Original Research Article

Does insurance knowledge and loss experience influence the adoption of Pradhan Mantri Fasal Bima Yojana? Evidence from Cotton farmers in Tamil Nadu

Abstract

This study investigates the factors influencing the adoption of crop insurance among cotton farmers in the Virudhunagar district of Tamil Nadu, India. Using a sample of 350 cotton farmers, the study explores how socio-economic factors, insurance knowledge, and past yield loss experiences impact farmers' decisions to adopt crop insurance. A probit model is employed to analyse the data, revealing that insurance knowledge and past yield loss experiences significantly affect insurance adoption. The study also identifies key constraints faced by insured farmers, such as delays in claim payments and low compensation during crop failures. Additionally, the research assesses the various risk management strategies employed by farmers, highlighting a predominant reliance on informal support systems and asset-based solutions. These findings underscore the need for enhanced insurance awareness and improved insurance schemes to better support farmers in managing agricultural risks.

Keywords: Crop insurance, Insurance knowledge,Risk management, Yield loss

1 Introduction

Crop insurance plays a vital role in mitigating the risks faced by farmers, especially in regions where agriculture is highly vulnerable to climate variability (Panda, 2021). In India, crop insurance schemes have been introduced since 1927, to protect farmers from financial losses due to unpredictable weather patterns, pest attacks, and other yield-reducing factors(Tiwari et al., 2020). Despite the availability of these schemes, their adoption remains inconsistent across different farming communities, particularly in rural areas where knowledge dissemination and awareness are often limited. Agricultural production, particularly in emerging regions such as Tamil Nadu, is fraught with challenges and risks caused by unpredictable weather patterns.

Cotton is an important cash crop in Tamil Nadu(Thirukumaran et al., 2024), especially in districts like Virudhunagar, Perambalur, Salem, and Ariyalur. It faces many risks, making it ideal for studying the factors that affect the use of crop insurance.For cotton farmers, such uncertainties are exacerbated by the reliance on rainfed agriculture and limited access to reliable irrigation. These factors make them vulnerable to significant financial losses, which can affect their livelihoods and socio-economic well-being. Understanding these factors is crucial to promoting wider insurance adoption, which can provide a safety net for farmers in risk-prone regions.

This study focuses on cotton farmers in the Virudhunagar district of Tamil Nadu, a region characterized by its reliance on rainfed irrigation(Swetha et al., 2023) and significant challenges related to water scarcity(Baanu & Babu, 2024) and climatic variability. The agricultural sector of Virudhunagarregion, particularly cotton cultivation, faces numerous challenges, including low and erratic rainfall, limited irrigation facilities, and fluctuating market conditions(Sathishkumar et al., 2024). With cotton being a vital crop for the district's economy, farmers must navigate these risks while maintaining crop productivity(Swetha et al., 2023). Crop insurance offers an essential mechanism for mitigating these risks, but its uptake is often influenced by farmers' awareness of insurance products, their previous experiences with crop loss, and their socio-economic backgrounds.

Insurance knowledge, in particular, plays a pivotal role in determining whether farmers see the value in paying premiums for a product that can protect them from potential losses.The district's vulnerability to adverse weather conditions has heightened the importance of examining the factors that drive farmers to adopt insurance products. In addition to weather-related risks, socio-economic constraints such as low income, small landholdings, and limited access to formal financial services further complicate the adoption process. The study focuses on understanding how these socio-economic factors, along with insurance knowledge and past yield loss experiences, influence cotton farmers' decisions to participate in crop insurance schemes.The study also seeks to explore the constraints faced by insured farmers in Virudhunagar.

2 Study area and sampling design

The survey was conducted in the Virudhunagar district of Tamil Nadu. With a total geographical area of 424,323 hectares, it is positioned between 77°20' and 78°26' East

longitude and 09°12' and 09°47' North latitude. This district experiences average mean minimum and maximum temperatures of 23.78°C and 33.95°C, respectively. The region faces significant challenges in irrigation due to low rainfall and limited access to reliable water sources. With only 57% of the district having access to guaranteed irrigation, the region is heavily reliant on rain-fed tanks to sustain its needs. The cultivation of food crops (Vikram et al., 2023)and cotton is vital for the region's economy, with cotton alone covering 11,740 hectares. The livestock sector also plays a crucial role in providing supplementary employment and sustainable income for small and marginal farmers(Anonymous).

The data was collected from 350 cotton farmers in the Virudhunagar district of Tamil Nadu, usingmultistage and simple random sampling techniques. First, a list of cotton farmers was collected from the Joint Director of Agriculture (JDA) and District Cooperative Central Bank (DCCB). Subsequently, 5 blocks named Arruppukottai, Virudhunagar, Rajapalayam, Kariapatti, and Sattur were randomly selected from this list. Further, 7 villages were randomly chosen from each block, and 10 households were picked at random from each village. This resulted in a total of 350 cotton farmers, with 230 insured and 120 uninsured. The survey was conducted using a structured questionnaire from mid-September to mid-October 2022. The focus of the survey was on interviewing heads of households with significant farming expertise and the ability to make important financial decisions. The questionnaire was divided into 3 sections: the socioeconomic background of the respondents, constraints faced by insured farmers, and thealternative risk management strategies adopted by farmers.

3 Empirical methodology

3.1 Probit model

The factors affecting farmers' adoption of crop insurance is investigated using the probit model. The adoption of crop insurance is used as a binary variable based on the answers about whether farmers have adopted crop insurance or not; it takes value 1 if the farmer has insured his crop and zero otherwise. Since the dependent variable is dichotomous, aprobit model approach was used to examine the influence of various socio-economic factors, loss experience, andcrop insurance knowledge on farmers' decision to crop insurance adoption.The probit model is specified as per equation (1).

$$Y = \alpha_0 + \beta_1 AGE + \beta_2 EDN + \beta_3 MEM + \beta_4 INC + \beta_5 FARMSIZE + \beta_6 EXP + \beta_7 IRRI + \beta_8 LIVESTOCK + \beta_9 CREDIT + \beta_{10} \text{MEDIAEXP} + \beta_{11} EXTCONT + \beta_{12} LOSS + \beta_{13} INSKNOW + U_i \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where,

Y = Adoption of crop insurance (1 if a farmer has adopted crop insurance and 0 otherwise)

AGE = Age of the farmer in years

EDN = Education level of a farmer (1 = no schooling, 2 = primary school, 3 = middle school, 4 = secondary school, 5 = higher secondary, 6 = graduate, 7 = postgraduate)

MEM =1if a farmer is a member of any organisation and 0 otherwise

INC = Logged value of annual income of a farmer

FARMSIZE =Size of the farm in acres

EXP = Number of years a farmer engaged in farming activities

IRRI = Availability of irrigation source (1, if a farmer has access to irrigation and 0 otherwise)

LIVESTOCK = 1 for holding livestock and 0 otherwise

CREDIT = 1 for access to credit and 0 otherwise

MEDIAEXP = Total score of frequency of mass media usage

EXTCONT = Total score of frequency of contact with extension personnel

LOSS = % of total yield loss experienced by farmers in the previous season

INSKNOW = Total score of statements reflecting insurance knowledge

U_i= Error term

3.2 Henry Garrett's ranking technique

Garrett ranking technique was used to rank the risk management strategies used by farmers and the constraints faced by insured farmers. Participants were asked to specify the rank for all factors and the results of such ranking have been converted into score value. According to Henry Garrett (1926) ranking method, the percentage score is computed by using the following formulae:

$$\text{Percentage position} = \frac{100\ (R_{ij} - 0.5)}{N_J}$$

where,

R_{ij} = Rank given for i^{th} variable by the j^{th} respondent

N_j = Number of items ranked by the j^{th} individual

By referring to the Garret's table, the percent positions estimated will be converted into scores referring to the table given by Garrett and Woodworth (1969). Thus, for each factor, the scores of various respondents will be added and the mean values will be estimated. The mean values thus obtained for each of the attributes will be arranged in descending order. The attributes with the highest mean value will be considered as the most important one and the others followed in that order.

4 Results and discussion

4.1 Socioeconomicprofile of surveyed farmers

The surveyed cotton farmers in Virudhunagar district exhibit a diverse socioeconomic profile (See Table1), reflecting various characteristics that impact their farming practices and insurance adoption. The average age of the respondents is 49 years, with the majority falling into the 46-55 age range (39.71%), indicating a relatively mature and experienced farming population. Education levels vary, with the majority having completed middle school (28.29%) and secondary education (18.86%), and a smaller percentage having attained higher education. This distribution highlights a significant portion of the farmers with basic education, which may influence their awareness and understanding of crop insurance options.Membership in agricultural organizations is relatively low, with only 40.57 percent of farmers being members. This lack of organizational affiliation could impact farmers' access to information and resources, including insurance knowledge. Annual income shows that half of the respondents earn between 250,000 and 500,000 INR, indicating a moderate-income level, while a small percentage earn over 1,000,000 INR. This income distribution suggests that while many farmers have a reasonable income, a significant portion might still struggle financially, affecting their ability to invest in insurance.

The average farm size of sampled households is 5.68 acres, with the largest group owning between 2 to 4 acres (35.14%). This moderate farm size reflects the predominance of small to medium-scale operations, which can influence the type of insurance products that are most suitable. The average farming experience is found to be 25 years approximately, with a majority having 16 to 30 years of experience, indicating a well-seasoned farming community

capable of adapting to agricultural risks but potentially resistant to new practices.The availability of irrigation sources is limited, with 61.71 percent of farmers lacking access, which emphasizes the reliance on rain-fed agriculture and highlights the importance of insurance in mitigating risk from water scarcity. Livestock ownership is relatively balanced, with 46.57 percent of farmers owning livestock, which may provide supplementary income and affect overall risk management strategies. Furthermore, 60.29 percent of farmers have access to credit, suggesting a relatively good level of financial support, which could influence their ability to afford insurance premiums.

Table 1. Descriptive statistics of socioeconomic characteristics of the respondents.

Particulars	Frequency (n=350)	%	Mean	SD
Age			49.08	8.88
Up to 35	23	6.57		
36-45	106	30.29		
46-55	139	39.71		
56-65	72	20.57		
more than 65	10	2.86		
Education			2.88	1.42
No schooling	75	21.43		
Primary School	66	18.86		
Middle school	99	28.29		
Secondary	66	18.86		
Higher Secondary	26	7.43		
Graduate	16	4.57		
Post Graduate	2	0.57		
Membership in organisation			0.41	0.49
No	208	59.43		
Yes	142	40.57		
Annual income			474,423	247,745
Up to 50,000	0	0.00		
50,000 to 250,000	47	13.43		
250,000 to 500,000	176	50.29		
500,000 to 1,000,000	115	32.86		
More than 1,000,000	12	3.43		
Farm size (acres)			5.68	3.78
up to 2	25	7.14		
> 2 to 4	123	35.14		
> 4 to 6	111	31.71		
> 6 to 10	66	18.86		
> 10	25	7.14		
Farming Experience			25.51	11.57
Up to 5	15	4.29		

6 to 15	66	18.86		
16 to 30	170	48.57		
31 to 45	80	22.86		
More than 45	19	5.43		
Availability of irrigation source			0.38	0.49
Yes	134	38.29		
No	216	61.71		
Livestock			0.47	0.50
Yes	163	46.57		
No	187	53.43		
Access to credit			0.60	0.49
Yes	211	60.29		
No	139	39.71		

4.2 Farmers' awareness level of crop insurance

The level of awareness regarding crop insurance among the surveyed farmers varies significantly (See Table 2). A substantial portion of farmers (45.14%) have a medium level of awareness, while 39.71 percent exhibit a low level of awareness. Only 15.14 percent of farmers demonstrate a high level of awareness about crop insurance. This distribution indicates that while a majority of farmers possess some knowledge of crop insurance, a significant proportion still have limited understanding. The relatively low percentage of highly aware farmers highlights a gap in effective communication and education about crop insurance benefits and options. Addressing this gap through targeted awareness campaigns and educational programs could potentially increase insurance adoption and improve risk management among cotton farmers.

Table 2. Distribution of sampled farmers based on their awareness level

Level of awareness	Frequency (n = 350)	%
Low	139	39.71
Medium	158	45.14
High	53	15.14

4.3 Yield loss experienced due to various risks

The data presented in Figure 1 highlights the percentage of yield loss experienced by farmers due to various risk factors, including droughts, floods, and pest infestations. The results demonstrate that drought, rainfall and pests & diseases leads to a loss of around 20

percent, 15percent, and10 percent, respectively. In essence, it is evident that drought causes a higher loss compared to rainfall and pests and diseases. Additionally, on average, insured farmers experience greater losses (51.04%) due to various risks compared to uninsured farmers (34.93%). Understanding these yield losses underscores the importance of implementing strategies such as crop insurance to help farmers manage the financial impact of these risks and ensure the stability of their operations.

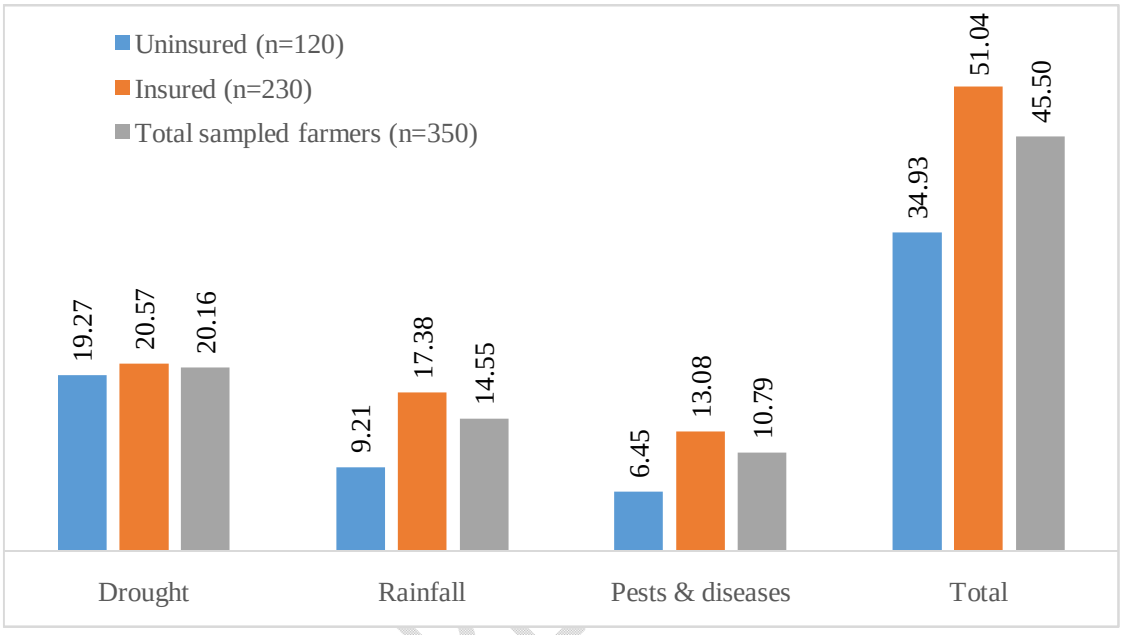

Figure 1.Yield loss experienced by farmers due to various risks (in %)

4.4 Results of theprobit model

The estimates from a probit model that examines the factors influencing the adoption of crop insurance by farmers are presented in Table 3.Results showed that education, organisational membership, media exposure, extension contacts, loss experience and insurance knowledge have a significant positive influence on the adoption of PMFBY. However, farming experience and irrigation access showed a significant negative effect on crop insurance adoption.

Education has a significant impact on farmers' likelihood of adopting crop insurance. The study found that an increase in education level leads to 2.1% higher likelihood of adopting crop insurance. This finding is supported by previous research(Aditya et al., 2018; Dragos et al., 2023; Fahad et al., 2018; Noor Khan & Hasan, 2022). Farmers with higher levels of education demonstrate improved capability in comprehending and procuring

insurance in comparison to their less educated counterparts. Furthermore, heightened levels of general education render farmers more inclined to transfer the risk exposure of their crops to specialized risk management institutions(Dragos et al., 2023). Additionally, membership in farmer organizations is associated with a 5.1% higher probability of adopting crop insurance. This finding is in line with the study by Sadati et al. (2010). This correlation may be attributed to the improved access to information, training, and collective bargaining that these organizations provide to farmers, thereby enhancing the accessibility and understanding of insurance. Given that insurance serves as a risk coping tool rather than an income-increasing investment, the role of training and education is pivotal(Dragos et al., 2023). Insurance procedures, such as sum insured and indemnity levels, often pose challenges for farmers to comprehend. Therefore, both education and extension programs in agriculture play a crucial role in fostering awareness about insurance schemes.

It is found that farming experience exerts a statistically significant negative impact,indicating that more experienced farmers are 0.4 percent less inclined to adopt crop insurance. This is in line with findings byMasara and Dube (2017) andNoor Khan and Hasan (2022). It is plausible that seasoned farmers have developed alternative coping mechanisms over time or perceive risks differently, possibly relying on traditional knowledge or risk-sharing arrangements. Additionally, access to irrigation also demonstrates a significant negative effect at the 5% level, resulting in a 5.0% reduction in the likelihood of insurance adoption. This result is similar to Sadati et al. (2010). This could be attributed to the fact that irrigated farms are typically less susceptible to drought and water-related risks, thereby reducing the perceived need for crop insurance.

Exposure to the media, including agricultural programs, advertisements, and information about insurance, has been found to have a highly significant positive effect. This suggests that farmers who are regularly exposed to such media content are 0.7% more likely to adopt insurance, as they become increasingly aware of its benefits and availability. Additionally, contact with agricultural extension services has shown a strong positive effect, with a marginal effect of 3.4%. Similar results were shown by Masara and Dube (2017). This can be attributed to the fact that extension officers often provide farmers with up-to-date information on best practices, including the advantages of insurance, thereby making farmers more likely to participate in insurance schemes.

The impact of previous crop losses on insurance adoption is statistically significant. Farmers who have experienced crop losses are 3.4% more inclined to consider insurance as a risk management tool. This finding is supported by Sadati et al. (2010), Noor Khan and Hasan (2022) and Rajeev and Nagendran (2023). This suggests that farmers are more likely to opt for insurance after experiencing substantial losses in the previous year and are also more willing to insure a larger portion of their land (Rajeev & Nagendran, 2023).Moreover, findings revealed that agricultural insurance knowledge exerts a positive influence on both the decision to insure. Specifically, farmers equipped with extensive insurance knowledge exhibit a 7.00% greater likelihood of embracing crop insurance. This finding is similar toNoor Khan and Hasan (2022) and Dragos et al. (2023). This is because individuals with limited knowledge of crop insurance may exhibit disinterest or may lack the necessary skills to understand its mechanisms and advantages (Dragos et al., 2023).Informed farmers can be better positioned to make judicious decisions regarding insurance products and comprehend payment terms, thereby cultivating trust in these products and in their own decision-making capabilities (Fahad et al., 2018).

Table 3. Estimates of the probit model: Adoption of crop insurance

Variables	Coefficients	Marginal effects
AGE	-0.020 (0.025)	-0.002 (0.002
EDN	0.236** (0.111)	0.021** (0.010)
MEM	0.562* (0.307)	0.051* (0.027)
INC	0.459 (0.374)	0.042 (0.034)
FARMSIZE	0.022 (0.062)	0.002 (0.006)
EXP	-0.037** (0.019)	-0.004** (0.002)
IRRI	-0.547** (0.278)	-0.050** (0.025)
MEDIAEXP	0.073*** (0.014)	0.007*** (0.001)
EXTCONT	0.373*** (0.056)	0.034*** (0.003)
CREDIT	0.452 (0.279)	0.041 (0.025)
LIVESTOCK	0.308 (0.274)	0.028 (0.025)
LOSS	0.378*** (0.104)	0.034*** (0.009)

INSKNOW	0.767*** (0.153)	0.070*** (0.012)
Constant	-12.758** (4.907)	
Log-likelihood	= -58.323	
LR chi^2 (13)	= 333.39	
Prob > chi^2	= 0.000	
Pseudo-R^2	= 0.741	
Number of observations	= 350	

Note: ***, **and * indicate significance levels of 1%, 5%, and 10% respectively. Numbers in parentheses are standard errors.

4.5 Constraints faced by insured farmers

The constraints faced by insured farmers are presented in Table4emphasizing several key issues that influence their experience with crop insurance.The foremost concern is the delay in the disbursement of claim payments, which significantly affects farmers' financial stability and trust in the insurance system. This delay can exacerbate financial stress during critical periods, making timely claims processing a crucial area for improvement.The second major constraint is no compensation even during crop failure. This issue reflects a significant gap in the insurance coverage or claims process, leaving farmers without necessary support. Addressing this problem could enhance the effectiveness and reliability of insurance schemes.The third constraint pertains to the lack of awareness about cut-off dates. Farmers' limited understanding of important deadlines can lead to missed opportunities for coverage, indicating a need for better communication and reminders about key dates.

Table4. Constraints faced by insured farmers (n = 230)

S. No.	Particulars	Mean Garret score	Rank
1	Lack of awareness about cut-off dates	57.96	III
2	The indemnity level is much less	54.89	V
3	Complex documentation and process work	46.72	IX
4	Delay in the disbursement of claim payments	76.72	I
5	Distant location of banks	34.75	XII
6	A lot of time wasted due to limited bank staff for crop insurance	42.30	XI

7	Important crops not included in notified crops	47.01	VIII
8	Lack of awareness about insurance benefits	51.13	VI
9	Low premium paying capacity	56.72	IV
10	No compensation even during crop failure	62.33	II
11	Lack of service/ cooperation from the bank	49.03	VII
12	Officials bias during the assessment of losses	44.13	X

Financial constraints such as low premium- paying capacity of farmers limit their access to coverage, which ranks as a significant concern. Additionally, inadequate indemnity levels and a lack of awareness about the benefits of insurance are notable issues. Addressing these concerns is imperative to enhance the perceived value of insurance and broaden its uptake. Better cooperation fromthe banks and ensuring the inclusion of key crops in the list of notified crops are essential for streamlining the insurance process and improving service quality. Furthermore, simplifying documentation requirements and ensuring fair loss assessment can facilitate effective navigation of the insurance system. Lastly, addressing logistical challenges, such as improving accessibility to banks and streamlining processes, is crucial for enhancing the efficiency of accessing insurance services.

4.6 Risk management strategies practiced by farmers to cope up with losses

The risk management strategies employed by the sampled cotton farmers have been assessed and ranked based on their preferences (See Table 5). Borrowing from friends and relatives emerged as the most widely practiced approach, boasting a high Garret score of 71.62. This method is favoured due to its accessibility and personalized nature, providing immediate support during financial crises. Following closely is the hypothecation of assets or jewels, which received a score of 67.20, enabling farmers to leverage their assets, though it comes with risks related to asset security. Bank loans, with a score of 62.68, represent the third most common strategy, offering stable financial support despite stringent requirements. Loans from moneylenders rank fourth (59.37), but are less favourable due to high interest rates and potential exploitation.

Table 5. Risk management strategies practiced by farmers (n=350)

S. No.	Particulars	Mean Garret score	Rank
1	Lease/sale of land	37.61	IX

2	Loan from moneylenders	59.37	IV
3	Bank loan	62.68	III
4	Borrowed from friends and relatives	71.62	I
5	Sale of assets	28.69	X
6	Agricultural insurance	42.45	VII
7	Crop diversification	48.32	V
8	Sale of livestock	38.84	VIII
9	Hypothecation of assets/jewels	67.20	II
10	Fallowing and engaged in other paid jobs	47.64	VI

Additional strategies include crop diversification (ranked fifth with a score of 48.32), contributing to risk mitigation by varying crops. The relatively lower adoption of agricultural insurance, ranking seventh (42.45), underscores the need for heightened awareness and accessibility. The sale of livestock (ranked eighth, 38.84) and leasing or selling land (ranked ninth, 37.61) are less preferred due to their long-term effects on farm productivity and livelihood. The least favoured strategy is the sale of assets, with the lowest score of 28.69, likely due to the significant losses it incurs. Overall, the rankings reflect a preference for informal support systems and asset-based solutions, alongside a reliance on bank loans. The lower adoption of agricultural insurance emphasizes the necessity for improved integration of insurance into farmers' risk management practices.

5 Conclusion

The study reveals that the adoption of crop insurance among cotton farmers in Virudhunagar district, Tamil Nadu, is significantly influenced by several factors including insurance knowledge, previous yield loss experiences, and socio-economic characteristics. Key findings indicate that farmers with higher levels of insurance knowledge and those who have experienced substantial yield losses are more likely to adopt crop insurance. Socio-economic factors such as education, membership in agricultural organizations, and media exposure also play a crucial role in shaping insurance adoption decisions.Despite the availability of crop insurance, its adoption remains low, primarily due to constraints such as delays in claim payments, inadequate indemnity levels, and limited awareness about insurance benefits and cut-off dates. These challenges highlight the need for improved communication strategies and administrative efficiencies to enhance the appeal and effectiveness of crop insurance schemes.The study also shows that while farmers utilize a

variety of risk management strategies, including borrowing from friends and relatives and hypothecation of assets, the role of crop insurance in their risk management portfolio is limited. This suggests that increasing awareness and addressing the procedural barriers associated with crop insurance could lead to greater adoption and better risk mitigation among cotton farmers.

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