

Problems and Countermeasures for High-standard Farmland Construction in Huang – Huai Plain: A Case Study of Zhoukou City

Yanan XU*, Tingting XUE, Yan XU, Sen YANG, Shuangcheng ZHU

Zhoukou Academy of Agricultural Sciences, Zhoukou 466001, China

Abstract Based on a review of relevant literature and the current status of permanent basic farmland and high-standard farmland construction in Zhoukou City, this study comprehensively discusses the main issues in advancing high-standard farmland construction, including inefficient water resource utilization and irrigation, high pressure on soil quality improvement, insufficient disaster resistance capacity, inadequate long-term management and maintenance mechanisms, and insufficient capital investment and integration. To effectively address these problems, a series of targeted countermeasures are proposed, such as optimizing water resource management and irrigation systems, improving soil quality, enhancing disaster prevention and mitigation capacity, establishing sound long-term management and maintenance mechanisms, and coordinating efficient resource allocation. This study provides a reference for comprehensively advancing high-standard farmland construction.

Key words High-standard farmland; Permanent basic farmland; Zhoukou City

DOI:10.19759/j.cnki.2164-4993.2026.04.006

Food security, as the cornerstone of national security, has always been a fundamental issue related to the national economy and people's livelihood. General Secretary Xi Jinping has repeatedly emphasized that the Chinese people's rice bowls should be firmly held in their own hands, and the bowls should mainly contain Chinese grain. This statement profoundly illustrates the extreme importance of ensuring food security. Building high-standard farmland, as a core measure of the strategy of "storing grain in the land and technology", is of great significance for improving the quality of arable land, enhancing the comprehensive production capacity of grain, and stabilizing grain output. It is a key path to ensure national food security^[1]. Vigorously promoting the construction of high-standard farmland can not only improve agricultural production conditions and enhance the capacity of farmland to resist disasters, but also promote the large-scale, specialized, and modernized development of agricultural production, thereby facilitating sustainable agricultural development. The *National High-standard Farmland Construction Plan (2021–2030)* explicitly designates the Huang – Huai – Hai region as a key area for high-standard farmland construction^[2]. Located in the hinterland of the Huang – Huai Plain, Zhoukou City is endowed with abundant cultivated land resources, with its annual grain sowing area and output consistently ranking among the top in Henan Province, shouldering a significant responsibility in safeguarding national food security. Within the overall layout of high-standard farmland construction in the Huang – Huai – Hai region, the construction progress and effectiveness of Zhoukou City have a profound impact on regional and even national food production security. However, in the process of advancing high-standard farmland construction,

Zhoukou City faces a series of urgent issues, such as inefficient water resource utilization and irrigation, high pressure on soil quality improvement, insufficient disaster resistance capacity, inadequate long-term management and maintenance mechanisms, and insufficient capital investment and integration. These issues severely constrain the quality and efficiency of high-standard farmland construction. Conducting an in-depth analysis of the issues in the high-standard farmland construction in Zhoukou City and exploring practical countermeasures are of great practical significance for enhancing the local agricultural comprehensive production capacity and ensuring food security. It can also provide useful references for high-standard farmland construction in the Huang – Huai Plain and other regions across the country.

Current Status of High-standard Farmland Construction in Zhoukou City

Construction scale and progress

In recent years, Zhoukou City has achieved remarkable progress in advancing high-standard farmland construction. By the end of 2025, a total of 702 600 hm² of high-standard farmland had been constructed, accounting for over 94% of its permanent basic farmland. Over time, the construction standards have gradually evolved toward large-scale and intelligent development. For example, the Henan Zhoukou National Agricultural High-tech Industrial Demonstration Zone has fully completed the construction of 7 067 hm² of high-standard farmland. In collaboration with the Aerospace Information Research Institute of the Chinese Academy of Sciences, it has built a smart agricultural information platform featuring "1 center, 4 foundational platforms, and 12 application systems" and a 120 hm² unmanned farm. Zhoukou City has explored the "Zhoukou Model" for high-standard farmland construction, which has driven and facilitated the development of 233 300 hm² of high-standard farmland and smart grain fields across the

Received: May 15, 2026 Accepted: July 18, 2026

Yanan XU (1988 –), female, P. R. China, intermediate economist, devoted to research about agricultural economics and crop breeding promotion.

* Corresponding author.

city.

Project distribution

The distribution of high-standard farmland projects in Zhoukou City is closely aligned with the local agricultural production pattern. Flat and contiguous cultivated land areas, primarily located in the major grain-producing counties such as Taikang County, Xihua County, and Fugou County, have been designated as priority zones for high-standard farmland construction, further enhancing agricultural production efficiency through project implementation. In areas with slightly undulating terrain and relatively scattered farmland, such as some townships in Xiangcheng City, the construction focuses on improving farmland production conditions through measures including the development of small-scale water conservancy facilities and the construction of roads suitable for small agricultural machinery.

Infrastructure development

In terms of irrigation facilities, Zhoukou City has adopted a combined model integrating multiple irrigation methods, among which tube well irrigation is widely applied in high-standard farmland. In some areas, sprinkler irrigation and drip irrigation technologies have been implemented. For example, in the Shangshui County farmland demonstration zone, integrated water-fertilizer machines, fixed sprinkler irrigation systems, and intelligent controllers have been installed, enabling precise control of irrigation water. Irrigation operations for thousands of mu of farmland can now be completed via mobile phones^[3]. Regarding drainage facility development, Zhoukou City has vigorously carried out renovation projects for ditches, culverts, and bridges. By 2024, an irrigation and drainage engineering system coordinating water sources, water utilization, and drainage had been preliminarily established.

In terms of field road construction, Zhoukou City has built a large number of well-laid-out, sturdy, and durable field roads in accordance with the requirements of high-standard farmland construction, which have greatly improved agricultural production efficiency and the transport conditions of agricultural products. Regarding the supporting power facilities, with the advancement of high-standard farmland construction, an increasing number of farmland areas have achieved full power coverage, providing a stable power source for irrigation equipment, agricultural product processing machinery, and other facilities.

Measures for improving cultivated land quality

Zhoukou City has actively carried out soil improvement efforts. On the one hand, it has vigorously promoted soil testing and formulated fertilization technology, rationally adjusting the application ratios of nitrogen, phosphorus, potassium, and medium and trace elements. On the other hand, it has actively promoted the planting and incorporation of green manure crops to increase soil organic matter content. Meanwhile, farmers are encouraged to apply organic fertilizers such as livestock manure and crop straw compost to enhance soil fertility and water and nutrient retention

capacity.

In terms of land leveling, Zhoukou City has carried out large-scale land leveling operations to make cultivated land more contiguous and concentrated, with particular attention paid to topsoil stripping and backfilling to ensure that the soil tillage layer is not damaged. Efforts have also been made in plot planning and farmland layout optimization. Furthermore, Zhoukou City has conducted a series of mechanization-friendly renovation works, so as to further improve the operational efficiency of agricultural machinery and reduce agricultural production costs.

Major Problems and Demand Analysis

Inefficient water resource utilization and irrigation

Precipitation in Zhoukou City is unevenly distributed across seasons, with significant interannual variability. For example, drought and water shortage often occur during the spring sowing period and the autumn grain-filling period. Meanwhile, the uneven distribution of rivers within the region results in insufficient irrigation water sources in some areas. For instance, in townships of Taikang County that are far from major rivers, crop yields are significantly reduced due to water scarcity in dry years. Some irrigation facilities in high-standard farmland constructed in earlier periods are severely aged, with problems such as damaged pipelines, malfunctioning valves, and silted tube wells, leading to low irrigation efficiency. Scientific irrigation practices are still being developed in some areas. For example, in the farmland of Xihua County, traditional flood irrigation is still employed, resulting in low water use efficiency, which can easily cause soil compaction and adversely affect crop root growth.

High pressure on soil quality improvement

For a long time, due to the excessive reliance on chemical fertilizers and neglect of organic fertilizer application in some areas, soil organic matter content has declined, leading to soil compaction and weakened water and nutrient retention capacity^[4]. For example, in some farmland in Dancheng County where wheat has been continuously cultivated for many years, the ratios of nitrogen, phosphorus, and potassium in the soil are imbalanced, resulting in sluggish yield growth. Meanwhile, farmers' limited educational levels and low motivation, as well as the lack of relevant technical training and guidance, are also constraining factors that make the promotion of soil improvement technologies difficult. For instance, practices such as green manure cultivation and straw incorporation require input costs and labor, and farmers show low enthusiasm, which undermines the effectiveness of soil improvement.

Insufficient disaster-resistant capacity

In recent years, extreme weather events in Zhoukou City have shown an increasing trend, with disastrous weather such as heavy rainfall, droughts, and high temperatures posing serious threats to agricultural production. Some of the water conservancy facilities and field roads in earlier high-standard farmland projects have

relatively weak disaster resistance capacity. For example, the drainage capacity of some drainage channels is insufficient, and some field roads cannot withstand heavy rainfall erosion. The coverage level of agricultural insurance in Zhoukou City still needs to be improved, and most farmers have low trust in insurance, resulting in a relatively low agricultural insurance coverage rate.

Imperfect long-term management and protection mechanisms

The post-construction maintenance mechanism for high-standard farmland is of great importance. If the division of responsibilities among departments is not clear enough, then buck-passing and disputes may easily occur. Meanwhile, the routine maintenance of high-standard farmland requires certain financial investment, but currently there is a lack of stable funding sources for maintenance in Zhoukou City, resulting in untimely repair and handling of infrastructure, with aging and damage becoming increasingly serious. The absence of a well-established maintenance system for high-standard farmland and the lack of effective supervision and assessment mechanisms make it difficult to ensure the quality and effectiveness of maintenance.

Insufficient capital investment and integration

High-standard farmland construction is a capital-intensive project, requiring substantial financial support for various aspects ranging from land leveling and water conservancy facility construction to soil improvement^[5-6]. Compared with developed regions, Zhoukou City has relatively limited fiscal revenue and constrained capital investment, making it difficult to further raise construction standards. The funding for high-standard farmland construction involves multiple government departments, including agriculture, water resources, and natural resources, making fund integration difficult and preventing the formation of effective synergy of capital. The enthusiasm of social capital for participation is low. At present, the proportion of social capital investment in high-standard farmland construction in Zhoukou City is relatively small, and the construction relies mainly on government fiscal funds, which is insufficient to meet the demands of large-scale and high-quality construction.

Countermeasures

Optimizing water resource management and irrigation systems

Optimizing water resource management requires coordinated efforts in multiple dimensions, including resource allocation and institutional safeguards. In terms of overall water resource planning, a unified regional water resource allocation mechanism should be established, leveraging existing reservoirs, river channels, and other water conservancy projects to achieve synergistic utilization of surface water and groundwater. For example, in farmland-concentrated areas such as Fugou County, large-scale water storage facilities including reservoirs and cisterns should be promoted to enhance water resource security capacity. In terms of institutional development, a dedicated irrigation management

agency should be established to coordinate water sources, formulate plans, and allocate water resources. Farmer training on water conservation should be strengthened to form a "technology + institution + awareness" integrated water-saving framework, thereby comprehensively improving the utilization efficiency of water resources.

Improving soil quality

Improving soil quality requires the establishment of a comprehensive system of "precision regulation-ecological restoration-technical support" to enhance farmland productivity and sustainability. In terms of precision fertilization, full coverage of soil testing and formulated fertilization technology should be achieved, and combined with big data and artificial intelligence technologies to establish soil nutrient databases and fertilization decision-making systems, and to deliver personalized fertilization plans to farmers via mobile apps. The "wheat-corn-soybean" rotation model in Shangshui County should be actively promoted to balance soil nutrients through crop rotation and reduce continuous cropping obstacles. In terms of soil fertility enhancement, the substitution of organic fertilizers and the promotion of green manure cultivation should be strengthened, for example, by promoting the planting of green manure crops such as milk vetch and vetch on winter fallow land. Regarding soil pollution, a comprehensive monitoring network should be established, and integrated remediation measures should be adopted for contaminated areas, for instance, in Chuanhui District, where hyperaccumulator plants are used to remediate heavy metal-contaminated soil.

Enhancing disaster prevention and mitigation capacity

Enhancing disaster prevention and mitigation capacity requires the establishment of a three-dimensional system of "monitoring and early warning-facility reinforcement-risk coverage". In terms of monitoring and early warning, a cross-departmental information sharing mechanism should be established, utilizing technologies such as satellite remote sensing and meteorological radar to achieve real-time monitoring and precise forecasting of extreme weather events such as heavy rainfall and droughts, thereby improving the timeliness of farmers' emergency preparedness. Shelterbelts should be planted around farmland to build ecological protection barriers that mitigate the impacts of windblown sand and soil erosion^[7]. Regarding the agricultural insurance system, in addition to further optimizing and increasing the proportion of fiscal subsidies, it is also necessary to promote cooperation between insurance institutions and research institutions and universities to develop comprehensive insurance products covering droughts, floods, and pests and diseases for crops such as wheat and corn, thereby increasing the penetration rate of agricultural insurance.

Establishing sound long-term maintenance mechanisms

A long-term maintenance mechanism requires the establishment of a maintenance system characterized by "clear responsible entities, stable funding, technical support, and effective supervision". In terms of responsible entities, the principle of "those

who benefit, those who maintain" should be strictly implemented, with maintenance responsibility agreements signed to define specific maintenance contents such as irrigation facilities and field roads, as well as assessment standards. In terms of funding guarantee, diversified funding channels should be established, with maintenance funds incorporated into the fiscal budgets at both municipal and county levels. Agriculture-related funds, including water conservancy maintenance and agricultural comprehensive development funds, should be consolidated, with 10% allocated for high-standard farmland maintenance. In terms of technical support, professional maintenance teams should be established through agricultural technology extension institutions to provide regular technical services such as irrigation equipment inspection and soil moisture monitoring, enabling automatic fault warning. For example, through this model, the Shangshui County demonstration zone has reduced facility fault response time to within 4 h. Meanwhile, supervision and assessment should be strengthened, and the agricultural and rural affairs department should take the lead in establishing a supervision team to conduct on-site inspections on a quarterly basis, so as to form a closed-loop management system of "responsibility-funding-supervision".

Efficient resource coordination

Efficient resource coordination requires the establishment of a linkage mechanism characterized by "fund integration, departmental collaboration, and factor aggregation". In terms of fund management and coordination, it is recommended to establish a working group composed of relevant departments such as finance, agriculture, and natural resources to formulate fund management measures. Meanwhile, investment and financing models should be innovated, with active efforts to encourage and attract the participation of social capital. Policy incentives such as tax reductions and land use priority should be provided to enterprises investing in high-standard farmland projects. In terms of departmental collaboration, a regular linkage mechanism should be established, with clear division of responsibilities among agriculture, natural resources, water resources, and other relevant departments to avoid redundant construction and resource waste. For example, in the construction of the Zhoukou National Agricultural High-tech Industrial Demonstration Zone, the joint approval by multiple departments reduced the processing time for preliminary project procedures to 30 working days, representing a 50% acceleration compared with the traditional process. Meanwhile, research resources have been integrated, and technological innovation centers have been established in collaboration with agricultural universities and research institutes to conduct joint research on key technologies such as soil improvement and water-saving irrigation in the Huang – Huai Plain. It will increase the conversion rate of research

achievements to over 60%, thereby achieving intensive resource utilization and maximum efficiency.

Conclusions

As a major agricultural city in the Huang – Huai Plain, Zhoukou City has achieved remarkable results in high-standard farmland construction, yet it also faces numerous challenges. Through in-depth analysis of the problems existing in water resource utilization, soil quality, disaster prevention and mitigation, maintenance mechanisms, and capital investment, this study has proposed targeted countermeasures, including optimizing water resource management and irrigation systems, improving soil quality, enhancing disaster prevention and mitigation capacity, establishing sound long-term maintenance mechanisms, and efficiently coordinating resources. In the future construction process, Zhoukou City needs to further strengthen policy implementation, increase capital investment, and enhance departmental collaboration, so as to continuously advance high-standard farmland construction toward higher quality and higher standards. Only in this way can it effectively improve the comprehensive agricultural production capacity, ensure the stable growth of grain production capacity, and make greater contributions to food security and sustainable agricultural development in the Huang – Huai Plain and even the whole country.

References

- [1] CHEN XY, LIU Y. Methods, paths, and countermeasures for high-standard farmland construction in Hebi City[J]. *Hebei Agricultural Machinery*, 2024(15): 70 – 72. (in Chinese).
- [2] KONG XZ, SONG LY. Progress and prospects of cultivated land quality improvement in China since the 18th National Congress of the Communist Party of China[J]. *China National Conditions and Strength*, 2025(4): 9 – 13. (in Chinese).
- [3] ZHANG NN. Research on the application of information technology in agricultural development in Henan Province[J]. *Cotton Science*, 2025, 47(6): 68 – 70. (in Chinese).
- [4] HOU XD, ZHANG XX. Exploring innovative paths for high-quality high-standard farmland construction: A case study of Shaanxi Province[J]. *Agriculture and Technology*, 2025, 45(2): 154 – 157. (in Chinese).
- [5] ZHANG KJ, ZHANG GS. Study on the realization path of building all permanent basic farmlands into high standard farmlands[J]. *Journal of Shandong Academy of Governance*, 2024(4): 33 – 41. (in Chinese).
- [6] XIONG SS. Discussion on the development of high-standard farmland construction under the new situation[J]. *New Farmers*, 2024(12): 13 – 15. (in Chinese).
- [7] LIU WP, CHEN WY, LI XH, *et al.* Reflections on the problems and countermeasures of constructing high-standard farmland from permanent basic farmland in Shantou City[J]. *Agricultural Development and Equipment*, 2025(2): 154 – 156. (in Chinese).