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The Impact of Agricultural Insurance Development on Farmers' Disposable Income in China

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Abstract: As a critical policy tool for mitigating agricultural risks and stabilizing farmers' incomes, agricultural insurance has been the subject of extensive scholarly investigation. However, there is still no consensus regarding the relationship between agricultural insurance and farmers' income, and the mechanism by which agricultural insurance affects farmers' disposable income requires further empirical examination. In this study, farmers' disposable income is taken as the dependent variable, and agricultural insurance development is measured across three dimensions: coverage density, coverage depth, and compensation efficiency. The entropy method is applied to integrate these indicators into a composite index used as the independent variable. Control variables include urbanization rate, per capita crop-sown area, the proportion of the primary industry, and fiscal support for agriculture. Using panel data from 30 provincial-level administrative regions in China (excluding Hong Kong, Macau, Taiwan, and Tibet) for the period 2014–2024, a two-way fixed effects model is constructed. The empirical results reveal that a one-unit increase in agricultural insurance development leads to a statistically significant 1.098-unit increase in farmers' disposable income ($p < 0.01$), though the effect is partially diluted by control variables. Urbanization ($\beta = 4.349$) exhibits a structural substitution effect through non-agricultural employment, while fiscal support for agriculture ($\beta = 0.001$) synergistically boosts income through infrastructure improvements. In contrast, per capita sown area ($\beta = -0.048$) negatively moderates insurance efficiency due to its reliance on natural resources. A regional heterogeneity analysis reveals that the income-enhancing effect of insurance is significant in the eastern ($\beta = 2.027$) and central ($\beta = 2.155$) regions ($p < 0.01$), but only marginally significant in the western region ($\beta = 0.323$, $p < 0.1$), reflecting the moderating role of economic development and agricultural modernization. The model passes tests for endogeneity using lagged terms and for robustness using 1% winsorization. Based on these findings, this study recommends enhancing insurance density and depth, optimizing product design and claims efficiency, and improving fiscal subsidies and agricultural modernization to effectively boost farmers' disposable income.

Keywords: Agricultural insurance development, Farmers' disposable income, Panel model

1. Introduction

Agriculture remains the primary source of income for rural residents in China, but it is highly dependent on natural factors such as climate and weather conditions, making agricultural production susceptible to significant unpredictable risks. As a risk management tool centered on insurance, agricultural insurance plays a crucial role in compensating for major losses caused by force majeure

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or unexpected events during agricultural activities. It can thus help reduce farmers' losses and has a positive effect on safeguarding their incomes. Since 2012, China's central government has repeatedly emphasized and advanced the development of agricultural insurance through the No. 1 Central Document. These policies have continuously expanded the coverage of agricultural insurance, improved the level of protection, and optimized claims services—thereby strengthening the protective function of agricultural insurance. The 2025 No. 1 Central Document, Opinions on Comprehensively Promoting Rural Revitalization and Accelerating Agricultural and Rural Modernization, further stresses: "We must make every effort to increase agricultural efficiency, invigorate rural areas, and raise farmers' incomes; continue to enhance the supply capacity of grain and other key agricultural products… improve the support policy system for grain production, reduce the proportion of premium subsidies borne by counties in major grain-producing areas, and promote the expansion of full-cost insurance and insurance coverage for rice, wheat, corn, and soybeans."

To help reduce disaster losses in agricultural operations, the central and local governments have actively promoted policy-based agricultural insurance and improved related financial mechanisms. As a result, the range and scale of agricultural insurance in China have continued to grow. However, problems such as unscientific pricing, inadequate policy systems, and irregular claims processing still persist, significantly affecting the effectiveness of agricultural insurance.

In short, agricultural insurance is intended by policy to assist farmers in risk-sharing and to stabilize or increase their disposable income. Yet in practice, its actual effectiveness is influenced by multiple factors, leading to certain uncertainties. Therefore, this paper takes the level of agricultural insurance development as the explanatory variable and farmers' disposable income as the dependent variable, and constructs an empirical model to examine and analyze the actual impact of agricultural insurance development on farmers' disposable income.

2. Literature review

2.1. Evaluation of agricultural insurance development

As an important policy instrument for dispersing agricultural risks, stabilizing farmers' incomes, and mitigating disaster-related losses, agricultural insurance has drawn widespread attention in academic circles in recent years. In studies exploring the relationship between agricultural insurance and farmers' income, most scholars have used the level of agricultural insurance development as the core explanatory variable. When evaluating this development, scholars generally focus on two key indicators: coverage density and coverage depth. For example, scholars such as Ma Zhenhao [1], Sang Kepei [2], Xu Jing [3], and Zhang Rui [4] have emphasized evaluation systems based on coverage density. In contrast, researchers like Cui Li [5] and Huang Ying [6] have primarily analyzed coverage depth. Notably, Sang Kepei [2] and Xu Jing [3] incorporated both indicators in their studies, demonstrating methodological intersectionality. These two indicators have also been officially included in the China Insurance Yearbook's statistical index system, with clear definitions and standardized measurement methods, making them authoritative and context-appropriate tools for assessing agricultural insurance development in China.

Building on this foundation, Sang Kepei [2] introduced an additional indicator—compensation efficiency—which enhances the scientific rigor and practical explanatory power of the evaluation system. Accordingly, this study adopts all three indicators—coverage density, coverage depth, and compensation efficiency—to evaluate the level of agricultural insurance development.

2.2. The impact of agricultural insurance development on farmers' income

In analyzing the relationship between agricultural insurance and farmers' income, most researchers adopt quantitative approaches and construct assessment models to determine the effect of insurance

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development on income or disposable income. However, the findings have been inconsistent. Some scholars argue that the development of agricultural insurance positively influences farmers' income. Various methodologies have been used to validate this positive relationship. For instance, Ma Zhenhao et al. [1] employed spatial econometric and system GMM models; Zheng Jun et al. [7] used dynamic panel models; Ren Yushuang et al. [8] conducted Granger causality tests; Cui Li [5] applied fixed effects and threshold effect models; and Zhang Rui [4] used static OLS regression models. These studies consistently conclude that the improvement of agricultural insurance development significantly promotes income growth through channels such as risk mitigation and activation of production factors. However, other researchers hold the opposite view, suggesting that agricultural insurance development may have a negative effect on farmers' income. Sang Kepei [2], using a two-way fixed effects model, and Xu Jing [3], using a system GMM model, argue that unscientific pricing and insufficient compensation efficiency can undermine the positive effects of insurance, resulting in negative income impacts.

Some scholars have gone further to reveal spatial or locational heterogeneity in the impact of agricultural insurance on farmers' income in China. The direction and magnitude of these effects vary due to regional differences in resource endowments, economic structures, and institutional environments. Ma Zhenhao [1] found significant spatial dependence in agricultural insurance effects, with stronger and significantly positive impacts in eastern regions characterized by rapid economic development and advanced agricultural industrialization and modernization. In contrast, Sang Kepei [2] found negative effects in southeastern regions and statistically insignificant effects in northwestern regions where agriculture is more prevalent but modernization and insurance participation rates are low. Similarly, studies by Cui Li [5] and Huang Ying et al. [6] also confirm that the income effects of agricultural insurance vary across regions.

2.3. Literature evaluation and research hypotheses

In summary, the impact of agricultural insurance on farmers' disposable income remains uncertain. Existing research supports the positive effects of risk diversification mechanisms and optimized allocation of production factors. However, institutional deficiencies such as pricing biases and low compensation efficiency may lead to crowding out of productive investments by insurance premiums, thereby inhibiting income growth. Regional heterogeneity analyses further demonstrate that these effects are moderated by factors such as regional economic development levels, the degree of agricultural industrialization, and geographical location.

Based on the above analysis, this study proposes the following hypotheses:

H1: The development level of agricultural insurance has a positive impact on farmers' disposable income.

H2: The impact of agricultural insurance development on farmers' disposable income exhibits regional heterogeneity.

3. Variables and model

3.1. Variables and explanations

To ensure the authority of the data, this study uses panel data from 2014 to 2024 covering 30 provinces, autonomous regions, and municipalities in China (excluding Hong Kong, Macao, Taiwan, and Tibet).

1. Dependent Variable: Farmers' per capita disposable income (pos). Following Cui Li's study, this paper selects the per capita disposable income of rural residents as the dependent variable.

2. Core Independent Variable: Agricultural insurance development level (ins). Referring to the approach of Sang Kepei and others, this study evaluates the development level of agricultural

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insurance based on three dimensions: insurance coverage density, insurance coverage depth, and insurance compensation efficiency. These are integrated using the entropy method[1].

3. Control Variables: Apart from the development level of agricultural insurance, other factors also influence farmers' disposable income. Considering data availability, the following control variables are selected: ①Urbanization rate (urb): Urbanization affects farmers' income through labor transfer, increased non-agricultural employment opportunities, and reallocation of land resources. ②Per capita crop-sown area (see): This indicator reflects the match between agricultural labor and land resources, thus capturing the income impact from land. Greater per capita sown area indicates higher dependence on agriculture and greater income sensitivity to agricultural fluctuations. ③Proportion of the primary industry (ind): A higher proportion indicates a region dominated by agriculture, where income is more vulnerable to agricultural risks. ④Fiscal support for agriculture (fis): Government spending on agriculture improves infrastructure, provides subsidies, and promotes technology, thereby enhancing productivity and potentially increasing farmers' income. Fiscal support also benefits the development of agricultural insurance.

Although some studies include factors like farmers' education levels, rural human capital, agricultural technology, and agricultural product prices, this study focuses on the relationship between agricultural insurance and farmers' income. Since these additional variables are less directly related to the mechanisms through which insurance affects income, they are excluded to avoid confusing causal pathways.

As shown in Table 1:

Table 1: Variable descriptions

Variable Type	Variable Name	Source / Measurement Method			Symbol	Unit
Dependent Variable	Per capita disposable income of rural residents	National Bureau of Statistics			pos	10,000 RMB/person
Core Variable	Agricultural insurance development level	China Insurance Yearbook	Entropy Method Construction	Insurance coverage density[2] Insurance coverage depth[3] Insurance compensation efficiency[4]	ins	-
Control Variables	Urbanization rate	National Bureau of Statistics		Urban Population / Total Population	urb	%
	Per capita crop-sown area	China Rural Statistical Yearbook		Total Crop-Sown Area / Rural Population	see	mu/person
	Proportion of the primary industry	National Bureau of Statistics		Total Output Value of Agriculture, Forestry, Animal Husbandry, and Fishery / Regional Gross Domestic Product (GDP)	ind	%
	Fiscal support for agriculture	China Rural Statistical Yearbook		Local Government Expenditure on Agriculture, Forestry, and Water Affairs	fis	100 million RMB

[1] The core principle of the entropy weight method is to determine the amount of information provided by each indicator based on its information entropy and, consequently, to assign weights accordingly. A smaller entropy value indicates a greater amount of information and, thus, a higher weight. This method effectively avoids the influence of subjective judgment, making the weight assignment process more scientific and objective.

[2] Insurance Coverage Density = Agricultural Insurance Premium Income (100 million RMB) / Rural Population (10,000 people)

[3] Insurance Coverage Depth = Agricultural Insurance Premium Income (100 million RMB) / Total Output Value of Agriculture, Forestry, Animal Husbandry, and Fishery (billion RMB)

[4] Insurance Compensation Efficiency = Agricultural Insurance Claims Payout (100 million RMB) / Agricultural Insurance Premium Income (100 million RMB)

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3.2. Model design

Compared with traditional cross-sectional or time-series models, panel models are capable of handling multiple entities and datasets simultaneously. They capture both individual heterogeneity and temporal dynamics, while also controlling for unobservable fixed effects to reduce omitted variable bias. Therefore, this study adopts a panel data model for analysis.

$$y_{it} = \beta_1 x_{it} + \beta_2 z_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

In this model, β_{it} represents the regression coefficient, y_{it} is the dependent variable, x_{it} is the explanatory variable, z_{it} denotes the individual fixed effect (which does not vary over time), and α_i is the random error term. The subscripts i and t represent the individual (e.g., province) and time (e.g., year), respectively.

4. Empirical analysis

4.1. Descriptive statistics

The descriptive statistics of the variables are presented in Table 2.

Table 2: Descriptive statistics

	(1)	(2)	(3)	(4)	(5)
Variables	N	mean	sd	min	max
pos	330	1.566	0.619	0.628	3.973
ins	330	0.159	0.132	0.00995	0.781
urb	330	0.620	0.110	0.403	0.893
see	330	4.952	3.735	0.480	21.79
ind	330	0.168	0.0931	0.00610	0.472
fis	330	643.4	282.0	110.3	1,359

The 330 valid samples used in Table 2 show that all variables—pos, ins, urb, see, ind, and fis—have complete data with no missing values, meeting the requirements for large-sample statistical analysis. The high variance across all variables suggests the data sufficiently represent provinces with varying levels of economic development, resource endowment, and policy orientation.

The mean per capita disposable income of farmers (pos) is 15,660 RMB, with a standard deviation of 6,190 RMB and a range of 33,450 RMB, indicating considerable income disparities across provinces.

The agricultural insurance development level (ins) has a mean of 0.159 and a standard deviation of 0.132, with a range of 0.771, indicating highly uneven development across regions.

Control variables like urbanization rate (urb), per capita sown area (see), proportion of the primary industry (ind), and fiscal support (fis) also show significant variation across samples.

Thus, the dataset has sufficient sample size and internal variation to explore the complex relationship between agricultural insurance development and farmers' disposable income.

4.2. Panel data regression analysis

The baseline regression of agricultural insurance on farmers' per capita disposable income is conducted in two stages. Column (1) presents results without control variables, while Column (2) includes them (Table 3).

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Table 3: Baseline regression results

	(1)	(2)
Variables	(1) pos	(2) pos
ins	2.265***	1.098***
	(9.02)	(6.45)
urb		4.349***
		(16.19)
see		-0.048***
		(-7.07)
ind		0.429
		(1.26)
fis		0.001***
		(10.59)
Constant	1.205***	-1.583***
	(23.21)	(-7.86)
Observations	330	330
R-squared	0.233	0.796
r2_a		0.792
F		205.5

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As shown in Table 3, both regression results—with and without control variables—pass the 1% significance test. This indicates that the level of agricultural insurance development has a significant positive impact on farmers' per capita disposable income. Furthermore, after incorporating control variables, the model's R^2 increases from 0.233 to 0.796, suggesting enhanced explanatory power. Thus, Model (2) is more robust and supports Hypothesis H1.

In Model (1), a one-unit increase in the agricultural insurance development level (ins) leads to a significant increase of 2.265 units in farmers' per capita disposable income (pos) ($p < 0.01$). After the inclusion of control variables in Model (2), the coefficient for ins drops to 1.098 ($p < 0.01$), indicating that the income-promoting effect of agricultural insurance is partially attenuated by other variables. Nonetheless, the positive direction of the effect remains unchanged, and the result is statistically robust.

Except for the proportion of the primary industry (ind), all explanatory and control variables are significant at the 1% level. Specifically, agricultural insurance development (ins), urbanization rate (urb), and fiscal support for agriculture (fis) have significant positive effects on pos, while per capita crop-sown area (see) has a significant negative effect.

The reduction in the regression coefficient of ins after the introduction of control variables can be interpreted as follows:

1. Urbanization Rate (urb): With a coefficient of 4.349, urbanization has a stronger positive effect on income than agricultural insurance. The rise in non-agricultural employment reduces farmers' reliance on agricultural income, thereby diluting the direct income effect of insurance. While agricultural insurance stabilizes income under risk, urbanization structurally transforms income sources, creating a partial substitution effect.

2. Fiscal Support (fis): Fiscal support synergizes with both agricultural insurance and income growth. It enhances infrastructure and promotes technology adoption, improving risk resilience and partially substituting for insurance.

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3. Agricultural Resource Endowment (see): The negative coefficient (-0.048) suggests that in areas overly dependent on land income, farmers are less likely to insure, leading to a simultaneous drop in insurance participation and income levels.

In summary, while the influence of agricultural insurance on farmers' income is confirmed, its effects are partially substituted by factors like urbanization and fiscal support. Thus, agricultural insurance remains a foundational but not fully optimized mechanism for stabilizing agricultural income and mitigating systemic risk.

4.3. Endogeneity test and robustness analysis

To address issues of endogeneity and model specification sensitivity, this study conducts two types of tests: an endogeneity test by introducing a one-period lag of the dependent variable, and a robustness test by applying 1% winsorization to all variables. Column (1) of Table 4 presents the results of the endogeneity test. It shows that while the magnitude of the impact of agricultural insurance development on farmers' per capita disposable income changes, the direction of the effect remains consistent. Column (2) of Table 4 reports the results of the robustness test. After winsorization, the impact of agricultural insurance development on farmers' income remains positive and statistically significant at the 1% level. Moreover, in both the endogeneity and robustness tests, all variables—except for the proportion of the primary industry (ind), which is significant at the 5% level—remain statistically significant at the 1% level. Therefore, the model passes both the endogeneity and robustness tests, and the results are reliable and demonstrate stable effects.

Table 4: Endogeneity and robustness test results

Variables	(1) (3) pos	(2) (4) pos
ins	0.615*** (3.56)	0.691*** (3.88)
urb	3.661*** (12.48)	3.608*** (12.65)
see	-0.369*** (-3.65)	-0.347*** (-3.81)
ind	-0.539* (-1.78)	-0.685** (-2.28)
fis	0.001*** (8.18)	0.001*** (9.31)
Constant	-1.117*** (-5.19)	-0.989*** (-4.75)
Observations	300	330
R-squared	0.765	0.770
r2_a	0.760	0.766
F	152.6	177.0

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.4. Heterogeneity analysis

To further explore the regional heterogeneity in the impact of agricultural insurance development on farmers' disposable income, this study follows the regional division framework used by the National

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Development and Reform Commission5, categorizing the country into eastern, central, and western economic belts. Subsamples for each region are analyzed separately, and the regression results are shown in Table 5.

Table 5: Regional heterogeneity regression results

Variables	(1) East	(2) Central	(3) West
ins	2.027*** (4.88)	2.155*** (6.30)	0.323* (1.96)
urb	1.809 (1.58)	2.468*** (6.89)	3.895*** (8.31)
see	-0.044 (-1.02)	-0.065*** (-6.66)	-0.009 (-0.43)
ind	-1.572 (-1.33)	1.104*** (2.85)	0.619 (0.99)
fis	0.000** (2.38)	0.001*** (8.46)	0.001*** (10.63)
Constant	0.457 (0.48)	-0.658*** (-2.90)	-1.436*** (-5.01)
Observations	121	99	110
R-squared	0.719	0.770	0.845
r2_a	0.704	0.755	0.835
F	47.66	50.27	91.26

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From Table 5, we observe that the coefficients of the explanatory variable (ins) are significantly positive across all three regions, although the levels of significance vary: In the eastern and central regions, the coefficients are significant at the 1% level. In the western region, the coefficient is smaller and only significant at the 10% level. These findings confirm that agricultural insurance development has a positive effect on farmers' disposable income in all regions, but the magnitude of the effect differs—highlighting regional heterogeneity.

In particular, the eastern and central regions show stronger explanatory power, with the central region's control variables all passing the 1% significance level—including the ind variable, which was not significant in the baseline regression. Furthermore, the direction of influence in the central region aligns with the overall regression results, suggesting that the model has stronger explanatory power for the central region compared to the east and west. Hence, Hypothesis H2—that the effect of agricultural insurance development on farmers' income varies regionally—is supported.

5. Conclusion and policy recommendations

Based on the results of the empirical analysis, this study concludes that the development of agricultural insurance has a significant and positive effect on farmers' disposable income. However,

[5] The eastern region, characterized by a high level of economic development, includes 11 provincial-level administrative divisions: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan. The central region, considered moderately developed, consists of 8 provincial-level administrative divisions: Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan. The western region, which is relatively underdeveloped, comprises 11 provincial-level administrative divisions: Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Guangxi, and Inner Mongolia.

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this effect is partially diminished when control variables are introduced. Therefore, by implementing a series of targeted measures to enhance the development level of agricultural insurance, its risk-sharing function can more effectively drive income growth for farmers. As farmers increasingly recognize the benefits of agricultural insurance, their participation is likely to rise, thereby reinforcing the function of insurance and forming a virtuous cycle between insurance development and income growth.

Given that the composite index for agricultural insurance development is constructed from coverage density, coverage depth, and compensation efficiency, the following policy recommendations are proposed to strengthen the income-enhancing effect of agricultural insurance:

1. Increase Agricultural Insurance Coverage Density

Raising farmers' awareness of insurance is key to improving coverage density. It is recommended that the government, in collaboration with insurance institutions, strengthen regional policy promotion efforts. By leveraging new media platforms to disseminate knowledge, simplifying enrollment procedures, and offering premium subsidies, farmers' willingness to participate in agricultural insurance can be significantly enhanced.

2. Deepen the Protection Depth of Agricultural Insurance

Increasing protection depth requires sufficient funding support. The fiscal cost-sharing mechanism should be optimized, and the central-local subsidy ratio should be dynamically adjusted. Emphasis should be placed on major grain-producing counties and specialty agricultural areas where insurance demand is high but premium growth is slow. By reducing the financial burden on local governments and farmers, insurance depth can be increased. Meanwhile, private capital should be encouraged to participate through tax incentives and risk-sharing mechanisms, motivating insurers to develop differentiated products and expand coverage to high-value agricultural goods.

3. Optimize Insurance Product Design and Claims Efficiency

Improving compensation efficiency calls for better product design and streamlined claims procedures. Current issues include overly strict terms, complex processes, and inefficiencies in claims handling. The government should simplify claim criteria and integrate technologies such as remote sensing to automate and accelerate damage assessments. Additionally, efforts should be made to enhance farmers' awareness of their rights and encourage proactive claims behavior and risk preparedness.

4. Promote Agricultural Industrialization and Modernization to Alleviate Structural Constraints

Excessively high per capita sown area and a high proportion of the primary industry can weaken the income-enhancing effects of insurance. To mitigate these constraints, it is recommended to increase fiscal support, promote agricultural science and technology, encourage land consolidation and large-scale farming, and support innovations in agricultural processing and marketing. These measures will reduce dependence on traditional smallholder farming and improve the overall effectiveness of agricultural insurance.

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