas to improve the comprehensive production capacity and grain self-sufficiency level of traditional southern grain production bases.

(2) **Construct food production guarantee bases under the Greater Food approach.** Guided by the Greater Food approach and based on en-

suring national food security, expand agricultural production space from cultivated land to other types of territorial space by adding agricultural advantage regions for important aquatic products, livestock products, and under-forest products. First, advance the construction of aquatic product production bases by leveraging water resource advantages in freshwater lakes and reservoirs in the Middle-Lower Yangtze River region, Pearl River Delta, and Sichuan Basin to develop terrestrial freshwater aquaculture advantage areas. Optimize the layout of nearshore aquaculture bases including factory farming in the Bohai and Yellow Seas, as well as cage culture, raft culture, and bottom-sowing culture along southern coasts. Second, construct livestock product production bases by strengthening the construction of pig, poultry egg, and dairy livestock production bases in the Northeast Plain, Huang-Huai-Hai Plain, Middle-Lower Yangtze River region, southeastern coastal areas, and Sichuan Basin. Advance pasture improvement in traditional pastoral areas of Inner Mongolia, Xinjiang, and the Qinghai-Tibet Plateau to cultivate large-scale green beef cattle and sheep breeding bases. Third, cultivate under-forest characteristic agricultural product advantage regions by leveraging forest resource advantages in Northeast and Southwest China to develop under-forest planting, breeding, and collection/processing economies. Build ecological cultivation bases for cold-region Chinese medicinal herbs in the Greater and Lesser Khingan Mountains and Changbai Mountain forest areas of Northeast China, and develop integrated under-forest economic production bases in the Sichuan Basin, Daba Mountain area, and Yunnan-Guizhou Plateau forest areas of Southwest China.

(3) **Guide modern urban agriculture layout in key urbanization areas.** Promote the construction of comprehensive fresh agricultural product production guarantee zones adjacent to megacities and large cities, and layout comprehensive national grain reserve guarantee bases and emergency guarantee centers in the Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta, and Chengdu-Chongqing urban agglomerations. Regional-level grain reserve guarantee bases and emergency guarantee centers should be established in the Central Plains, Guanzhong Plain, Lanzhou-Xining, Tianshan North Slope, Middle Yangtze River, and Central Yunnan urban agglomerations to enhance food supply security and resilience against major risks in key urbanization areas. To ensure effective vegetable supply, guarantee grain production functions, and strengthen characteristic agricultural products, protect cultivated land and permanent basic farmland and other high-quality agricultural land resources in the suburbs and surrounding rural areas of megacities and large cities to construct urban ecological zone agricultural projects. Develop facility vegetable bases, large-scale livestock and poultry farms, and standardized healthy aquaculture farms, while strengthening agricultural product processing, storage, and cold-chain logistics facilities to improve green agricultural production capacity and nearby supply of

fresh agricultural products.

(4) **Promote the construction of livable, business-friendly, and beautiful villages by category.** Based on natural conditions and development status in different rural areas, adopt measures such as agglomeration and upgrading, urban-suburban integration, characteristic protection, and relocation and consolidation to promote village construction in agricultural regions. Intensify environmental improvement efforts, improve infrastructure construction, enhance basic public service capacity, and create livable living spaces. Guarantee production spaces for new rural industries and business forms, agricultural product processing and distribution industries, and modern rural service industries. Protect ecological spaces with beautiful landscapes and continue the rural spatial pattern of organic integration between humans and nature.

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6. Major Projects in Agricultural Regions

(1) **High-standard basic farmland transformation project.** In northern regions, address water conservancy facility shortcomings, with the Northeast Plain focusing on constructing water control irrigation hubs and cultivating fertile tillage layers in black soil areas, the Huang-Huai-Hai Plain emphasizing water-saving irrigation facilities and comprehensive saline-alkali land management, and the Loess Plateau Rim and oasis areas in Gansu and Xinjiang promoting soil improvement, salinization prevention, and farmland water-saving facilities. In southern regions, the Middle-Lower Yangtze River Plain and southeastern coastal areas should focus on improving the quality and efficiency of high-standard farmland, strengthening flood control, drainage, and acid soil improvement, while southwestern mountainous areas should emphasize farmland quality improvement to address fragmented sloping farmland.

(2) **Black soil protection project.** In concentrated black soil distribution areas such as the Sanjiang Plain, Songnen Plain, and Liaohe Plain, focus on cultivating fertile black soil tillage layers, improving supporting facilities in large and medium-sized irrigation districts, and renovating drainage systems in low-lying waterlogged areas. Conduct land parcel consolidation, transform sloping farmland, implement erosion gully control projects, and control soil erosion in black soil areas. Promote rotation systems such as grain-soybean, grain-cash crop, and grain-forage rotations, and implement the “Longjiang Model” and “Sanjiang Model” of straw crushing and deep plowing returning to enhance organic matter content and grain production capacity in black soil.

(3) **Comprehensive development and consolidation of Qinghai-Tibet Plateau valley areas.** In the Qinghai-Tibet Plateau, prioritize comprehensive development and consolidation of valley areas with better climate

conditions and suitable water and soil resources, such as Tibet's "Two Rivers and Four Tributaries" valley area and Qinghai's Huangshui River Valley. In Tibet's "Two Rivers and Four Tributaries" area, develop large-scale artificial irrigated grassland and irrigated agriculture in the Ali and Zanda valleys through self-flow irrigation canals supporting water conservancy hubs in the upper reaches of the Shiquan and Xiangquan Rivers, and guide ecological migration from the northern Tibet Plateau pastoral area. In the Nianchu River Basin, promote large-scale contiguous high-standard farmland construction and supporting water conservancy facilities to improve existing farmland quality. In the Shannan Yarlung Tsangpo River valley, develop large-scale irrigated agriculture through river beach land consolidation, bank protection projects, and farmland irrigation water conservancy construction to accommodate ecological migration from the northern Tibet Plateau pastoral area. In Qinghai's Yellow River Valley, develop large-scale irrigated agriculture through self-flow irrigation canals supporting the Yellow River cascade hydropower development project, and guide ecological migration from the Three-River-Source pastoral area.

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Note: Figure translations are in progress. See original paper for figures.