

## **PRACTICE AND REFLECTIONS ON PROMOTING THE CONSTRUCTION AND MANAGEMENT OF MODERN IRRIGATION DISTRICTS THROUGH THE “SYNERGY OF GOVERNMENT AND MARKET”**

### **PRATIQUES ET REFLEXIONS SUR LA PROMOTION DE LA CONSTRUCTION ET DE LA GESTION DE PERIMETRES IRRIGUES MODERNES GRACE A LA «SYNERGIE ENTRE GOUVERNEMENT ET MARCHÉ»**

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#### **ABSTRACT**

The "Synergy of Government and Market" serves as a crucial pathway to enhance the capacity of irrigation districts in supporting and safeguarding national food security. Based on the pilot practices launched by the Ministry of Water Resources of the People's Republic of China to promote the construction of modern irrigation districts through deepening the comprehensive reform of agricultural water prices, this paper expounds four modes for introducing social capital, including concession operation, the "Farmland Irrigation+", agricultural water rights trading and green finance, and analyzes the implementation paths, practical effects and applicable conditions of each model. Furthermore, the paper puts forward targeted suggestions for attracting social capital to participate in the construction and management of modern irrigation districts, such as adhering to government guidance, establishing a sound water price formation mechanism, promoting moderate-scale operation, and advancing industrial integration and development. The research is intended to provide a reference for the innovation of construction and management modes of modern irrigation districts under the background of the reform of water conservancy investment and financing.

**Keywords:** synergy of government and market; modern irrigation districts; concession operation model; "farmland irrigation+" model; agricultural water rights trading model; green finance model.

#### **RESUME**

La «synergie entre gouvernement et marché» sert d'un moyen crucial à améliorer la capacité des districts d'irrigation pour soutenir et pour préserver la sécurité alimentaire nationale. Sur la base des pratiques pilotes lancées par le Ministère des ressources en eau de la République populaire de Chine pour promouvoir la construction de périmètres irrigués modernes grâce à l'approfondissement de la réforme globale des prix de l'eau agricole, cet article expose quatre modèles d'introduction du capital social, dont l'exploitation des concessions, le «Farmland Irrigation+», le commerce des droits d'eau agricoles et la finance verte, et analyse les voies de mise en œuvre, les effets pratiques et les conditions applicables à chaque modèle. En outre, le document propose des recommandations ciblées pour attirer le capital social afin de participer à la construction et à la gestion des périmètres irrigués modernes, telles que l'adhésion aux directives gouvernementales, l'établissement d'un mécanisme solide de fixation du prix de l'eau, la promotion d'une exploitation à échelle modérée ainsi que l'intégration et le développement industriels. La recherche vise à fournir une référence pour l'innovation des modes de construction et de gestion des périmètres irrigués modernes dans le contexte de la réforme de l'investissement et du financement de la conservation de l'eau.

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**Mots-clés :** Synergie entre gouvernement et marché; Périmètres irrigués modernes; Modèle de gestion par concession; Modèle «Irrigation agricole +»; Modèle d'échange de droits d'eau agricole; Modèle de finance verte.

## 1. Introduction

In 2025, the summer grain output of irrigated farmland accounted for more than 88% of the total summer grain output estimated by national remote sensing monitoring. The grain reduction phenomenon in drought-stricken areas mainly occurred in rain-fed farmland. Large and medium-sized irrigation areas have sufficient water reserves and high water supply security, resulting in significant gains in stable production [1]. China's monsoon climate characteristics and natural geographical conditions determine that the lifeblood of grain production lies in water conservancy. Agricultural production is highly dependent on irrigation. A well-developed irrigation and drainage system is a vital piece of infrastructure for supporting the rural revitalization strategy and safeguarding national food security. However, it is difficult to support the construction, renovation, operation and maintenance of the large-scale irrigation area backbone projects and the "last mile" field projects across the country by relying solely on government power. It is necessary to give full play to the guiding role of government investment, better leverage the decisive role of the market in resource allocation, and guide financial institutions and social capital to invest in irrigation area construction and maintenance through multiple channels. "Synergy of Government and Market" is the key path to enhance the irrigation area's ability to support and ensure national food security. Due to the characteristics of irrigation district construction, such as strong public welfare, large investment scale, long return cycle and weak operating income, there are few models of "Synergy of Government and Market" suitable for the construction and maintenance of modern irrigation districts[2]. From 2023 to 2024, the Ministry of Water Resources launched 46 pilot projects to deepen the comprehensive reform of agricultural water prices and promote the construction of modern irrigation districts. Based on the existing water resources endowment, irrigation type and planting structure characteristics, various localities have adopted various methods to attract social capital to participate in the construction and maintenance of modern irrigation districts, so as to promote the sustainable development and sound operation of irrigation districts. The main models currently being promoted include franchise operation, "farmland water conservancy +", agricultural water rights trading, and green finance. This article combines reform pilot cases to introduce the specific implementation methods and effects of attracting social capital through "synergy of government and market" approaches, analyzes the models that can be promoted and the conditions required for implementation, and aims to provide a reference for the innovation of the "synergy of government and market" approach to promote the construction and maintenance of modern irrigation districts under the background of water conservancy investment and financing reform.

## 2. Synergy of Government and Market” Model for Irrigation Districts

### 2.1. Concession Operation Model

The concession operation model is an important means of implementing a "synergy of government and market" approach in the water conservancy sector. In the construction of modern irrigation districts, the main implementation methods include Build-Operate-Transfer (BOT), Renovate-Operate-Transfer (ROT), and Transfer-Operate-Transfer (TOT). The county government authorized its investment representative and the purchased concessionaire to establish a project company, jointly undertaking the responsibilities of project financing, construction, operation, and maintenance services. The project company recovers its investment costs and obtains a certain profit through water sales; The profits are used mainly used to cover the principal and interest of financing loans as well as operational costs. The government-authorized investment representative does not participate in profit distribution before the project generates excess profits. Simultaneously, the government calculates the water supply price based on the investment amount confirmed by the final settlement audit in accordance with the principles of 'cost recovery, reasonable returns, higher prices for higher quality, fair burden-sharing and dynamic adjustment'. As for Yuanmou County primarily cultivates special agricultural products such as organic vegetables, the water supply fee is set at ¥1.15 per cubic meter in accordance with the 'permitted cost plus reasonable return' principle, taking into account the affordability of water users. Liaoyang Irrigation

District of Liaoning Province attracted ¥32.3 million of social capital through the TOT model, which was used specifically for the modernization of the irrigation district, including the renovation of irrigation and drainage systems, information technology upgrades, and management facility updates [3]. The main sources of income for social capital are agricultural irrigation water fees and industrial water supply fees. The government completes the cost supervision of agricultural water supply through deepening the comprehensive reform of agricultural water pricing and has increased the implemented water price from ¥0.10 to ¥0.22 per cubic meter (the operation and maintenance cost water price is ¥0.1788 per cubic meter). Through the "price adjustment (increase and reduction)", the overall burden on farmers is not increased; water supply to industrial enterprises provides stable cash flow support for the project company.

A key feature of the concession operation model is that local governments are responsible for the preparation, implementation and supervision of concession projects, whilst private capital invests in, constructs and operates irrigation infrastructure and water supply services within a specified timeframe and scope, thereby generating revenue. Under this model, private capital leverages its advantages in fundraising, management, and technological innovation, effectively reducing the fundraising pressure on local governments and improving the quality and efficiency of public goods and services. It is worth noting that in 2024, six departments, including the National Development and Reform Commission, jointly issued the "Administrative Measures for Franchising of Infrastructure and Public Utilities", which clarifies that public-private partnerships should be limited to projects with operational revenue, with user fees as the return on investment, and prohibits the use of public funds to cover project construction and operating costs. For cash crops, a stable water fee revenue mechanism can attract private capital based on the principle of "permitted costs plus reasonable returns". However, the primary function of irrigation districts remains ensuring food security. Whilst price mechanisms are used to protect the enthusiasm for grain production, the availability of diverse business opportunities is key to advancing the concession operation model. The Meijiang Irrigation District in Jiangxi could charge raw water fees for supplying water to urban waterworks, whilst the Liaoyang Irrigation District in Liaoning could collect compensation fees for replenishing reserve wells for industrial enterprises. As for the Jin'an sub-district of the Pishihang Irrigation District, where irrigation water fees for food crops constitute the sole source of income, the government should take the lead in encouraging social capital to collaborate with grain-growing enterprises, village-level economic cooperatives and large-scale farmers to transfer land rights, thereby generating additional revenue through large-scale operations.

## 2.2. "Farmland Irrigation+" Model

The 'Agricultural Water Conservancy +' model is an integrated approach that builds upon agricultural water conservancy infrastructure and combines it with economically viable industries. By revitalizing existing assets within irrigation districts and converting the value of aquatic ecological products, it promotes the long-term operation and maintenance of agricultural water conservancy facilities. Taking advantage of the comprehensive agricultural water price reform, Nanxun District in Zhejiang Province invested in the construction of 800 hectares of farmland irrigation infrastructure in Lianshi. By utilizing the high-quality agricultural water resources resulting from the reform, the district has capitalized on its water town characteristics, deepened the integration of culture and tourism, and introduced social capital to operate cultural and tourism projects. This has led to the creation of modern agricultural industrial parks such as the Lianxi Grand View Garden High-Efficiency Agricultural Industrial Park, the Qianjin Future Farm, and the Shanyan Wanmu Fang Green Farm. In 2024, the number of tourists visiting the cultural tourism industry increased by 72.94% year-on-year, and the profits were used to support the maintenance of farmland irrigation facilities, effectively ensuring their long-term effectiveness. Suqian's Sucheng District in Jiangsu Province has leveraged its abundant water resources, in line with the needs of industries such as 'Beautiful Villages', 'Specialty Agriculture' and 'Ecological Tourism', to implement the 'Agricultural Water Conservancy + Ecological Tourism' model. This approach has attracted 35 million yuan in social capital investment for the construction of agricultural water conservancy facilities.

The 'Agricultural Water Conservancy+' model need to take into account regional resource endowments and industrial foundations to identify viable integrated business models. It must establish clear mechanisms for reinvesting profits, setting aside a certain proportion of revenue or retaining a portion

of the premium to ensure a long-term source of funding for the operation of agricultural water conservancy facilities, thereby transforming them from 'public welfare assets' into 'profit-generating assets'. The sustainable development of this model depends on three key safeguards. Firstly, the selection of business models must be precisely tailored to regional resource endowments, avoiding a 'one-size-fits-all' approach. For instance, water towns in the south should emphasize integrating culture and tourism, whilst arid regions in the north should focus on water-saving irrigation and the cultivation of distinctive agricultural products; secondly, multi-faceted and coordinated policy support is required. The government should play a guiding role, leveraging social capital through fiscal subsidies, tax and fee reductions, and land use guarantees, whilst establishing third-party oversight mechanisms to ensure that reinvestment funds are used strictly for their intended purposes. Thirdly, a clear mechanism for the distribution of benefits is required, with contracts clearly defining the rights and responsibilities of all parties—including the government, social capital and farmers—as well as key terms such as the proportion of funds to be reinvested and the intended use of the funds. As the Rural Revitalization Strategy is further advanced, and against the backdrop of efforts to strengthen county-level industries that enrich the people and develop distinctive county-level economies, this model will further expand its scope of integration, enabling agricultural water conservancy facilities to truly become high-quality assets that underpin food security and revitalize rural industries.

### *2.3. Agricultural Water Rights Trading Model*

By clarifying water usage entitlements, the reform of agricultural water rights has encouraged water users to proactively adopt water-saving measures and facilitated the transfer and trading of surplus water across sectors and regions, thereby achieving the optimal allocation of water resources. This reform has also raised funds for the construction and maintenance of irrigation districts, promoting the sustainable development of modern irrigation systems. The Damogang Reservoir Irrigation District in Henan, leveraging the advantages of piped irrigation, has adopted a combined approach of assigning rights to individual households and village groups, issuing 202 water rights certificates and confirming water rights total 12.5531 million cubic meters. It has refined measures for the repurchase, trading and financial supervision of water rights, developed a water rights trading system, established trading rules, and constructed a unified, open, transparent and efficient county-level agricultural water rights trading system. Since the reform, agricultural water rights trading has generated ¥2.53 million. After deducting funds paid for repurchases, the remaining revenue has been allocated to the maintenance and upkeep of the irrigation district's main and field-level infrastructure, as well as water management labor costs. Since the implementation of the agricultural water rights reform, local residents have actively participated in water-saving initiatives, achieving near-universal coverage of efficient water conservation, with the water utilization coefficient for farmland irrigation in the district reaching 0.85. Litong District in Ningxia has implemented a 'contract-based water conservation plus water rights trading' scheme [4], introducing contract-based water conservation service providers to carry out modern water-saving upgrades in irrigation districts. These providers are granted the right to the revenue from the trading of water rights associated with their water-saving targets. The proceeds from water rights trading are distributed among the project company, the water users' cooperative and individual farmers in a ratio of 7:2:1. This approach not only safeguards the motivation of farmers and investors but also provides a source of funding for the maintenance of agricultural water conservancy facilities.

The implementation of a water rights trading model requires certain conditions, including clearly defined water rights and the corresponding metering and monitoring capabilities, as well as the presence of potential trading partners and the necessary engineering infrastructure for such transactions. A clear definition of water rights is a prerequisite for trading. In the Damogang Reservoir irrigation area, based on the construction of metering facilities, rights are confirmed to village groups where metering cannot be done to individual households. Precise metering and monitoring capabilities provide the technical support for trading. In pumped irrigation areas, a "dual control of water and electricity + electricity-to-water conversion" method is used to meter water consumption at pumping stations. Well irrigation areas and pipeline irrigation areas can use RFID card controllers and other terminal equipment to achieve "one card per household, card-based water release."; The Southern Abundant Water Gravity Flow Irrigation Area uses a combination of "metering to large households and metering to village groups" to improve the metering infrastructure. Potential trading partners and the existing infrastructure determine

the feasibility of trading. From the perspective of trading partners, the demand side primarily includes industrial enterprises, urban water supply companies, and entities responsible for ecological water replenishment. Changsha County in Hunan has achieved coordinated water resource allocation and supply across the county through waterway connectivity projects, enabling surplus agricultural water to be conveyed via existing water conservancy infrastructure to water treatment plants. This not only addresses urban water supply shortfalls but also generates value returns for agricultural water conservation.

#### *2.4. Green Finance Model*

The state has introduced a series of policies to promote the application of green finance in the water sector. "The National Water Conservation Action Plan" calls for the improvement of policies governing the entry of financial and social capital into the water conservation sector. "The Water Conservation Regulations" encourage financial institutions to provide various forms of water conservation financial services. "The Guidelines on Accelerating the Development of the Water Conservation Industry" propose the promotion of financing services such as 'water conservation loans'. These policies provide strong policy support for the development of green finance in the water sector. The Water Resources Bureau of Yongxiu County, Jiangxi, has joined forces with the Yongxiu County Rural Commercial Bank to explore the launch of a special financial service known as the 'Water-Saving Loan' for agriculture. They have established a fast-track 'green channel' for loan approval and disbursement to improve processing efficiency through optimizing loan terms, preferential interest rates and innovative collateral arrangements. This initiative provides large-scale farmers with ¥200,000 in unsecured, low-interest loans for the maintenance of water conservancy facilities on their contracted land. Yongchun County in Fujian has introduced the "Water Finance Loan" scheme, which offers mortgage loans secured against the property rights of small-scale rural water conservancy projects. The county's Water Conservancy Bureau has collaborated with the local credit union to establish an investment and financing platform, disbursing a total of ¥2.6 million for the construction, management and maintenance of agricultural water conservancy facilities.

Green finance models, through government-bank cooperation, establish green finance service platforms for entities with financing needs and relevant financial institutions, leveraging financial capital to solve financing difficulties and promote the upgrading and transformation of farmland irrigation facilities and agricultural water conservation and efficiency improvement. In the construction and maintenance of modern irrigation districts, financial support can be provided to new types of agricultural operators—such as family farms and large-scale growers—who require small amounts of capital over short periods. This will help them to rapidly advance the renewal and upgrading of irrigation equipment and agricultural water conservancy facilities. By offering preferential interest rates, streamlining approval processes and introducing innovative forms of collateral, the financing costs and barriers for these new agricultural operators can be reduced, thereby stimulating their enthusiasm for participating in the construction, maintenance and management of agricultural water conservancy infrastructure and in agricultural water conservation.

### **3. Reflections on Attracting Social Capital to Participate in the Construction and Maintenance of Modern Irrigation Districts**

#### *3.1 Adhering to Government Guidance is a Necessary Guarantee*

As private capital is primarily driven by profit, the public-interest nature of irrigation district construction and maintenance, coupled with long return cycles, acts as a barrier to its participation. Therefore, it is essential for the government to play a guiding role in terms of policy and funding, creating a viable environment for private investment through coordinated planning and appropriate mechanisms establishment. At the policy level, the government can introduce a comprehensive policy system covering the entire process of entry, operation, and exit, clearly defining the areas open to private capital, appropriately lowering market entry barriers, and standardizing investment return mechanisms. By specifying revenue-sharing ratios and granting priority rights to develop supporting resources, the government can provide private capital with stable revenue expectations. In terms of financial support,

the government can leverage the catalytic effect and risk-sharing role of public funds to alleviate the initial investment pressure on private capital. Furthermore, by establishing a risk compensation mechanism, the government can provide reasonable compensation for losses incurred by private capital due to force majeure events such as policy adjustments or natural disasters, thereby further reducing investment risks and enhancing the enthusiasm and confidence of private investors.

### *3.2 Reasonable Water Pricing Mechanism is a Key Element.*

Water price is not a simple charging standard, but an important regulatory tool through which the government, acting as the 'visible hand', balances the public interest with market principles. A mechanism for establishing reasonable water prices, by taking into account water supply costs, the scarcity of water resources and users' ability to pay, promotes the conservation and efficient use of water resources. It balances the interests of farmers with the long-term development of irrigation districts, opens up channels for private capital to enter the irrigation sector, and resolves the problem of funding shortages for construction, operation and management. Considering that the water price of grain crop irrigation areas should reach the level of operation and maintenance costs after the precise subsidy, the "price increase and decrease" of water use will not increase the burden on farmers; the water price formation mechanism of "reasonable income" should be established in the economic crop irrigation area, and the rate of return should be determined according to different investment entities; the water price system of "industry to subsidize agriculture" and "economic crops to subsidize grain" should be implemented with the county as the unit [5]. A dynamic water price adjustment mechanism should be established to ensure that private capital receives stable returns commensurate with the risks involved, thereby mitigating policy and market risks.

### *3.3 Appropriate Scale Operation is the Core Foundation*

Judging by the successful experience of existing pilot schemes, private capital involved in the construction of modern irrigation districts is mainly invested in government-transferred land, such as agricultural industrial parks and 600 acres farmland demonstration zones. Agricultural investment projects typically require a long payback period, whilst fragmented land holdings make it difficult for investors to secure stable returns, thereby increasing investment risk. Large-scale farming reduces unit costs through the central procurement of agricultural inputs such as seeds, fertilizers, and pesticides. By consolidating small plots into larger fields and reducing land fragmentation, land utilization is significantly improved, facilitating the deployment of modern agricultural equipment and technology, which in turn enhances grain yield and quality; Through land transfer and concentrated, contiguous cultivation, agricultural production efficiency is enhanced and labor costs reduced, offering social capital lower investment costs and higher profit margins [6]. This better stimulates the multiplier effect of agricultural water price adjustments, delivering economies of scale for social capital.

### *3.4 Industrial Integration and Development is an Important Support*

Revenue from agricultural water supply alone is often insufficient to achieve a balance between investment and returns. It is necessary to revitalize irrigation district assets and resources and expand revenue sources while adhering to laws and regulations. Exploration should be undertaken to incorporate agricultural water fees, water rights trading revenue, land transfer revenue, agricultural sales revenue, and agricultural tourism revenue as sources of investment returns for irrigation districts. Where conditions permit, the agricultural industry chain should be extended by introducing agricultural production enterprises to develop germplasm resources, deep processing of grains, and integrated crop-livestock farming, thereby increasing the economic added value of crops and raising the overall revenue of the irrigation district. Through reasonable profit distribution, a modern irrigation district community of shared interests should be established, deeply integrating multiple elements such as the government, enterprises, water user cooperatives, farmers, and financial institutions.

## 4. Conclusion

After the completion of the "14th Five-Year Plan" large and medium-sized irrigation area continued construction and modernization transformation projects, the support will be mainly provided by ultra-long-term special treasury bonds. While the investment per mu has increased, the scope of support has also narrowed. We need to seize the opportunity of deepening water conservancy investment and financing reform, accelerate the innovation of investment and financing mechanisms, and broaden the channels for fund-raising [7]. Taking the comprehensive reform of agricultural water prices as the "key", we should give full play to the leverage and regulation role of the price mechanism; promote the reform of agricultural water rights, and better play the role of market mechanism in allocating water resources. We need establish pathways for converting the value of irrigation district infrastructure and aquatic ecological products, thereby fostering new business models. Financial institutions are encouraged to develop innovative financial products and services based on the actual development needs of various new types of agricultural operators, whilst expanding the scope of acceptable collateral [8]. We will actively explore the integration of water infrastructure investment trusts (REITs) with the construction, operation and management of irrigation districts. A diversified, multi-tiered and multi-channel policy framework for investment and financing in irrigation district construction needs to be established, with a focus on 'soft infrastructure'. We should promote the high-quality development of irrigation districts to provide robust support for ensuring national food security and the stable and secure supply of key agricultural products [9-11].

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