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The Impact of Agricultural Insurance and Agricultural Loans on Farmers' Income

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Abstract: Based on the practical need for financial support to increase farmers' income within the context of rural revitalization, this paper explores the impact of agricultural insurance and agricultural loans on farmers' income and their synergistic mechanism. The study aims to clarify the directional effects, regional disparities, and interactive outcomes of these two factors on sustainable farmers' income, providing empirical evidence and policy references for improving the rural financial service system. Utilizing panel data from 31 provinces in China from 2012 to 2022, the research conducts an empirical analysis using the SYS-GMM model and panel threshold model. The results indicate that both agricultural insurance and agricultural loans exhibit a significant inhibitory effect on the growth of farmers' income, suggesting that the current synergistic mechanism between agricultural insurance and agricultural loans fails to effectively promote income growth and even demonstrates a "synergy failure" phenomenon. Further analysis reveals that this negative impact shows distinct regional heterogeneity, being particularly pronounced in eastern China, while relatively moderate in central and western regions. The conclusion posits that the current development and linkage model of agricultural insurance and agricultural loans in China have not yet fully realized their income-enhancing effects, and their efficacy is influenced by regional economic conditions and development stages.

Keywords: Agricultural Insurance; Agricultural Loans; Farmers' Income.

1. Introduction

The report of the 20th National Congress of the Communist Party of China underscores that the most arduous and onerous tasks in the comprehensive construction of a modern socialist country remain concentrated in rural areas. It is imperative to prioritize the development of agriculture and rural regions, sustainably consolidate poverty alleviation outcomes, and strengthen farmers' endogenous motivation. Rural revitalization bears on the overall situation, and financial support is of critical significance. The 2023 Central No. 1 Document further stipulates that a New Era and in line with the spirit of the 20th National Congress of the Communist Party of China, multi-channel efforts should be made to boost farmers' income, enhance agricultural efficiency, and safeguard farmers' rights and interests, among which financial instruments serve as a key driving force. Notably, China's exploration of agricultural-financial collaboration has a long-standing history. In 2020, the China Banking and Insurance Regulatory Commission emphasized the need to deepen the coordination between insurance and loans to help address the issue of farmers' low sustainable income. The "loan support + insurance guarantee" model not only fulfills the risk underpinning function of insurance but also contributes to enhancing financial institutions' willingness to provide services, thereby stabilizing and increasing farmers' income.

Currently, rural financial services in China still face numerous constraints. At the farmer level, the limited education level and weak risk awareness of the agricultural population lead to insufficient understanding of agricultural insurance; the prevalence of small-scale farming and low industrialization curtails insurance demand. At the financial institution level, there is inadequate coverage of commercial insurance, imperfect policy support in some regions, and insufficient innovation in specialized agricultural insurance products. Simultaneously, credit rationing exists in the rural loan market, with financial and social capital showing weak willingness to enter agriculture, resulting in an overall shortage of fund supply. Based on data from 31 provinces (municipalities and autonomous regions) in China, this paper investigates the impact of agricultural insurance, agricultural loans, and their linkage model on sustainable farmers' income through theoretical and empirical analysis, delves into the underlying mechanisms and regional disparities, and proposes targeted policy recommendations accordingly.

In the study of farmers' income, academia generally focuses on its structural evolution and sustainable growth pathways. Data from the National Bureau of Statistics (2023) shows that wage income has become the primary source of disposable income for rural residents, while the share of property income and transfer income continues to rise. Chen Dan [1] points out that increasing farmers' income relies on optimizing the income structure and expanding new channels. Research by Xu Jundi and Zou Xiaofeng [2] indicates that fiscal support for agriculture and industrial structure upgrading can effectively promote farmers' income growth, but policy coordination is necessary to avoid conflicts. Zhang Yating [3] confirms the positive promoting effect of rural financial development on farmers' income. The growth rate of per capita disposable income is often used as a key indicator for measuring income sustainability.

Research conclusions regarding the impact of agricultural insurance on farmers' income are divergent. Some studies affirm its positive role. R. Miao [4] argues that insurance can effectively disperse disaster risks and prevent income decline. Khatri-Chhetri et al. [5] point out that agricultural insurance can also serve as a credit enhancement tool in the context of climate change. Li Ao et al. [6] emphasize its leverage effect in poverty alleviation. On the other hand, other studies reveal the limitations and conditional nature of its effects. Research by Banerjee et al. [7] suggests that insurance does not necessarily promote loan repayment and may sometimes exacerbate financial risks. Chen Qiuyue [8] indicates that due to the simplistic design and low coverage level of agricultural

insurance products, their role as a credit enhancement tool for loans has not been fully realized.

The impact of agricultural loans on farmers' income is also subject to debate. Most studies support their positive effect. Wang Zhifei and Liu Saihong [9] confirm that agricultural loans can effectively reduce the urban-rural income gap, with agricultural revitalization playing a mediating role. Tang Yong and Lu Taisheng [10] find that loans can enhance farmers' investment and production capacity, promoting long-term income growth. However, some studies point out the challenges to its effectiveness. He Lilong et al. [10] find that agricultural loans from formal financial institutions have insignificant income-enhancing effects on impoverished households. Xu Wei and Xie Yumei [11] note that the "rich-poor bundling" and "bank-insurance interaction" mechanisms fail to effectively alleviate rural credit rationing. Wei Lihong et al. [12] reveal practical issues such as lack of collateral and mismatched funding cycles in loan applications through case studies.

Regarding the synergistic relationship between agricultural insurance and agricultural loans, academia has not reached a consensus. Studies supporting synergistic effects find that their combination can form a positive mechanism. Zheng Jun and Tang Zhenyu [13] confirm the synergistic advantages between the two, jointly promoting agricultural output growth. Wang Qian et al. [14], using a coupling coordination degree model, find that the three systems of agricultural insurance, agricultural loans, and farmers' income are overall in a primary stage of coordinated development. Research by Luo Tingting [15] shows that the linkage between the two can effectively enhance farmers' risk resilience and agricultural income. However, some studies hold reservations. Banerjee et al. [16] argue that agricultural insurance does not significantly improve farmers' loan repayment capacity. The research by Ye Chengjie and Qiu Bo [17] further reveals context dependency, suggesting that during non-disaster periods, agricultural loans may increase income downside risk, while agricultural insurance in normal years may suppress income growth potential, with synergistic effects varying according to external conditions.

In summary, existing research provides diverse perspectives on financial support for increasing farmers' income. However, further in-depth exploration is needed regarding the synergistic mechanism between agricultural insurance and agricultural loans, the conditional nature of their effects, and regional heterogeneity. Therefore, building on prior research, this paper will focus on how agricultural insurance and agricultural loans affect farmers' income growth and analyze the intrinsic pathways of their interaction in income enhancement and poverty reduction. Integrating China's realities and referencing international experience, this study aims to propose targeted recommendations for improving the rural financial service system within the context of rural revitalization, thereby providing references for promoting sustainable agricultural and rural development and the continuous growth of farmers' income.

2. Theoretical Analysis and Research Hypotheses

Agricultural insurance supports farmers' income growth by stabilizing their income expectations and dispersing production risks. After enrolling, farmers tend to expand production scale and introduce new equipment to enhance output efficiency. However, agricultural insurance in China does not yet cover all crops, and subsidy standards differ among crops, directly influencing farmers' planting decisions. The expansion of insurance coverage, coupled with government compensation, helps smooth post-disaster income fluctuations and maintain agricultural production stability. Simultaneously, agricultural production is vulnerable to natural disasters. Agricultural insurance assists in risk identification and dispersion before disasters and provides loss compensation afterward, thereby stabilizing farmers' income. Insurance companies enhance farmers' disaster prevention awareness by monitoring insured agricultural conditions and providing risk training. Timely claim settlement after disasters effectively mitigates income volatility and safeguards farmers' production and livelihood. The current limited coverage of agricultural insurance and inconsistent subsidy standards across crops constrain its practical effectiveness, rendering the impact of agricultural insurance on farmers' income growth uncertain.

H1: The impact of agricultural insurance on farmers' income growth is ambiguous.

Theoretically, agricultural loans can achieve an effective balance between an institution's own sustainable development and the implementation of poverty alleviation goals by reducing transaction costs for financial institutions and securing credit funds. This can alleviate financial institutions' "credit reluctance" and enhance credit supply to farmers. However, these positive effects are premised on agricultural loans being "accurately" directed to target farmers. In practice, since the initiation of financial poverty alleviation in China, the issue of "targeting inaccuracy" has persisted. Although the state continuously improves top-level design and adopts various measures to enhance targeting precision and fund allocation accuracy, the "crowding-out effect" on the most vulnerable groups remains widespread. Research indicates that compared to non-poor households, poor households have a relatively insufficient demand for small poverty alleviation loans, while the infusion of agricultural loans often more readily boosts the credit demand of non-poor households. This targeting bias may lead to a mismatch between agricultural loans and farmers' income, resulting in an insignificant or even opposite effect of loan investment on farmers' income.

H2: Agricultural loans have a reverse effect on farmers' income growth.

Information asymmetry is prominent in the rural financial market. Agricultural insurance follows the law of large numbers, enabling the overall management of production risks within a region; agricultural loans focus on individual credit assessment. Their combination can integrate risk information and client information, mitigating adverse selection and moral hazard caused by information asymmetry. Agricultural insurance can lock in a minimum income level for farmers, akin to a "put option," thereby reducing income volatility. The "bank-insurance interaction" mechanism also helps lower operational risks for financial institutions and enhance their willingness to lend. Research shows that the impact of agricultural insurance and agricultural loans on farmers' income is not simply linear and may exhibit threshold effects.

H3: Agricultural loans and agricultural insurance have a synergistic effect in promoting farmers' income growth.

3. Research Design

3.1. Model Specification

This paper employs relevant econometric models for empirical investigation of the aforementioned theories. The fixed effects model is primarily used in the analysis.

$$Y = \beta_0 X_{it} + \sum \beta_1 Control_{it} + \beta_2 + \tau_t + \epsilon_{it}$$

Ymeasures the income level; X_{it} represents the development level of agricultural insurance in synergy with agricultural loans in each region; $Control_{it}$ *are control variables varying over time and regional characteristics: fiscal support for agriculture, rural education level, rural healthcare level, per capita GDP;* τ_t denotes year fixed effects; ϵ_{it} represents the composite disturbance term.

This paper intends to apply the SYS-GMM method to empirically study the effect of the synergy between agricultural insurance and agricultural loans on sustainable farmers' income in China through analysis of the entire sample and to explore heterogeneity. Based on the above, the SYS-GMM model is established as follows:

$$\begin{aligned} Y_{it} = {} & \beta_0 + \beta_1 Y_{it-1} + \beta_2 Insurace_{it} + \beta_3 Ag_Loan_{it} \\ & + \beta_4 (Insurance_{it} \times Ag_Loan_{it}) \\ & + \sum_{j=1}^{n} \alpha_j X_{j,it} + u_i + v_t + \epsilon_{it} \end{aligned}$$

i and t represent province and year, respectively; Y_{it} denotes the growth rate of rural per capita disposable income in province i in year t; Y_{it-1} denotes the growth rate of rural per capita disposable income in province i in year t-1; $Insurance_{it}$ and Ag_Loan_{it} represent the development levels of agricultural insurance and agricultural loans in province i in year t, respectively; $(Insurance_{it} \times Ag_Loan_{it})$ is the product of the development levels of agricultural insurance and agricultural loans, representing the interaction term between agricultural insurance and agricultural loans in province i in year t; $X_{j,it}$ denotes a series of control variables influencing income level; u_i denotes individual effects; v_t denotes time effects; ϵ_{it} is the random disturbance term.

To study the nonlinear relationship between the synergy of agricultural insurance and agricultural loans in promoting farmers' income, and to analyze the impact of agricultural insurance and agricultural loans on farmers' agricultural income under different farmers' income levels, this paper establishes a panel threshold model. The specific model is as follows:

$$\begin{aligned} Y = {} & \mu_i + \beta_1 X_{it} Insurance(q_{it} \le Y_1) \\ & + \beta_2 X_{it} Insurance(Y_1 > q_{it}) + \epsilon_{it} \end{aligned}$$

In the above formula, I(·) represents the indicator function, q_{it} represents the threshold variable, Yrepresents the single threshold value to be estimated, q_{it} represents the regression coefficient, μ_i reflects individual fixed effects, and ϵ_{it}s the random disturbance term.

3.2. Variable Description

Income Growth Rate (Y): In this paper, we select the growth rate of rural per capita disposable income to reflect the living standard and overall income situation of a region. Since the development of agricultural insurance and agricultural loans is closely related to residents' income, higher income growth typically implies less severe local poverty and greater prosperity. Therefore, this paper uses the income growth rate as the dependent variable in the model for analysis.

Agricultural Insurance Development Level (Insurance): Currently, agricultural insurance premium income is considered an indicator that more accurately reflects the regional level of agricultural insurance development. Therefore, this paper selects "per capita agricultural insurance premium income" as the measure for the development level of agricultural insurance.

Agricultural Loan Development Level (Ag_Loan): In existing research, the balance of agricultural loans is commonly used to measure the development level of agricultural-related loans. Agricultural loans cover a broad scope, effectively reflecting the overall situation of a region's financial investment in agriculture-related fields. This paper obtains the development level of agricultural loans by calculating the logarithmic value of the ratio of each province's agricultural loan balance to its agricultural gross product.

Furthermore, this paper introduces the interaction term (I_A) between the agricultural insurance development level (Insurance) and the agricultural loan development level (Ag_Loan) to measure the synergistic development degree of agricultural insurance and agricultural loans. Since the first two indicators have undergone logarithmic transformation, the interaction term (I_A) does not require further logarithmic transformation.

Control Variables: Given the variability and complexity of rural living conditions and the multitude of factors affecting farmers' income, the scientific selection of effective control variables is crucial for analyzing stable income growth for farmers. Based on a review of relevant literature, this paper ultimately identifies four control variables, specified as follows:

(1) Economic Development Level (G): Per capita GDP is used as an indicator to measure the regional economic development level. A higher value of this indicator suggests a more prosperous regional economy; conversely, a lower value indicates relatively lagging economic development.

(2) Rural Education Level (E): The portion of fiscal expenditure allocated to education is used as an indicator to measure the education level, and this value is logarithmically transformed. Since the accumulation of human capital, such as education, typically involves a certain lag effect and is difficult to directly convert into productivity in the short term, this paper uses the one-period lagged rural education level as a control variable in the GMM model.

(3) Rural Healthcare Level (M): The rural healthcare development level is measured by taking the logarithm of medical expenditure within farmers' consumption expenditure. The improvement of medical conditions is not only related to farmers' health but also indirectly affects their income-earning capacity.

(4) Fiscal Support for Agriculture Level (F): State financial support for agriculture is an important guarantee for promoting agricultural development and increasing farmers' income. This paper selects government fiscal expenditure on agriculture, forestry, and water affairs as the measurement indicator. This indicator can more comprehensively reflect the level of government financial investment in agricultural production, forestry, water conservancy, etc., thereby demonstrating the support for agricultural endeavors.

Table 1. Variable Description

Dependent Variable	Sustainable Income	Y	Ln (Per Capita Disposable Income)
Independent Variables	Agricultural Insurance Dev. Level	Insurance	Ln (Agricultural Insurance Premium Income / Rural Population)
	Agricultural Loan Dev. Level	Ag_Loan	Ln (Agricultural Loan Balance / Agricultural Gross Product)
Control Variables	Economic Development Level	G	Ln (GDP / Total Population)
	Rural Education Level	E	Ln (Fiscal Expenditure on Education)
	Rural Healthcare Level	M	Ln (Consumption Expenditure on Medical Care)
	Fiscal Support for Agriculture Level	F	Ln (Fiscal Expenditure on Agriculture, Forestry, and Water Affairs)
Dependent Variable	Sustainable Income	Y	Ln (Per Capita Disposable Income)

3.3. Sample Selection

This paper uses Eviews 13 as the econometric analysis software. To mitigate instability caused by heteroscedasticity, logarithmic transformations are applied to sustainable income, agricultural insurance development level, agricultural loan development level, rural healthcare level, rural education level, economic development level, and fiscal support for agriculture level. Based on data organization and availability, the final sample comprises 341 observations from 31 provinces across China from 2012 to 2022. Data are sourced from the *China Statistical Yearbook*, *China Financial Yearbook*, *China Insurance Yearbook*, *China Rural Statistical Yearbook*, as well as websites of the Ministry of Finance and the National Bureau of Statistics, etc. The descriptive statistics of the main variables are presented below:

Table 2. Statistical Characteristics

Variable	Obs	Mean	Std. Dev.	Min	Median	Max
Y	341	0.092	0.023	-0.005	0.089	0.161
Insurance	341	-0.054	0.962	-3.472	-0.105	2.191
Ag_Loan	341	6.661	5.551	1.580	4.560	37.046
I_A	341	0.583	8.014	-27.568	-0.502	58.372
G	341	10.915	0.449	9.862	10.869	12.239
E	341	6.612	0.700	4.548	6.656	8.261
M	341	6.870	0.599	4.186	6.973	9.708
F	341	6.238	0.566	4.614	6.310	7.214

4. Empirical Results and Analysis

4.1. Baseline Regression Results

This paper ultimately empirically analyzes the impact of agricultural insurance development level (Insurance), agricultural loan development level (Ag_Loan), and their interaction term (I_A) on sustainable income (Y) from both static and dynamic panel model perspectives. The specific test results are as follows:

Table 3. Instrument Variables

			(3)	(4)	(5)
	OLS	FE	SYS-GMM	SYS-GMM	SYS-GMM
Insurance				-0.022*** (-17.89)	
Ag_Loan					-0.006*** (-18.38)
I_A	-0.001*** (-2.69)	-0.001 (-0.97)	-0.002*** (-15.09)		
G	-0.001 (-0.31)	0.026** (1.88)	0.046*** (7.04)	0.088*** (-12.86)	-0.002 (-0.29)
E(-1)	-0.001 (-0.63)	0.006 (0.90)	0.006 (1.05)	-0.017*** (-0.38)	0.035*** (5.12)
M	-0.016*** (-11.37)	0.002 (0.66)	-0.012*** (-7.-1)	-0.016*** (-6.95)	-0.011*** (-3.69)
F	-0.002 (-0.77)	0.004 (0.83)	-0.075*** (-26.83)	-0.057*** (-17.15)	-0.070*** (-28.24)
Cons	0.230*** (9.29)	-0.280** (-2.06)			
N	341	341	341	341	341
R2	0.54	0.83			
Adj.R2	0.54	0.81			

As can be seen from the table above: The regression results examine the impact of the synergistic interaction term (I_A) between agricultural insurance and agricultural loans, agricultural insurance (Insurance), and agricultural loans (Ag_Loan) on income growth, respectively. Among them, the synergistic term (I_A) passes the significance test at the 1% level in both OLS and SYS-GMM estimations, with coefficients of -0.001 and -0.002, respectively, indicating a significant negative impact of their synergy on income; this effect is not significant in the FE estimation. This suggests that the synergy between agricultural insurance and agricultural loans is insufficient.

Individually, the coefficient for agricultural insurance development level (Insurance) is -0.022 in the SYS-GMM estimation, significantly negative at the 1% level; the coefficient for agricultural loans (Ag_Loan) is -0.006 in the SYS-GMM estimation, also significantly negative at the 1% level. This indicates that both factors individually play a key role in farmers' income growth.

Among the control variables, the economic development level (G) significantly and positively promotes income in most dynamic estimations, while rural healthcare (M) and fiscal support for agriculture (F) levels generally show significant negative associations. Overall, this indicates that current agricultural financial tools and their interactive mechanisms do not effectively support the enhancement of sustainable farmers' income.

4.2. Robustness Checks

Table 4. Robustness Checks

	Excluding Fiscal Support for Ag	Excluding Central Regions	Excluding Western Regions
I_A	-0.0004*** (-2.97)	-0.0017*** (-8.20)	-0.0028** (-2.29)
G	0.058*** (11.98)	0.0335*** (8.66)	0.0485 (1.56)
E(-1)	-0.082*** (-27.59)	0.0031 (0.76)	0.04467* (1.84)
M	-0.024*** (-18.28)	-0.0103*** (-6.47)	-0.0104 (-1.19)
F	-	-0.0629*** (-20.55)	-0.1071*** (-11.43)
N	310	259	199
P-value	0.23	0.18	0.29

As can be seen from the table above: Robustness checks through subsample regression analyses excluding central and western regions provide robust support for the core findings of this study. First, the interaction term (I_A) between agricultural insurance and agricultural loans maintains a statistically significant negative impact across all subsamples, confirming the universality of the "financial synergy failure" phenomenon, rather than a result driven by specific regions. Second, the intensity of its negative impact exhibits a robust gradient characteristic, systematically revealing that the negative synergy problem is most severe in the eastern region, while the central and western regions have a mitigating effect in sequence.

Among the control variables, the coefficients and significance of the economic development level (G) and fiscal support for agriculture (F) change regularly with sample variations in line with theoretical expectations, cross-validating the genuine existence of regional heterogeneity patterns. Therefore, based on this robust evidence that withstands sample changes, the proposed policy proposition of "abandoning a one-size-fits-all national approach and implementing regionally targeted policies" has a solid empirical foundation and higher credibility.

5. Research Conclusions and Policy Recommendations

This paper uses data from 31 provinces in China from 2012 to 2022 and analytical methods such as SYS-GMM and threshold models for research. The results indicate that agricultural insurance and agricultural loans have a significant inhibitory effect on farmers' income. However, in terms of regional heterogeneity, the impact of agricultural loans and agricultural insurance on farmers' income differs across the eastern, central, western, and northeastern regions.

Therefore, based on the findings of this study, the following policy implications are derived:

(1) Improving the bank-insurance interaction mechanism requires deepening cooperation based on regional characteristics. Synergy between agricultural insurance and credit helps enhance farmers' risk resilience and income stability, and differentiated strategies should be adopted according to local practical needs. In the northeastern region where synergistic effects are evident, cooperation can be deepened by exploring the use of high-standard insurance policies as standardized collateral and promoting comprehensive service packages. Central grain-producing regions should focus on developing credit products that match insurance coverage levels to enhance production credit support. Western regions can leverage the credit enhancement function of insurance to jointly expand the coverage of basic credit and inclusive insurance. Eastern regions can collaborate on innovation, developing composite products such as "income insurance + supply chain finance" targeting large-scale agriculture and market risks. At the national level, differentiated policies can be used to guide and support the piloting and promotion of various bank-insurance cooperation models.

(2) To stabilize farmers' income expectations, a multi-layered risk dispersion mechanism needs to be established. This requires moving beyond the traditional "bank + insurance" model and introducing third-party forces such as reinsurance, guarantee funds, and government support to share risks collectively. Specifically, an "agricultural insurance + credit + reinsurance" model can be implemented: farmers purchase agricultural insurance when obtaining loans, while insurance companies transfer extreme risks through reinsurance or guarantee funds. This arrangement can effectively disperse concentrated risks for financial institutions, enhance their enthusiasm for serving agriculture, and ultimately, by stabilizing financial supply, reduce farmers' financing costs, providing a guarantee for their long-term income.

(3) Promote the integration and innovation of products and services to enhance supply-demand matching efficiency. Financial institutions should deepen collaboration, integrate insurance and credit data through information sharing, build more accurate customer evaluation models, and design products with linked premiums and credit limits accordingly. Simultaneously, they can jointly innovate collateral methods, tap into the financial value of assets such as agricultural insurance policies, agricultural machinery, and live livestock,

and launch flexible pledged financing products, such as "claim right pledge loans," to help farmers quickly resume production after disasters. Furthermore, leveraging the localized advantages of rural commercial banks and credit cooperatives, their branches can be developed into "one-stop" windows integrating insurance, credit, and services, reducing the cost and difficulty for farmers to access financial services.

(4) Optimize regulation and ecosystem development to guide financial resources downward. In terms of regulation, differentiated policies can be implemented for bank-insurance cooperation institutions involved in agriculture, such as providing appropriate leeway in risk capital and non-performing loan tolerance, while establishing special assessment and accountability exemption mechanisms to motivate grassroots units. At the market level, while supporting traditional institutions in serving rural areas, multiple entities such as village banks and specialized insurance companies can be prudently introduced to form a complementary competitive landscape. Particularly, by increasing the number of participants in the agricultural insurance market, enhancing product and service competitiveness, and promoting the transition of agricultural insurance and credit from simple combination to deep integration, solid financial support can be provided for stabilizing and increasing farmers' income.

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