



Can Agricultural Capital Increase Farmers' Income?

—A Study Based on the Perspective of Farmers' Operating Income

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Abstract. As a crucial component of China's modernization, agricultural modernization holds significant importance. This study examines the role of agricultural capital in driving agricultural, rural, and farmer development, with a focus on how it impacts farmers' operating income. By analyzing theoretical frameworks and empirical data, the research explores the relationship between agricultural capital and farmer income, as well as how different groups' control over capital shapes agricultural evolution. Findings suggest that farmers are increasingly marginalized in the agricultural value chain during modernization. The study concludes with policy recommendations, including strengthening legal frameworks and fostering a new generation of professional farmers to enhance their socioeconomic standing.

Keywords: Agricultural Modernization; Agricultural Capital; Farmers' Operating Income

1 Introduction

Agricultural modernization serves as the cornerstone and vital component of national modernization. It holds profound strategic significance for safeguarding national food security, promoting comprehensive rural vitalization, and achieving common prosperity. Within this process, agricultural capital, as a key factor of production, profoundly influences agricultural production efficiency, industrial structure, and farmers' livelihoods and development through its allocation methods and operational models. However, the relationship between the expansion of agricultural capital and the growth of farmers' income is not one of simple linear promotion; it exhibits significant complexity and contradictions. On one hand, investment in agricultural capital is widely regarded as a core driver for enhancing agricultural productivity and increasing farmers' income. On the other hand, historical experiences and theoretical research, both domestic and international, indicate that the profit-driven nature of capital may lead to the marginalization of smallholder peasants within the agricultural value chain, weakening their status as independent operators and even exposing them to the risk of dispossession (as observed in the Pingwan County model and analyses by scholars such as Marx and Lenin).

This study aims to conduct an in-depth analysis of the dual role and impact mechanisms of agricultural capital in China's agricultural modernization process, specifically from the perspective of farmers' operating income. By synthesizing relevant theoretical frameworks, examining practical models of agricultural capital allocation in China, and employing empirical testing using macro-level time-series data from 1978 to 2022 (including Granger causality tests, impulse response analysis, and Vector Error Correction Models), this research seeks to answer the core questions: Does the growth of agricultural capital inevitably lead to an increase in farmers' operating income? What are the pathways through which it operates? How does capital controlled by different allocative entities differentially affect farmers' operating income? The findings will provide a theoretical basis for understanding the dynamic changes in farmers' income during agricultural modernization and offer empirical references for formulating fairer and more effective agricultural capital policies and strategies for increasing farmers' income.

2 Agricultural Capital

2.1 The Role of Agricultural Capital

In terms of conceptual definition, "modern agriculture" refers to agricultural production that leverages modern factors—such as technology and contemporary agricultural practices—within the existing agricultural framework, adapting to the productivity and scientific standards of the time. Its forms of production vary across different eras and levels of productivity^[1]. Agricultural capital: Includes: (1) Physical capital (agricultural machinery, irrigation facilities); (2) Financial capital (credit, subsidies); (3) Human capital (farmer skill training); (4) Social capital (cooperatives, production-marketing alliances).

In the actual agricultural production process, agricultural capital also plays a different role. Vegetable industry in Shouguang City, Shandong Province, China, the local government has encouraged farmers to adopt modern planting techniques by providing low-interest loans (financial capital) and greenhouse subsidies (physical capital), increasing farmers' average annual income by 35% (data from 2018 to 2022). In contrast, in Pingwan County, China, the agricultural capital company will distribute the land transferred from farmers to its "custodians" for cultivation, and the custodians will then hire local farmers for agricultural production. During this period, all agricultural resources required for agricultural production, such as fertilizers, seeds, and agricultural machinery, need to be obtained from the company. Farmers have become part of the company's production process.

2.2 Different Scholarly Perspectives on Agricultural Capital

Marxist scholars primarily employ a political economy perspective, viewing agricultural capital as a tool for exploiting surplus value—a stance particularly emphasized by the peasant economics school. This school generally criticizes the influx of exogenous capital into agriculture while supporting capital spontaneously generated and accumulated by farmers. Zhanping Hu argues that agricultural development mostly rely on

farmers' own capital and remains pessimistic about the prospects of "capital going rural" [2].

Lenin, in his works, categorized capitalist agriculture into two paths: First, the "top-down" Prussian path, where feudal landlords gradually transformed into capitalist Junkers. Due to the incompleteness of this self-revolution by the landlord class, the country remained semi-colonial and semi-feudal for an extended period. Second, the "bottom-up" American path, where capital accumulation occurred through the self-differentiation of peasants. Over time, this led to the stratification of farmers into poor peasants, middle peasants, and rich peasants, with wealth disparities gradually widening due to class dynamics.

Some scholars argue that small-scale commodity producers in modern society are, in reality, subordinated to industrial and agricultural capital. Despite owning some means of production (e.g., land, small-scale machinery), they remain exploited within hidden, indirect production relations and thus belong to the proletariat [3].

In Western capitalist countries, agricultural capital is more narrowly defined as production factors for agriculture, with its class attributes downplayed. During its agricultural transformation, the U.S. saw large farm owners and agricultural capital leverage technological advantages to dominate the sector, ultimately replacing smallholder-based farming with a bourgeois-led, wage-labor model [4].

In Europe, England and other countries carried out agricultural capitalization through enclosures—commodifying peasant land or forcibly dispossessing farmers—then employing landless peasants in production, completing the transition over centuries. France, however, achieved this shift primarily through national agricultural policies rather than land seizures [5]. Japan, meanwhile, utilized farmer debt and tenancy relations to enhance competitiveness and market vitality within agriculture [6].

2.3 The Allocation of Agricultural Capital in China

(1) When Agricultural Capital is Held by Enterprises

The path of agricultural capitalization follows a top-down model. Since China's reform and opening-up, the transformation of agricultural input markets has typically been government-led, with state-owned or private enterprises acting as implementing agents. Due to the prolonged collective ownership system and its institutional inertia, the capitalization process has been gradual. The state has progressively transferred operational rights over agricultural inputs to private enterprises. As scholar Zhijun Li's periodization of agricultural policies demonstrates, this phased liberalization has shaped China's agricultural capital development trajectory [7].

(2) When Agricultural Capital is Held by Farmers

The capitalization process becomes bottom-up, often exacerbating internal differentiation among farmers. Post-reform policies gradually relaxed control over agricultural inputs, transferring operational rights to private enterprises while also permitting farmer participation in the sector. Since the household responsibility system was implemented, disparities among farmers—based on individual capability and resource access—have widened, a phenomenon tacitly encouraged by state policy.

After four decades of development, while land contracting rights remain non-transferable, operational rights and agricultural production inputs/outputs have become fully marketized and commodified. The most significant consequence of farmer-held capital is accelerated rural stratification: Income gap: The richest 10% of rural households earned 8.2 times more than the poorest 10% in 2012; by 2022, this ratio grew to 9.17. Asset polarization: Land-use rights increasingly concentrate among "new professional farmers".

3 Farmer Income

3.1 Definition of Farmer Income

Farmer income generally refers to earnings derived from agricultural production and operations, or harvest yields. According to the China Rural Statistical Yearbook, farmer income comprises four components: operational income, wage income, transfer income, and property income.

The income level of Chinese farmers: In 2023, the per capita disposable income of rural residents was approximately 21,000 yuan (a year-on-year increase of 6.3%), but it was still only 40% of urban residents' income. Meanwhile, the dominant farming model in China is smallholder agriculture, accounting for 98% of agricultural operators, with an average cultivated land area of 7.5 mu (0.5 hectares), resulting in low production efficiency. In contrast, large-scale entities such as family farms and cooperatives make up only 2% of agricultural operators but contribute 20% of agricultural output value. Additionally, challenges such as rural population aging and labor outflow persist.

3.2 Trends in Farmer Income

Farmer income serves as the most direct indicator of rural development, with the two sharing a dynamic and mutually reinforcing relationship that collectively drives socio-economic progress in rural areas. Increased income provides the material foundation for farmers to invest in their own and their children's development.

(1) Operational Income: Steady Growth with Underlying Volatility

Operational income (primarily from crop cultivation and household sidelines) has shown moderate but stable growth, reflecting the inherent resilience of agricultural production. During the 1980s–1990s, it accounted for over 60% of total income, serving as the primary livelihood source. Post-2000, while its absolute value continued rising, its growth rate lagged behind wage income, leading to a declining share.

(2) Wage Income: The Engine of Structural Transformation

Wage income exhibits the most pronounced growth trajectory, mirroring the historic shift of rural labor toward non-agricultural sectors. From 1978–1990, it represented less than 20% of total income, with livelihoods heavily land-dependent. After the 1992 market economy reforms, the rise of township enterprises and mass rural-to-urban migration accelerated wage income growth. Post-2000 urbanization further amplified this trend, with wage income surpassing operational income in 2015—becoming the dominant driver of income growth.

3.3 The Impact of Agricultural Capital on Marginalized Farmers

Agricultural capital—encompassing physical assets, financial resources, human capital, and social networks—has a dual impact on marginalized farmers. While it can empower through inclusive measures like microcredit programs (e.g., China's Precision Poverty Alleviation loans), affordable technologies (e.g., subsidized mini-tractors in Yunnan), and collective action (e.g., Taobao Villages' e-commerce), significant barriers persist. Many smallholders face exclusion from formal credit due to lack of collateral, high-tech adoption gaps (e.g., limited drone use in Guizhou's ethnic villages), and risks of displacement from large-scale commercialization. For instance, Sichuan's Yi minority farmers saw a 42% income rise after targeted interventions like terraced field upgrades and bilingual training, yet market access remains unstable for 30%. To ensure equitable benefits, policies must prioritize land-title-backed microloans, context-appropriate low-cost tools, mobile-based training in local languages, and safeguards against elite capture in cooperatives. Ultimately, agricultural capital's impact hinges on deliberately inclusive design—bridging the gap between efficiency-driven scaling and pro-poor resource allocation for truly sustainable rural development.

4 Empirical Analysis

4.1 Indicator Selection and Data Sources

The study utilizes four key indicators spanning 45 years (1978-2022), with primary data sourced from the China Rural Statistical Yearbook and supplementary data from the China Statistical Yearbook. To mitigate heteroskedasticity effects, all variables were logarithmically transformed. The indicators are defined as follows:

oi: Per capita operational income of farmers

wi: Average wage income of farmers

pin: Individual household investments in agriculture

ain: Total investments in agriculture, forestry, animal husbandry and fishery (excluding individual household investments)

Their logarithmic forms are denoted as $\ln oi$, $\ln wi$, $\ln pin$, and $\ln ain$ respectively.

Prior to formal analysis, data preprocessing was conducted to address significant scale disparities across indicators. For instance, agricultural investment values (typically in tens or hundreds of thousands) were uniformly divided by 10 for visualization purposes. This normalization ensures comparability while preserving the underlying statistical relationships.

4.2 Model Specification

Prior to conducting data analysis, it is essential to perform unit root testing. In this study, the Augmented Dickey-Fuller (ADF) test is employed to examine the presence of unit roots in non-stationary time series. The test equation is specified as follows:

$$\Delta y_t = \hat{\rho} y_{t-1} \sum_{i=1}^k \hat{y}_t \Delta y_{t-1} + \hat{v}_t$$

If the test results indicate the presence of a unit root (non-stationarity), the series must undergo first-order differencing before being retested for unit roots. Subsequently, a Vector Autoregression (VAR) model is constructed. This model is widely employed for forecasting interdependent time series systems and analyzing the dynamic impacts of stochastic disturbances on the system. The general specification is as follows:

$$y_t = \phi_1 y_{t-1} + \dots + \phi_p y_{t-p} + Hx_t + \varepsilon_t, t = 1, 2, \dots, T$$

4.3 Granger Causality Test

The Granger causality test results show that both farmers' individual investments and wage income can serve as Granger causes of farmers' operational income, indicating that changes in these two factors may influence operational income in the short term. The impact of nationwide agricultural investment (excluding individual farmers' investments) on operational income may not manifest immediately and warrants further investigation.

4.4 Impulse Response Analysis

The impulse response function analysis provides an intuitive examination of how shocks from one endogenous variable affect another and predict subsequent changes. Since this study focuses on the influence of other variables on farmers' operational income, the analysis selectively evaluates impulse response graphs of other variables' impacts on operational income. The results (Figure 1) show the following:

After a one-unit shock from agricultural investment excluding individual farmers' investments (dlnain), operational income shows a sustained but mild decline. Combined with the Granger causality test results, this suggests a lagged but prolonged effect on operational income.

Shocks from wage income (dlnwi) also negatively impact operational income. Although both are components of farmers' disposable income, there appears to be a certain degree of mutual exclusivity, indicating that off-farm income does not contribute to improving operational income.

Farmers' individual investments (lnpin) demonstrate a clear and direct positive contribution to operational income.

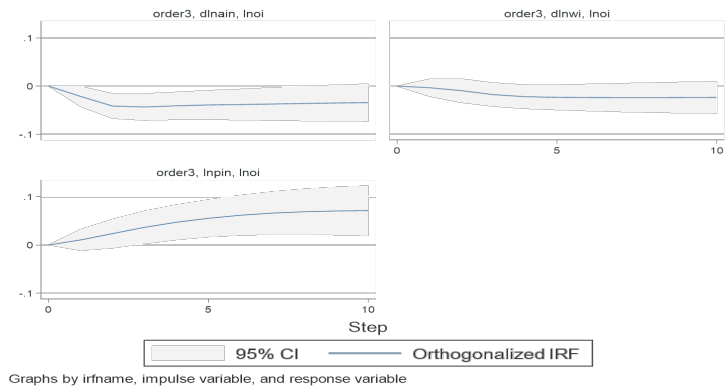


Fig. 1. Impulse Response Function Graph

Following the impulse response function analysis, a cointegration test was conducted to examine potential long-term relationships between the variables. The prerequisite for cointegration testing requires all data to be unit root processes. Based on prior ADF test results, the study selected farmers' operational income (oi), individual investments (pin), log-transformed wage income (lnwi), and log-transformed agricultural investments excluding individual farmers' contributions (lnain) as test variables.

The trace test yielded a result of 2, indicating the existence of a long-term equilibrium relationship among these variables. Subsequently, a Vector Error Correction Model (VECM) was estimated, producing the following specification:

$$oi = -365.208 + 2.01pin + 309.823lnwi - 200.165lnain$$

Key findings from the model:

1. Farmers' individual agricultural investments demonstrate a positive impact on operational income (coefficient: +2.01)
2. While wage income shows a positive coefficient (+309.823), this appears contradictory to the impulse response results. This discrepancy can be explained by the logarithmic transformation - wage income must reach substantially high levels before generating significant effects on operational income.
3. Consistent with prior analysis, aggregate agricultural investments (excluding individual contributions) exhibit a negative influence on operational income (coefficient: -200.165)

5 Conclusions and Policy Recommendations

5.1 Conclusions

Both the top-down and bottom-up development processes of agricultural capital are inevitably accompanied by the marginalization and exploitation of smallholder farmers due to the profit-seeking nature of capital, manifested through agricultural wage labor

and the phenomenon of "large farmers outcompeting smallholders." Regarding the negative effects of urban capital entering rural areas, academic circles generally attribute the main cause to inadequate government supervision and control over the process of agricultural capital facilitating urban-rural factor exchange. This has led to issues such as significant management problems in capital enterprises going unregulated and unaccountable, as well as exploitation of policy loopholes to fraudulently obtain agricultural subsidies. In contrast, the state strongly encourages the spontaneous bottom-up accumulation of agricultural capital among farmers themselves.

5.2 Policy Recommendations

First, it is necessary to strengthen supervision over agricultural capital enterprises and enhance the social responsibility of enterprises entering rural areas. Local governments at all levels should actively respond to central policies and, based on existing investment promotion policies, formulate agricultural capital operation rules that are better suited to local agricultural conditions. For example Brazil's "ABC Plan", The government and banks provide soybean growers with special low-carbon agricultural loans (financial capital), requiring farmers to adopt no-till technology (technical capital), ultimately reducing soil degradation and increasing yields by 20% (2021 evaluation report). As leaders of enterprises, entrepreneurs' management models and business philosophies significantly influence their companies' operational approaches. They must not only possess the ability to effectively manage capital and enterprises but also demonstrate noble patriotic sentiments, consciously fulfilling the mission and responsibility of Chinese entrepreneurs to "let those who get rich first bring along those who get rich later." Second, China should vigorously develop the family farm operation model, protect the basic rights of farmers transitioning out of agriculture, and cultivate professional farmers. The country should promote the professionalization of farmers, transforming the term "farmer" from a social identity into an occupational designation, while expanding the middle-income group among farmers. For example, at Chaohu area of Anhui, there are a large number of professional farming families who go to various parts of the country to contract land. This is exactly the capitalist family farm proposed in this article. These farmers only need a couple, agricultural machinery and a small number of hired workers to complete the cultivation of hundreds of acres of land, and most of them can make a profit. This type of farmers tend to look for land that has failed after "capital going to the countryside" because these lands have already reached a certain scale, saving them the cost of negotiating with the local government for land transfer. In summary, the development of farmers requires the joint efforts of all parties, especially the correct guidance of the government on agricultural capital companies and the proper use of farmers' internal capital, so that profits can fall to farmers.

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