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Changing Course of Crop Insurance with Climate Change

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ABSTRACT

Agriculture is significant to the economic sector as it contributes 19% to GDP and provides the primary means of subsistence for 58% of the population. Climate change has caused widespread impacts, losses, and damage to the environment and human systems. There is a significant connection between agricultural output and climate change. Indian farmers' productivity and economic gains from agriculture have never been stable. Climate catastrophes have caused huge losses to the farmers making it very important to the economic sector in recent decades. Insurance is considered an effective mechanism for encouraging farmers to improve productivity and adaptability. In India, the Pradhan Mantri Fasal Bima Yojana and Restructured Weather-Based Crop Insurance are the two current crop insurance schemes. The crop insurance focuses primarily on main staple crops like rice and wheat and also horticulture crops. An attempt is made in this paper to evaluate the performance of Pradhan Mantri Fasal Bima Yojana and Weather Based Crop Insurance Scheme (WBCIS) in India with a particular focus on area insured and claims settlement ratio. The standard of parameters of working insurance policy keeps changing year after year the indemnity levels do not quantify the actual loss. A specific analysis was made to present the performance of the claims settlement ratio. The conclusion of this paper discusses the necessity to increase the claim settlement ratio after giving an outline of the Kharif and Rabi seasons.

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1.0 INTRODUCTION

Globally, significant losses and damages have been caused by the extensive consequences of climate change on the human ecosystem. According to Swiss Re the global economic loss from natural disasters spiked to USD 275 billion in 2022 and insured losses covered 45% of the loss. Agriculture is directly dependent on weather conditions. India is highly vulnerable to climate change and the

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impacts substantially jeopardise its economic and social progress. Extreme weather conditions have made climate change a major threat to agriculture productivity (RBI 2020).

Sinha (2004) remarks, Crop Insurance is a major instrument to protect agriculture vulnerability.

PMFBY is a government-sponsored crop insurance scheme that unites numerous stakeholders on a single platform. The main feature features of the scheme are one premium, one season. It covers all kharif and rabi seasons and all annual commercial and horticulture crops. The coverage period is from the pre-sowing period to the post-harvesting period. There are three levels of indemnification available, ranging from 70% to 90%.

Weather Based Crop Insurance (WBCI) was introduced to give protection against yield loss caused by weather adversities. It works on the concept of the Area approach and the Reference unit area (RWA)is deemed to be the homogenous unit of Insurance. The reference unit area collects data from Automatic weather stations. Claims arise when there is a deviation from actual weather parameters in RUA. The weather-based Index insurance uses publicly available data providing transparency and avoiding moral hazard and adverse selection to farmers. The premium is based on historical data of about 25 years to 100 years of the reference unit areas. Premium beyond cap value is borne by the government on a share basis.

1.1 Review of Literature

Climate change represents a significant global challenge with profound implications for various sectors, including agriculture. This section provides a review of relevant literature on the impact of climate change on agricultural production.

1.1.1 Climate Change and Altered Weather Patterns

Climate change has led to altered weather patterns, including changes in temperature and precipitation regimes (Masson-Delmotte *et al.,* 2021). These shifts in climate variables have direct and indirect consequences for agriculture.

Extreme heat events, for instance, can result in reduced crop yields and even crop failures. High temperatures during critical growth stages can lead to reduced grain formation in crops like maize and wheat (Lobell *et al.,* 2011).

1.1.2 Increased Frequency of Extreme Weather Events

Climate change has also been associated with an increase in the frequency and intensity of extreme weather events, such as droughts and floods (Lesk *et al.,* 2016). These events disrupt agricultural activities and can lead to significant crop losses.

Droughts, in particular, have been shown to have devastating effects on crop production. Research by Schlenker and Roberts (2009) found that increased temperatures and reduced precipitation due to climate change have contributed to significant yield reductions in key crops.

1.1.3 Shifts in Pest and Disease Patterns

Changing climatic conditions can affect the distribution and behaviour of pests and diseases, posing additional challenges to agriculture (Bebber *et al.,* 2013). Warmer temperatures can expand the range of certain pests, leading to increased infestations.

For example, the spread of the pine beetle in North American forests has been linked to milder winters associated with climate change, resulting in extensive damage to timber resources (Bentz *et al.,* 2010).

1.1.4 Variability in Crop Yields

Climate variability, characterized by fluctuations in temperature and precipitation from year to year, has been shown to affect crop yields (Zhang *et al.,* 2015). Such variability introduces uncertainty into agricultural planning and management.

Farmers often struggle to adapt to changing climate conditions, as demonstrated by the findings of Seo and Mendelsohn (2008), who observed that climate variability can reduce the efficiency of agricultural investments.

1.1.5 Regional Variations in Impact

The impact of climate change on agriculture varies by region. Different areas face distinct climate challenges, and adaptation strategies must be tailored accordingly. For instance, regions with limited water resources may be more vulnerable to drought-related crop losses (Wang *et al.,* 2009).

1.2 Statement of Problem

Climate change represents a profound global challenge, manifesting in a multitude of ways that threaten the stability and sustainability of agricultural systems. Among its multifaceted impacts, climate change exerts a significant and escalating influence on agricultural production, posing substantial risks to farmers' livelihoods and food security. In this context, it is imperative to examine the intersection of climate change and crop insurance, specifically assessing how the evolving climate patterns are reshaping the landscape of agricultural risk management.

As temperatures rise, precipitation patterns become increasingly erratic, and extreme weather events grow in frequency and intensity, agriculture faces unprecedented uncertainties. These climatic shifts contribute to a heightened vulnerability of crops to various stressors, including droughts, floods, heatwaves, and pests. Consequently, the once-established paradigms of agricultural production and risk mitigation, as embodied by crop insurance schemes, are being challenged.

The traditional parameters and actuarial models upon which crop insurance policies are based may no longer adequately capture the dynamic and evolving risks faced by farmers in the era of climate change. Questions arise about the suitability of existing insurance structures in safeguarding farmers' interests, managing production risks, and ensuring the sustainability of agricultural systems. Moreover, the differential impacts of climate change across regions, crop types, and farming practices introduce complexity into the assessment of insurance effectiveness.

In light of these considerations, a critical research gap emerges concerning the ability of current crop insurance frameworks to adapt and respond effectively to the changing climate-induced risks in agricultural contexts. A comprehensive understanding of how climate change alters the risk landscape for farmers and how insurance mechanisms can or should evolve to address these changes remains lacking.

1.3 Research Gap

The existing literature on crop insurance predominantly focuses on its operational aspects, coverage rates, and the extent of its adoption. However, there is a notable dearth of research that systematically investigates the evolving relationship between climate change and crop insurance, and

the necessary adaptations required to ensure its continued relevance and efficacy. This research paper aims to bridge this gap by exploring the changing course of crop insurance in the face of climate change and providing insights into potential policy adjustments and innovations that can better align agricultural risk management with the realities of a changing climate.

1.4 Objectives

- Examining the trends of the market for Pradhan Mantri Fasal Bima Yojana and Weather-Based Crop Insurance
- To evaluate the performance of the Pradhan Mantri Fasal Bima Yojana and Weather-Based Crop Insurance data on area insured, gross premium paid, claim settlement ratio.
- To enunciate the problems and challenges pertaining to agricultural insurance

2.0 RESEARCH METHODOLOGY

2.1. Research Design

The research employs a quantitative research design to analyse the changing course of crop insurance in the context of climate change. This design allows for the systematic collection and analysis of data related to Kharif and Rabi crops over a five-year period, from 2017-18 to 2021-22.

2.2 Data Sources

The sources of data for this study are as follows:

- *Pradhan Mantri Fasal Bima Yojana (PMFBY):* The study relies on secondary data obtained from the Pradhan Mantri Fasal Bima Yojana, a flagship crop insurance program in India. This data includes information on insured crops, and claims settled.
- *Weather-based Crop Insurance:* In addition to PMFBY data, weather-based crop insurance data is collected to understand the influence of climatic factors on crop insurance outcomes.

The study utilizes data published by the Department of Agriculture and Farmers' Welfare in the report "Agricultural Statistics at a Glance-2022." This source provides comprehensive information on agricultural production, crop area, and related statistics. And also, the data from the Agriculture Census 2015-16 is utilized to understand baseline agricultural characteristics and trends in the study region.

2.3 Limitations

The limitations of the study, such as data constraints or potential biases, are acknowledged to provide a balanced perspective on the research outcomes.

3.0 ANALYSIS OF DATA

Table 1

Market Size of the PMFBY and Weather-Based Crop Insurance Scheme in Kharif and Rabi Seasons

Years	Number of Farmers *(₹ in Lakhs)*	Area Insured *(₹ in Lakh / Hectares)*	Sum Insured *(₹ in crores)*	Gross Premium *(₹ in crores)*
2017-18	532.22	496.4	2,01,966	24,468
2018-19	581.93	532.61	2,35,740	29,688
2019-20	616.41	508.44	2,21,561	32,329

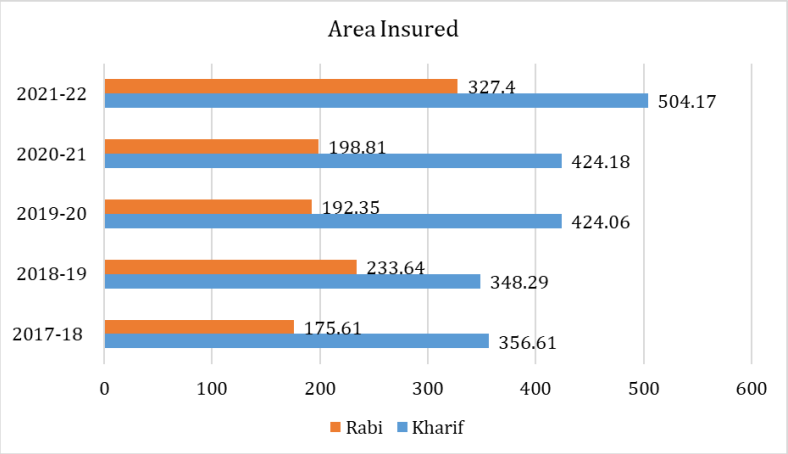
2020-21	622.99	495.44	1,99,672	31,700
2021-22	831.57	459.01	1,81,096	30,196
All Years	3,185.12	2491.9	10,40,035	1,48,381

Source: Agricultural Statistics at a Glance 2022

It is evident from Table *1* that this scheme had a maximum subscription of 831.57 lakh farmers in 2021-22. The area insured has significantly decreased from 532.61 lakh hectares in 2018-19 to 459.01 lakh hectares in 2021-22 with an insured sum of ₹1,81,096 crores, which was at ₹2,35,740 crores in 2018-17.

Figure 1

Season-wise Area Insured under PMFBY and WBCI (in Lakh per Hectares)



Source: Extracted from Agricultural Statistics at a Glance 2022

The total area insured under Kharif for the period of 2017-18 to 2021-22 is 2057.31 and Rabi for the period of 2017-18 to 2021-22 is 1127.31.

3.1 Claims Settlement Ratio

Claim settlement ratio is an indicator of effective functioning of insurance. This paper defines claim settlement as a percentage of claims payable to farmers. With the definition, the claim settlement ratio is calculated.

Table 2

Claims Settlement Ratio in PMFBY and WBCI

Year	Claims Payable			Claims Paid			Settlement		
	Kharif (1)	*Rabi (2)*	*Total (3)*	*Kharif (4)*	*Rabi (5)*	*Total (6)*	*Kharif (7)*	*Rabi (8)*	*Total (9)*
2017-18	18074.5	3993	22067.5	18073	3991	22064	99.99	99.95	99.98
2018-19	19664	9527	29191	19173	9493	28666	97.50	99.64	98.20
2019-20	21759.2	5969.9	27729.1	21490	5869.72	27359.72	98.76	98.32	98.67
2020-21	14544.72	6290	20834.72	14226.56	6165	20391.56	97.81	98.01	97.87
2021-22	13360	3061	16421	12112	2793	14905	90.66	91.24	90.77
Mean for reference Period	17480.48	5768.18	23248.66	17014.91	5662.344	22677.26	96.94	97.43	97.09

Note: Percentages are calculated by using the data for all the reference years.

Source: Agricultural Statistics at a Glance –2022

** (7), (8), (9) Calculated from Table.3.25 (b)- Agricultural Statistics at a Glance –2022

The claims settlement ratio as presented in Table *2* show that it has been showing variation in recent years. It is seen from the data that the claims settlement ratio has been decreasing marginally from 99.99 in 2017-18 to 98.20,98.67,97.87 in the respective years of 2018-19,2019-20,2020-21. It drastically decreased to 90.77 in 2021-22. The analysis from the season-wise claims settlement ratio shows that it was high at 97.09 per cent for the Rabi season, compared to the Kharif season's 96.94 per cent. These ratios prove the fact that in Rabi season around 2.57 per cent of the claims payable were unpaid to farmers and in Kharif season 3.06 per cent remained due to the farmers. A total of 2.91% of the claims payable for that specific agricultural year, were not paid to the farmers.

3.2 Gross Premium and Claims Paid

Table 3

Gross Premium and Claims Paid

Year	Kharif			Rabi		
	Gross premium	*Claims Paid*	*Claims Paid/ Gross Premium*	*Gross premium*	*Claims Paid*	*Claims Paid/ Gross Premium*
	(1)	***(2)***	***(3)***	***(4)***	***(5)***	***(6)***
2017-18	18142.81	18073.59	99.62	6324.88	3991.87	63.1
2018-19	21111.16	19173	90.82	8576.09	9493.63	110.7
2019-20	23914	21490.01	89.86	8415	5869.72	69.8
2020-21	20692.46	14226.56	68.75	11007.22	6165.1	56.0
2021-22	19036	12112.64	63.63	11160.86	2793.78	25.0
Average	20579.286	17015.16	82.5368	9096.81	5662.82	64.92

Source: Agricultural Statistics at a Glance 2022

**(3,)(6) Calculated from Agricultural Statistics at a Glance 2022

Table *3* indicates the season-wise gross premium collection amounts and claims paid under crop insurance schemes during 2017-18 to 2021-22. The amount of gross premiums collected in Kharif (₹20579.28 crore) exceeded the amount collected in Rabi (₹9096.81 crore). In a similar direction, the total amount of claims paid during Kharif (₹17015.16 crore) was higher than the total amount of claims paid during Rabi (₹5662.82 crore). It is evident from the data that in 2018-19(110.7%), 2019-20(69.8) major portion of the premium paid were used for the payment of claims, which results into inadequate funds for recycling the funds for the efficient management of Schemes.

4.0 RESULTS AND DISCUSSION

Agriculture is the primary source of living for 58% of the Indian population, and it is highly vulnerable to climate change, protection through insurance is critical. The primary goal of the study is to evaluate the efficiency of Pradhan Mantri Fasal Bima Yojana and weather-based crop insurance in terms of total number of farmers covered, total number of area covered, claim payment, and premium under this scheme.

Though there is an increase in farmers to 831.57 lakhs in 2020–21, the area covered by crop insurance remains small at only 459 hectares. The latest NSS 77th round Survey revealed that the percentage distribution of agricultural households owning less than two hectares of land is 89.4%. As the majority of small farmers are high there is an increase in a number of farmers and not in the area insured. Though the claim settlement ratio differs only by 2.96%, the number of people subscribing to this scheme is less because of basis risk. It can be minimised by proper coverage using more

weather stations for WBCI. The Evidence from findings of PMFBY also show that performance fluctuated through seasons and the delayed pay out against approved claim is the reason for low subscription to the scheme.

5.0 SUGGESTIONS AND POLICY RECOMMENDATIONS

5.1 Integration of PMFBY and WBCIS

The most important shortcoming of PMFBY is the delay in the payment of indemnity due to the long time required to collect yield data based on crop-cutting experiments. In the context of climate change, to expedite the release of pay-out, WBCIS is being promoted to replace PMFBY in due course of time. The basis risk is significant in WBCIS and has a significant impact on crop output. Another significant barrier is the defective product design, which fails to define the trigger event and the poor measurement of local weather parameters due to far-flung locations is also major hindrance. It is necessary to create a hybrid solution that combines the best aspects of both schemes.

5.2 Public-private Partnership

A joint effort from the Indian government and International Organizations is required in the form of public and private sector partnerships. To lessen the effects of the climate crisis, assistance from global development partners is necessary through international climate financings sources like the Green Climate Fund and Green Bonds. The design of the product, marketing, underwriting, and claims handling can significantly be influenced by the private insurance sector. The government is required to provide financial support for climate-related insurance in a variety of ways, including premium subsidies, guarantees, financial assistance for reinsurance facilities, or covering operating expenses.

6.0 CONCLUSION

India being a monsoon-dependent agricultural economy schemes like PMFBY and WBCIS acts as a mechanism to mitigate yield risks and for the stabilization of crop incomes. From the conclusive findings of this article, we can conclude that delay in claim settlement and only a few farmers are getting benefits from this scheme. There is a huge variation in the numbers of farmers covered, sum insured, area insured, the premium collected, claim payments, and the total number of farmers under the umbrella of this scheme. Lack of awareness and transparency are also ineffective to the functioning of the scheme. Technological advancement, region-specific programs, inclusion of micro and small farmers, insurance unit level awareness program, timely payment of the claim, low insurance cost along with a comprehensive administration framework to protect and assist farmers' agricultural income can make crop insurance work more effectively for farmers than insurance companies and Governments.

REFERENCES

Bebber, D. P., Ramotowski, M. A. T. & Gurr, S. J. (2013). Crop pests and pathogens move polewards in a warming world. *Nature Climate Change, 3*(11), 985-988. https://doi.org/10.1038/nclimate1990

Bentz, B. J., Régnière, J., Fettig, C. J., Hansen, E. M., Hayes, J. L., Hicke, J. A., Kelsey, R. G., Negrón, J. F. & Seybold, S. J. (2010). Climate Change and Bark Beetles of the Western United States and Canada: Direct and Indirect Effects. *BioScience, 60*(8), 602-613. https://doi.org/10.1525/bio.2010.60.8.6

Lesk, C., Rowhani, P. & Ramankutty, N. (2016). Influence of Extreme Weather Disasters on Global Crop Production. *Nature, 529*(7584), 84-87. https://doi.org/10.1038/nature16467

Lobell, D. B., Schlenker, W. & Costa-Roberts, J. (2011). Climate Trends and Global Crop Production Since 1980. *Science, 333*(6042), 616-620. https://doi.org/10.1126/science.1204531

Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., ... & Zhou, B. (2021). Climate Change 2021: The Physical Science Basis. *Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, *2*.

Schlenker, W., & Roberts, M. J. (2009). Nonlinear Temperature Effects Indicate Severe Damages to U.S. Crop Yields Under Climate Change. In proceedings of the *National Academy of Sciences, 106*(37), 15594-15598. https://doi.org/10.1073/pnas.0906865106

Seo, S. N. & Mendelsohn, R. (2008). Measuring Impacts and Adaptations to Climate Change: A Structural Ricardian Model of African Livestock Management. *Agricultural Economics, 38*(2), 151-165. https://doi.org/10.1111/j.1574-0862.2008.00289.x

Sinha, S. (2004). Agriculture Insurance in India: Scope for Participation of Private Insurers. *Economic and Political Weekly, 39*(25), 2605-2612.

Wang, D., Zou, C. B., & Shrestha, A. (2009). Climatic Change and Its Impact on Chinese Agriculture. *International Journal of Climatology, 29*(11), 1605-1618.

Zhang, T., Zhu, X., & Cai, J. (2015). Effects of Climate Variability and Climate Change on Crop Yields: A Review of Research Methods and Statistical Approaches. *Theoretical and Applied Climatology, 120*(1-2), 200-216.