

Crop Insurance and its Role in Indian Agriculture: A Comprehensive Review

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ABSTRACT: Crop insurance plays a crucial role in safeguarding the interests of farmers and ensuring the sustainability of Indian agriculture, which is highly vulnerable to climate risks. This comprehensive review paper aims to analyze the role of crop insurance in Indian agriculture by examining its historical evolution, policy frameworks, and implementation challenges. It also evaluates the impact of crop insurance on various aspects of Indian agriculture, including farmers' livelihoods, agricultural productivity, and food security. The review focuses on major initiatives such as the Pradhan Mantri Fasal Bima Yojana (PMFBY) and the Weather-Based Crop Insurance Scheme (WBCIS), comparing their strengths and weaknesses in managing agricultural risks. Challenges in implementing crop insurance schemes, such as administrative and logistical issues, financial sustainability, and data collection, are discussed. The paper concludes by highlighting the need for innovative approaches and collaboration among stakeholders to enhance the effectiveness and reach of crop insurance in India. The study on Crop Insurance faces challenges such as data accuracy, farmer awareness, and policy implementation complexities. Despite these challenges, this review provides valuable insights for policymakers, researchers, and stakeholders in formulating strategies to enhance the resilience and sustainability of Indian agriculture.

Keywords: Crop insurance, Indian agriculture, climate risks, Pradhan Mantri Fasal Bima Yojana, Weather-Based Crop Insurance Scheme.

INTRODUCTION

Indian agriculture, known as the backbone of the nation's economy, sustains the livelihoods of millions and contributes significantly to food security. However, it faces numerous challenges, particularly its vulnerability to climate risks. India's agricultural landscape is heavily dependent on monsoon rainfall, making it susceptible to droughts, floods, erratic weather patterns, and other climatic uncertainties (Todmal, 2022; Birthal and Hazrana 2019). These risks pose significant threats to crop production, farmer incomes, and overall agricultural stability. In managing these inherent risks, crop insurance has emerged as a crucial instrument to safeguard the interests of farmers and ensure the sustainability of Indian agriculture. Crop insurance provides financial protection against losses caused by natural risks like natural calamities, pests, diseases, etc. (Bhise *et al.*, 2007). By providing a safety net, crop insurance helps farmers recover from losses, stabilize their incomes, and sustain agricultural productivity, thereby contributing to the overall resilience of the sector.

The objectives of this comprehensive review paper are twofold. Firstly, it aims to provide an in-depth analysis of the role of crop insurance in Indian agriculture. By examining the historical evolution, policy frameworks, and implementation challenges, this paper sheds light on the effectiveness and limitations of crop insurance

schemes in mitigating agricultural risks. Furthermore, it evaluates the impact of crop insurance on various aspects of Indian agriculture, including farmers' livelihoods, agricultural productivity, and overall food security. The scope of this review paper encompasses an extensive analysis of crop insurance schemes implemented in India, with a particular focus on major initiatives such as the Pradhan Mantri Fasal Bima Yojana (PMFBY) and the Weather-Based Crop Insurance Scheme (WBCIS). The paper will explore the policy frameworks, premium rates, coverage, and claim settlement procedures of these schemes, comparing their strengths and weaknesses in managing agricultural risks.

Moreover, there are many challenges that were faced in the implementation of crop insurance schemes in India. These challenges include a lack of transparency, high premiums, delays in conducting crop-cutting experiments, and non-payment/delayed payment of claims to farmers (Gulati *et al.*, 2018). The issues pertaining to area yield data as these are not collected for all crops and all regions insufficient time-series of area yield data for a given region or inconsistency of historical area yield data implies technical problems in crop insurance in India (Sarangi and Panigrahi 2016). Hence, understanding these challenges is crucial to identifying areas for improvement and making policy recommendations for enhancing the effectiveness and

reach of crop insurance. Lastly, this review paper aims to evaluate the impact of crop insurance on Indian agriculture and assess the socioeconomic implications of crop insurance on farmers' livelihoods, risk-taking behavior, and access to credit. Furthermore, we will analyze the role of crop insurance in ensuring food security by examining its contribution to production stability, management of price fluctuations, and overall resilience of the agricultural sector.

By consolidating existing literature, statistical data, and case studies, this comprehensive review paper seeks to provide valuable insights into the role of crop insurance in Indian agriculture. It aims to contribute to the existing knowledge base and stimulate further research in this crucial area, ultimately assisting policymakers, researchers, and stakeholders in formulating effective strategies to enhance the resilience and sustainability of Indian agriculture.

EVOLUTION OF CROP INSURANCE IN INDIA

Shri J.S. Chakravarthi of Mysore State proposed a rain insurance scheme as early as 1915, which was based on the area approach, aiming to insure farmers against drought (Raut and Bhandari 2021). He published papers in the Mysore Economic Journal and authored a book titled "Agricultural Insurance: Practical Scheme suited to Indian Conditions" in 1920. In the post-independence period, crop insurance gained more attention. In 1947, the Central Legislature discussed the subject, and Dr. Rajendra Prasad, the Minister of Food and Agriculture at the time, assured that the government would examine the possibility of crop and cattle insurance. A special study was commissioned in 1947-48 to explore the modalities of crop insurance. The study considered two approaches: the individual approach and the homogeneous area approach. The study recommended the adoption of the homogeneous area approach due to the lack of reliable data on individual farmers and the moral hazards involved in the individual approach. The Ministry of Agriculture circulated the scheme for adoption by the state governments, but the states did not accept it at that time (Beula *et al.*, 2021; Sahoo *et al.*, 2018; Pandey, 2015).

This historical review provides insights into the early discussions and considerations surrounding crop insurance in India. While the homogeneous area approach was favored, the implementation faced challenges and did not gain widespread acceptance initially (Raju & Chand 2008). Subsequent efforts and developments in crop insurance in India have built upon these early discussions and experiences. In October 1965, the Government of India decided to introduce a Crop Insurance Bill and a Model Scheme of Crop Insurance, allowing states to implement crop insurance if they chose to do so. However, the issue continued to be debated and discussed for over two decades. In the early 1970s, limited and ad-hoc experiments on crop insurance were conducted. The first crop insurance program was initiated in 1972-73 by the General Insurance Department of the Life Insurance Corporation of India, focusing on H-4 cotton in Gujarat. Later, the General Insurance Corporation of India took

over the program and expanded it to include crops like Groundnut, Wheat, and Potato in states such as Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, and West Bengal. This experimental scheme was based on the "Individual Approach," but it covered only 3110 farmers, with a premium of 4.54 lakhs against claims of 37.88 lakhs. It became evident that individual farm-based crop insurance programs were not financially sustainable in the country.

In the mid-1970s, Professor V. M. Dandekar proposed the "Homogeneous Area approach" for crop insurance. In line with this approach, the General Insurance Corporation of India introduced the Pilot Crop Insurance Scheme (PCIS) in 1979, with participation from voluntary state governments. The scheme covered various crops, and the risk was shared between the GIC and the respective state governments in a 2:1 ratio. Premium rates ranged from 5 to 10 percent of the Sum Insured. The PCIS operated until 1984-85, with participation from 13 states, covering 6.27 lakh farmers. The premium collected amounted to 1.97 crore, and claims totaled 1.57 crore (Yoga and Vetrivel 2012; Singh, 2010; Rao, 2002). This period marked a shift from the individual approach to the homogeneous area approach, which was deemed more suitable and sustainable for crop insurance in India (Banerjee and Bhattacharya, 2011).

Evolution of government-led schemes and their impact. The introduction of government-led schemes played a pivotal role in the evolution of crop insurance in India. In 1985, the government launched the Modified National Agricultural Insurance Scheme (MNAIS) to provide comprehensive coverage for all crops. This scheme was later replaced by the National Agricultural Insurance Scheme (NAIS) in 1999, which provided coverage for yield losses due to natural calamities, such as drought, flood, and pest attacks. The scheme also provided coverage for localized risks, such as hailstorms and landslides (Green, 2023). In 2016, the government launched the Pradhan Mantri Fasal Bima Yojana (PMFBY), a flagship crop insurance scheme that aimed to provide affordable and comprehensive coverage to farmers. PMFBY replaced NAIS and MNAIS, and it covered all food crops, oilseeds, and commercial crops (Venkatesh, 2008).

The impact of government-led schemes has been significant. The implementation of crop insurance schemes has led to increased adoption of new technologies and stabilizing farmers' income. However, there have also been challenges, such as inadequate coverage of non-loanee farmers, poor penetration in remote regions, and a lack of awareness among farmers (Gulati *et al.*, 2018).

Role of the public and private sector in providing crop insurance. The role of the public and private sectors in providing crop insurance has evolved over time. Initially, crop insurance schemes were primarily administered by the public sector, with government agencies like the Agricultural Insurance Company of India (AIC) responsible for implementing them. However, in recent years, the private sector has become increasingly involved in providing crop insurance. Since 2003 the private sector has played a role in

underwriting the risk, developing new products, and gathering technical information and skills (such as weather data and developing indices) (Fisher & Surminski 2012). The enhanced product offerings and the increased participation of private sector insurance markets are anticipated to bring about substantial advantages for farmers and governments alike. These benefits include faster settlement of insurance claims, a fairer distribution of subsidies, reduced basis risk, and political economy gains for the government such as improved fiscal management, enhanced agricultural policy signaling, and diminished adverse selection (Mahul *et al.*, 2012). However, there have also been concerns regarding the involvement of private companies, such as accuracy, trustworthiness, information asymmetry, etc. (Agricultural Finance Corporation Ltd., 2011).

CROP INSURANCE POLICY FRAMEWORKS

In India, several crop insurance schemes have been implemented and modified to provide coverage and financial protection to farmers. The latest is the Pradhan Mantri Fasal Bima Yojana (PMFBY), which was launched in 2016. PMFBY aims to provide comprehensive insurance coverage to farmers for yield losses caused by natural calamities, pests, and diseases. It covers all food crops, oilseeds, and commercial crops, and offers flexible premium rates based on the level of risk in different regions (Ministry of Agriculture and Farmers Welfare, 2016). Another significant scheme is the Weather-Based Crop Insurance Scheme (WBCIS), introduced in 2007, which covers yield losses caused by adverse weather conditions. WBCIS uses weather parameters to determine crop losses (Nair, 2010).

Comparison of premium rates, coverage, and claim settlement procedures. One critical aspect of crop insurance policy frameworks is the comparison of premium rates, coverage, and claim settlement procedures across different schemes. Under PMFBY, premium rates are fixed based on the crop and the geographical location, and they are subsidized by the government to make insurance affordable for farmers. The coverage under PMFBY includes yield losses due to natural calamities, post-harvest losses, and localized risks such as hailstorms and landslides. The claim settlement procedures have been streamlined with the introduction of technology, allowing for quicker assessment and disbursement of claims (Ghosh, 2023). In comparison, WBCIS operates on an individual basis, with farmers choosing specific weather parameters and crop stages for coverage. Premium rates under WBCIS are determined based on the crop, weather conditions, and the sum insured. The claim settlement procedures involve assessment based on weather data from designated weather stations (Shirsath *et al.*, 2021).

Evaluation of the effectiveness of different policy frameworks. The effectiveness of different crop insurance policy frameworks can be evaluated based on several factors. One important aspect is the extent of coverage provided to farmers. Weather-based Crop Insurance is different in its approach from crop

insurance as it uses weather parameters as a 'proxy' for crop yields in compensating the cultivators for deemed crop losses. Another factor is the timeliness and efficiency of claim settlement procedures (Byjesh *et al.*, 2014). Technological interventions such as land records digitization, ensuring authentic enrollments, and quick claim settlement mechanisms by encouraging online enrolment and claim settlements via., CSCs (Common Service Centers) (Bhadoriya *et al.*, 2022). Additionally, the affordability of premiums and the level of government subsidy play a crucial role in the effectiveness of crop insurance schemes.

Evaluating the effectiveness of different policy frameworks requires rigorous analysis and empirical evidence. Studies have examined the impact of crop insurance schemes, such as PMFBY and WBCIS, on farmers' income stability, access to credit, and risk management strategies (Agricultural Finance Corporation Ltd., 2011). These evaluations provide insights into the strengths and limitations of different policy frameworks and offer valuable recommendations for improving their effectiveness.

CHALLENGES IN IMPLEMENTING CROP INSURANCE SCHEMES

Administrative and logistical challenges: The successful implementation of crop insurance schemes is often hindered by various administrative and logistical challenges. One significant challenge is the identification and registration of eligible farmers. Additionally, the process of premium collection and timely dissemination of insurance policies to farmers across different regions requires efficient coordination between insurance companies, banks, and government agencies (Aggarwal *et al.*, 2016). The administrative burden of managing the enrolment, premium collection, and claim settlement processes can overwhelm the existing infrastructure, leading to delays and inefficiencies. Administrative cost is very high as crop cutting method is used for loss assessment (Sarangi and Panigrahi 2016).

Financial sustainability and cost-sharing mechanisms. The financial sustainability of crop insurance schemes is a critical challenge. The cost of providing insurance coverage to a large number of farmers, particularly in a country like India with a significant agricultural sector, can be substantial. In designing a crop insurance program the determination of the premium is of the utmost importance. On the one hand, sufficient revenue has to be generated to meet the payment of claims, but on the other, the premium should be perceived as reasonable and affordable (UNCTAD secretariat, 1994).

Issues pertaining to data collection, yield estimation, and claim settlement: Accurate data collection, yield estimation, and claim settlement pose significant challenges in implementing crop insurance schemes. The availability and reliability of historical data on crop yields and weather patterns are crucial for determining appropriate coverage and premium rates. However, data gaps, inconsistent data collection methods, and limited access to reliable data sources can affect the accuracy

of risk assessment and underwriting (Aggarwal *et al.*, 2016). The dominance of small and marginal farmers, highly heterogeneous farm practices and farm yields, and lack of objective yield data have been serious obstacles in designing a workable crop insurance (Murthy *et al.*, 2018). This can lead to disputes and delays in claim settlement. Additionally, ensuring transparency, fairness, and efficiency in the claim settlement process by using innovative technology is crucial to maintaining farmers' trust in the system (Rai, 2019).

Addressing these challenges requires innovative approaches and collaboration among multiple stakeholders. Remote sensing technologies have the potential to decrease the expenses associated with monitoring conventional insurance agreements, enhance the options accessible to small-scale farmers, and lower their expenditures. In addition, smart contracts, which utilize blockchain technology to encompass all the details of the contract terms and automatically carry out the intended actions, offer a versatile and cost-effective means of mitigating risks. These contracts are secure, traceable, irreversible, and can be customized to address various risks and payouts, all while minimizing transaction costs and eliminating the requirement for intermediaries (Bahn *et al.*, 2021). Enhancing financial sustainability may involve exploring innovative funding mechanisms, such as risk pooling, catastrophe bonds, or public-private partnerships (ESCAP, 2018). Timing in claims settlement also becomes a key challenge to be addressed since access to financial services for small and marginal farmers is a major challenge due to the stringent processes followed to establish creditworthiness (Nagendra *et al.*, 2020). The crop insurance schemes incorporate technology-driven approaches, such as satellite imagery and remote sensing, to accurately assess crop losses and expedite claim settlement (Ghosh, 2023).

IMPACT OF CROP INSURANCE ON INDIAN AGRICULTURE

Crop insurance has emerged as a crucial risk management tool for Indian farmers, providing financial protection against crop losses due to natural calamities, pests, and diseases. The impact of crop insurance on Indian agriculture can be analyzed from various dimensions, including its socioeconomic impact on farmers' livelihoods, its influence on crop diversification and risk-taking behavior, and its effect on agricultural investments and credit availability.

Evaluation of the socioeconomic impact on farmers' livelihoods: Crop insurance can play a significant role in protecting farmers' livelihoods by providing a safety net against crop losses. Studies have shown that crop insurance can reduce the vulnerability of farmers to income shocks, increase their income stability, and enhance their ability to invest in their farms and households (Jabbar *et al.*, 2020). In addition, crop insurance can also improve the overall well-being of farmers by reducing their stress levels and improving their mental health (Zhao *et al.*, 2019; Agarwal *et al.*,

2022). The availability of crop insurance can also help attract more farmers to agriculture and prevent them from migrating to urban areas in search of better opportunities.

Analysis of crop diversification and risk-taking behavior among farmers: Crop insurance can also influence farmers' risk-taking behavior and crop diversification strategies. Crop insurance provides several benefits to farmers, including boosting their overall well-being. These advantages include enhancing farmers' creditworthiness, as it serves as collateral for crop loans. Additionally, it encourages farmers to invest in high-risk and high-profit crops, leading to increased expenditure on agricultural inputs and, consequently, higher agricultural output. Moreover, crop insurance helps stabilize the farm household's consumption by guaranteeing a minimum income from agriculture (Biswal and Bahinipati 2022). This can lead to increased crop diversification and improved soil health, leading to long-term agricultural sustainability. Crop insurance can also provide farmers with the confidence to invest in high-risk, high-reward crops, leading to increased agricultural productivity and income.

Assessment of the influence of crop insurance on agricultural investments and credit availability: The availability of crop insurance can also have a significant influence on agricultural investments and credit availability. Crop insurance can act as collateral for obtaining loans from banks and other financial institutions, which can improve farmers' access to credit and reduce their reliance on informal sources of credit. This can lead to increased investment in agriculture, leading to long-term agricultural sustainability and economic growth.

ROLE OF CROP INSURANCE IN ENSURING FOOD SECURITY

Crop insurance plays a vital role in ensuring food security by providing a safety net to farmers against crop losses due to natural calamities, pests, and diseases. The availability of crop insurance can stabilize food production, manage price fluctuations and market volatility, and contribute to national and regional food security.

The contribution of crop insurance to food production stability: Crop Insurance helps in providing stability to farm production and increases the income of the farmers. Crop insurance helps in the stabilization of farm production and the income of the farming community (Joseph *et al.*, 2012; Prakash and Gupta 2014).

The role of crop insurance in managing price fluctuations and market volatility: Crop insurance can also play a crucial role in managing price fluctuations and market volatility. Crop losses due to natural calamities, pests, and diseases can negatively affect the biological yield causing monetary loss to the producer (Romstad, 2020). The availability of crop insurance can help stabilize prices by ensuring that farmers are adequately compensated for their losses, reducing the need for government intervention in the market. This can improve the efficiency of the

agricultural market and ensure that consumers have access to affordable and nutritious food.

The implications for national and regional food security: The availability of crop insurance can have significant implications for national and regional food security. Global food security is at risk due to various extreme events, including those triggered by climate change, economic or geopolitical shocks, and outbreaks of pests or diseases. The intricate nature of how these events occur and the numerous ways in which they cause a chain reaction of consequences pose substantial obstacles for both food systems research and policy (Mehrabi *et al.*, 2022). The availability of crop insurance can reduce the impact of these shocks on farmers, stabilizing food production, and ensuring that consumers have access to affordable and nutritious food. Crop insurance can also help improve the livelihoods of farmers, leading to increased investment in agriculture and improved agricultural productivity, contributing to long-term food security.

FUTURE PROSPECTS AND INNOVATIONS

Exploration of emerging trends and technologies in crop insurance: The future of crop insurance holds promising prospects with the emergence of new trends and technologies. One such trend is the utilization of mobile and digital platforms for live capturing of crop loss status and claims for insurance (Barooah and Siddiqui 2018). Fraudulent claims, intermediary payment transactions, and big data handling are some of the many issues faced by insurance companies. Blockchain can resolve the issues through its security and transparency provided by the distributed ledger which also furnishes the authenticity of the participants. Besides, its characteristic of recordkeeping comes in handy with the huge amount of customer data that is immutable in the blockchain ledger. Additionally, by using smart contracts real-time data on the claims, reimbursements or payments can be fetched from multiple systems in no time (Kaur and Parashar 2021). With the implementation of IoT technology farmers can be insured with their crops and livestock. An added advantage of DA in insurance is the fact that the insurance companies have access to the data from the remote farms and can initiate an automated payout through the IoT mobile payments systems when extreme conditions are observed. This can eliminate the need for a lengthy claim process, where the insurance company needs to ascertain the extent of damage by visiting the farms (Elijah *et al.*, 2018).

Integration of satellite data, remote sensing, and machine learning in risk assessment: The integration of satellite data, remote sensing, and machine learning techniques holds immense potential in revolutionizing risk assessment for crop insurance. Remote sensing has been proven to be an effective tool for assessing and monitoring vegetation parameters, crop vigor, and yield estimation (Mookherjee, 2016). Precision agriculture, alongside machine learning, has the potential to reduce agricultural insurance premiums by defining risks improving risk assessment tools, and allowing farms to move more quickly to prevent crop losses (Cook and

O'Neill, 2020). Advanced analytics and predictive models based on these technologies can improve the accuracy of crop loss estimation and provide early warning systems for potential risks.

Major areas of policy intervention for improving the effectiveness and reach of crop insurance in India:

To enhance the effectiveness and reach of crop insurance in India, several policy recommendations can be considered. There is a need for better-coordinated efforts among government agencies, insurance companies, banks, and other stakeholders involved in the crop insurance schemes for its effective implementation (Raju *et al.*, 2016). An effective design and efficient implementation mechanism is required to ensure timely benefits, especially to the small and marginalized farmers (Ministry of Agriculture, 2010). Second, there is a need for a comprehensive and standardized database for historical weather and crop yield data, which can be utilized for accurate risk assessment and yield estimation (Agricultural Finance Corporation Ltd., 2011). Additionally, promoting awareness and knowledge dissemination about crop insurance among farmers, especially small and marginal farmers, can increase their understanding and participation in these schemes. Finally, exploring innovative partnerships between the public and private sectors, including reinsurance companies and agricultural technology firms, can bring in expertise, capital, and technological advancements to strengthen crop insurance programs.

CONCLUSIONS

Crop insurance plays a vital role in Indian agriculture by providing financial protection, stabilizing food production, and managing market risks. However, there is still work to be done to enhance the effectiveness, efficiency, and reach of crop insurance schemes. Policy recommendations focusing on institutional coordination, data management, awareness generation, and innovative partnerships can contribute to the improvement of crop insurance programs. Overall, crop insurance has the potential to significantly contribute to the well-being of Indian farmers, agricultural stability, and food security. By addressing the identified challenges, embracing future prospects, and implementing evidence-based policy recommendations, crop insurance can continue to evolve and play an instrumental role in safeguarding the livelihoods of farmers and ensuring the sustainable development of Indian agriculture.

FUTURE SCOPE

The future scope of the study includes exploring advanced technologies for more accurate assessment and efficient claim processing, delving into the behavioural economics of farmers' participation, adapting policies to climate change challenges, evaluating policy effectiveness, enhancing inclusivity for smallholders, fostering interdisciplinary collaborations, conducting comparative international analyses, and assessing the long-term socioeconomic impacts of crop insurance. These research directions

aim to provide a holistic and forward-looking perspective on the role of crop insurance in Indian agriculture, offering valuable insights for policy enhancement and sustainable agricultural practices.

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