

# Research on Safeguarding Chinese Farmers' Agricultural Income: A Perspective Based on the Reasonableness of Income Insurance Pricing for Cotton in Xinjiang, China

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**Abstract:** The Chinese government attaches great importance to agricultural and rural development as well as increasing farmers' incomes. Farmers' income is sensitive to price fluctuation and yield of the crop. Income insurance is a financial instrument that China is exploring to safeguard farmers' income, however, its performance has been less than satisfactory. There is an urgent need to identify the problems and optimize the problematic aspects of income insurance. The essence of income insurance lies in assessing the magnitude of income risk. However, in practice, the income insurance has not been successfully promoted nationwide. This suggests that the current model for income risk still faces unresolved issues.

**Keywords:** Agricultural Income ; Cotton in Xinjiang ; Research on Safeguarding Chinese Farmers

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## 1. Background Information

Agriculture, as the fundamental industry of the Chinese nation, directly impacts the survival and development of other sectors. Furthermore, the development of agriculture is closely tied to Chinese national security. The Chinese government places significant emphasis on the development of agriculture, rural areas, and the increase of farmers' income. The Central Committee of the Communist Party of China has repeatedly stressed the importance of addressing the issues of "agriculture, rural areas, and farmers" as a priority in the work of the entire Party (Di et al., 2012).<sup>[1]</sup> The report of the 20th National Congress of the Communist Party of China highlights the need to "accelerate the construction of an agricultural powerhouse and comprehensively advance rural revitalization. The Chinese government has sought to build mechanisms to increase farmers' income through various channels. However, years of minimum purchase prices and temporary storage policies have led to distortions in market price signals and an oversupply of agricultural products. Both the stockpiles and import volumes of Chinese agricultural products have risen, increasing the fiscal burden on the government.

In 2022, the Central Document No. 1 further emphasized the importance of ensuring food production and the supply of key agricultural products, and explored the implementation of cost insurance and income insurance for sugarcane. Against the backdrop of the market-oriented transformation of agricultural product prices in China, the rational use such as income insurance rather than price insurance can help farmers achieve risk avoidance, thereby contributing to the stability and development of the national economy .

## 2. Literature review

### 2.1 Progress of Cotton Insurance Research in China

First and foremost, scholarly endeavors are dedicated to comprehensively interpreting and assessing the ramifications of US cotton insurance policies. This endeavor necessitates a meticulous examination of the array of insurance options made available to cotton farmers, coupled with an evaluation of the transformative effects stemming from the introduction of novel insurance products mandated by the 2014 US Farm Bill (Biener et al., 2015)<sup>[2]</sup>. It is noted that the provisions of the 2014 US Farm Bill afford cotton farmers the flexibility to select insurance policies tailored to both irrigated and non-irrigated acreage, thereby conferring a distinct advantage upon cotton farmers.

Secondly, scholarly inquiries delve into probing the potential implications of cotton insurance on the financial standing of cotton farmers and the spatial extent of cotton cultivation .

Thirdly, empirical investigations are directed towards elucidating cotton farmers' propensity to engage with emerging cotton insurance products. Fourth, there exists a concerted effort towards exploring the applicability of index insurance mechanisms within the framework of cotton insurance.

Finally, scholarly discourse revolves around intricate issues pertaining to cotton insurance premiums. Siameh notably highlight the inherent variability in yield risks among different cultivars of the same crop, thereby engendering disparate insurance premium rates across cultivar categories (Di et al., 2012).

## **2.2 Income Insurance Pricing Methodology**

In the United States, crop revenue insurance has emerged as the principal offering within the agricultural insurance market, reflecting its broad acceptance and integration into the risk management frameworks of American farmers. In stark contrast, the Chinese agricultural sector is only beginning to explore the potential of such insurance schemes, which remain in preliminary and exploratory phases. Traditional risk management tools in agriculture typically address either price fluctuations or variations in yield independently.

Revenue insurance within crop insurance programs parallels traditional yield insurance in its reliance on actual historical yields. This type of insurance mandates the provision of 4-10 years of yield data to accurately establish the levels of yield protection afforded to farmers. In instances where a farmer lacks sufficient historical yield data, a predetermined proportion of the average yield data from the corresponding county is utilized as a surrogate measure (Biener et al., 2015).

This approach is reflective of the evolving technological landscape, which has significantly enhanced crop productivity, leading to the introduction in 2012 of provisions for farmers to make trend adjustments to their historical yield data to better reflect current yield potentials.

Similarly, Li and Kong (2009) highlight the strong correlation between futures and spot prices for cotton in Xinjiang. Their research indicates that futures prices can serve as leading indicators for spot price movements, thereby providing a basis for more accurate and responsive pricing mechanisms in revenue insurance schemes. The interaction between these two markets underscores the potential benefits of utilizing futures prices in insurance product design, as they can enhance the predictive accuracy and reliability of revenue projections (Milhollin et al., 2014)<sup>[3]</sup>

## **3. Research methodology**

By thoroughly examining the risks associated with cotton prices and yields, this study aims to better understand the volatility of the cotton market and identify factors contributing to potential income instability.

Furthermore, the research explores an income insurance pricing model based on risk analysis, with the goal of identifying a reasonable pricing range for current cotton income insurance policies.

The specific steps are as follows:

First, the study conducts a detailed analysis of both meteorological and non-meteorological risks affecting cotton prices and yields. Using cointegration models, the major influencing factors are quantified, and their volatilities assessed.

Second, based on the risk analysis results of price and yield, a comprehensive assessment of income risk—incorporating both meteorological and non-meteorological factors—is carried out.

Finally, probability distribution models and Copula models are employed to construct an income insurance pricing model tailored to cotton farmers in Xinjiang.

The ultimate objective is to determine a reasonable pricing range for cotton income insurance under current market and climatic conditions.

### **3.1 Multiple Linear Regression**

Multiple linear regression is a commonly used statistical technique aimed at exploring the relationship between a dependent variable and multiple independent variables, quantifying their linear associations. This study employs a multiple linear regression model to analyze the impact of Xinjiang cotton prices, yield, and associated risk factors. The model assumes a linear relationship between the independent variables and the dependent variable, meaning the expected value of the dependent variable can be explained as a linear combination of multiple independent variables.

### **3.2 Least Squares Method**

This section outlines the estimation method used in multiple linear regression, specifically the principles of the least squares method, the mathematical formulas for parameter estimation, the properties of these estimates, and the evaluation of model fit. First, the least squares method is one of the most commonly used parameter estimation techniques in multiple linear regression analysis. Its

fundamental principle is to estimate the model parameters by minimizing the sum of the squares of the residuals—differences between observed data and predicted values.

### 3.3 Cointegration Model and Granger Causality Test

In a time series analysis, if the variables are non-stationary, traditional t-tests and F-tests may fail, leading to spurious regression phenomena, where the regression results appear significant but do not reflect true relationships. Directly using ordinary least squares regression may yield statistically insignificant results. Therefore, by combining cointegration tests and Granger causality tests, it can ensure the accuracy of the model and the economic interpretability of the results when analyzing non-stationary data. The combination of cointegration tests and Granger causality tests provides ample assurance of the model's stability and predictability, ensuring that ordinary least squares regression results are statistically meaningful and economically interpretable.

### 3.4 Copula Model Analysis and Joint Risk Distribution

To comprehensively assess the income risks faced by cotton farmers in Xinjiang, the research further introduces the Copula model. The application of the Copula model allows it to estimate the correlation between yield and price risks, revealing their interactions in income fluctuations. Through the Copula model, it can construct a joint distribution model for price and yield, quantifying their interdependencies and thus providing a multidimensional perspective for understanding the income risks of cotton farmers. This multidimensional analysis helps illuminate the income fluctuations experienced by farmers under the dual influences of yield and price volatility and provides precise mathematical tools for risk management.

### 3.5 Design and Pricing of Traditional and Index-Based Income Insurance

In managing income risk, traditional income insurance and index-based income insurance are two parallel methods, each with its advantages and applicable scenarios. This study examines the pricing mechanisms of both types of insurance and evaluates their effectiveness using Monte Carlo simulation methods.

**Traditional Income Insurance:** Traditional income insurance compensates based on the actual income losses of cotton farmers. This insurance relies on farmers' yields and market prices, compensating the difference when income falls below a pre-agreed standard. This method ensures that farmers receive compensation based on their actual planting conditions, but its disadvantages include complexity in operations and high costs, requiring verification of each farmer's losses. Therefore, traditional income insurance is advantageous for small-scale farmers but faces significant cost and management challenges when implemented on a larger scale.

By evaluating the pricing and assessment of traditional and index-based income insurance, this research can offer cotton farmers two distinct income risk management options. Traditional income insurance is suitable for small-scale or specific groups, while index-based income insurance provides an efficient risk hedging tool for large-scale agricultural production. By combining these two approaches, policymakers can design flexible insurance policies tailored to different risk environments and farmers' needs.

## 4. Conclusion

The income risk associated with agricultural products is a critical issue for the successful implementation of the income insurance. The pricing of insurance for agricultural income risk is the focal point of this study. If the pricing of income insurance is too high, farmers will be unwilling to bear such a large premium. Conversely, if the pricing is too low, the insurance company will have little to no profit margin, making the model unsustainable. Therefore, reasonable insurance pricing directly affects the effectiveness of the income insurance.

The key aspects of this paper is introducing a new pricing method for income risk insurance, which will help enhance insurance companies' willingness to engage in agricultural income insurance projects.

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