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When Implementation Goes Wrong

Lessons from Crop Insurance in India

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ABSTRACT

Based on experiments to bring about comprehensive crop insurance coverage over the last 50 years, the Indian government introduced a new crop insurance program, called Pradhan Mantri Fasal Bima Yojana (PMFBY), in April 2016. Coming after two successive years of drought, the scheme aimed at reducing the burden of smallholders who borrow at high rates of interest but remain at the mercy of the "weather god" to reap optimal returns. Although this new program filled many gaps in the previous crop insurance interventions, it still could not attract smallholder and marginal farmers to fully subscribe to it. It also faced its own set of challenges. It earned farmers' wrath because of lack of transparency in crop loss assessments and delayed settlement of claims. The government of India had to make the program voluntary under pressure from farmers' associations, although it was designed as mandatory for famers seeking institutional credit.

This paper's focus is identifying the reasons for failure of PMFBY in most of the states despite its improved features, and comparing these states with a state where it has been relatively successful. It does this through evidence collected from a field study in Marathwada—a drought-prone region in western India, with the nation's highest rate of farmer suicides. It takes learnings from stakeholder interviews in Marathwada to design implementation strategies for PMFBY's success and win back the confidence of farmers. The state of Karnataka, in contrast to Marathwada, is an outlier among states in India, with a record of successful implementation of the PMFBY program. This paper studies PMFBY program implementation in Karnataka through a positive deviance case study approach. Though Karnataka hasn't yet seen full success in terms of penetration achieved in crop insurance, its model can help develop best practices for implementation of PMFBY. The paper argues that getting buy-in from all stakeholders, adopting remote sensing technologies, strengthening infrastructure and institutional capacity, conducting outcome evaluation, and putting in place a monitoring system could be effective mechanisms to mainstream the program among smallholder farmers.

Keywords: crop insurance, agricultural risk management, remote sensing, mobile technology, implementation science, adaptation, sustainability, India

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1. INTRODUCTION

Crop insurance programs continue to experience challenges in achieving their objective of reducing risks faced by farmers and helping them cope with income losses. In the context of India, recent experience shows that even with good intentions and reforms to support smallholders through crop insurance programs, success remains elusive. Several challenges continue to thwart implementation of the insurance program. They include loopholes in the design of the program that are exploited by the insurance companies, the agriculture department officials, and sometimes the farmers themselves. Research on crop insurance programs in developing countries identifies adverse selection and moral hazard (Gulati, Terway, and Hussain 2018; Reyes et al. 2017; Zhao 2017) as challenges (due to difficulty in measuring risks and monitoring farmer behavior), in addition to lack of efficiency in claims handling (Roberts 2005), lack of financial and human resources for crop yield surveys, and the absence of legal and regulatory frameworks to protect farmers against potential insurer malpractice (Mahul and Stutley 2010). Low demand for crop insurance products in developing countries is also a problem, and it raises the question of sustainability and viability (Linnerooth-Bayer, 2011). Crop insurance programs offer an uncertain benefit in exchange for a certain cost, and not many farmers see this favorably, resulting in low uptake of crop insurance products (Serfilippi, Carter, and Guirkinger 2018).

Literature on the missing markets for risk reduction continues to grow from the seminal work of Newbery and Stigliltz (1984). Further, Stiglitz (1989) has argued for possible government interventions in the absence or failure of private, nonmarket solutions. Crop insurance in developing countries is a typical case of prevalent market failures where nonmarket institutions may not be able to fix it (Stiglitz 1989). How to overcome the problem of missing markets for risk faced by farmers in developing countries has been highlighted by several recent papers (such as Hazell 2017). These studies propose various solutions for developing private markets. Yet in the absence of a flourishing private sector to meet the needs of the smallholder facing climatic risks, developing-country governments are increasingly intervening to fill the gap, albeit with poor implementation. This paper focuses on implementation challenges facing the largest government-sponsored crop insurance program in India for the lessons that could be useful for other developing countries.

India's crop insurance market has been plagued by all of the issues discussed above. In addition, the large number of small agricultural landholdings, financial constraints for insurers, and the high cost of administration of the program (because of asymmetric information in agriculture) have proved to be barriers to development of the private crop insurance market in India. These factors stopped private insurers from developing innovative solutions and models in insurance. Over the years, while the government focused on creating a subsidized insurance model, it failed to create an enabling environment for private market institutions, nor did it develop a competitive market for crop insurance. It failed to make investments in infrastructure and technology in the country and provide crop insurers with reliable data to design actuarially sound insurance products. It also missed the opportunity to create appropriate legal and regulatory frameworks, and help private insurers access the reinsurance market. Without modern infrastructure, a crop insurance scheme in India cannot be lucrative for either the farmers or private insurance companies, concluded Rai (2019). Gulati, Terway, and Hussain (2018) identified the need to "fix the system" in India to ensure the success of the Pradhan Mantri Fasal Bima Yojana (PMFBY) crop insurance scheme. Until a robust market structure is in place, the private crop insurance market may not take off in India. The government's subsidy for crop insurance, until that time, will work as a shield to protect farmers from income fluctuations. Many governments across developing and developed countries continue to subsidize their crop insurance programs (Reyes et al. 2017), exactly for the same reasons. However, the scenario would change if private insurers were able to reduce their transaction costs. As Williamson (2005) argued, failures of the system and market can be avoided if transaction costs are optimized by firms. If private insurers and government can work together and bring down the administrative cost of running the PMFBY program, it can succeed. This paper shows that the

high transaction cost to provide crop insurance can be reduced by technology, and in the process, farmers can become resilient and operate in a smooth manner.

Given its poor performance, abolishing PMFBY is the first-best solution, but it is not politically feasible at this point in time, with the program having functioned for more than five years. Political dynamics will make it hard to terminate the program. Subsidized insurance is seen as a way of influencing election outcomes (Hazell 2017). The second-best solution here is to continue the scheme with modifications. The PMFBY program can function in a more efficient manner through improvements in its implementation, as shown by the findings of this paper.

Although crop insurance markets in Africa and those in Southeast Asia have been studied extensively for challenges in implementation of crop insurance programs, studies specific to the Indian crop insurance market have been limited (Robles 2021). Sarangi and Panigrahi (2016) identified the key challenges in the previous Indian insurance program, the National Agricultural Insurance Scheme (NAIS) (discussed later in this paper in depth), including expensive premiums, lack of transparency in yield assessments, and late compensation. However, ever since PMFBY was introduced in India in 2016, there has not been any in-depth assessment of its implementation challenges. Gulati, Terway, and Hussain (2018) presented the issues of the PMFBY program but considered only its first-year data. Bhushan and Kumar (2017), at the Centre for Science and Environment, found that implementation of the PMFBY program was seriously compromised, but this again was based on data and research done in the initial phase of launching the scheme. Recently, a study by Ghosh and colleagues (2020) showed Indian farmers' preference for certain features in an insurance product, but it did not identify gaps in the existing framework of PMFBY. It was silent on changes needed to improve the program's implementation.

This paper fills the gap in existing studies with respect to India's new crop insurance program, PMFBY. It combines the positive deviance approach with the principles of implementation science to conduct case studies that contrast a best-performing state with a worst-performing state.

Positive deviances can guide the process of implementation by identifying the programmatic improvements in similar contextual settings for peer-to-peer learning. It is a growing approach in development investigation that identifies entities within a population who are outperforming their peers and analyzes factors underpinning this positive deviance (Albanna and Heeks 2018). Although the approach is used in many domains, including nutrition and health (Amugsi 2020; Alzunitan et al. 2020; Ousman et al. 2020), its use in agriculture-related areas has been limited to mostly descriptive reviews of positive deviants. However, recently, Toorop and others (2020) studied positively deviant farmers (those who outperformed their peers) in the resource-poor state of Bihar, India, to redesign farming systems, and succeeded in improving farm productivity. Ruggeri and Folke (2020) used the positive deviance approach to pick out outliers from economically disadvantaged groups and analyze them to design better interventions; they, too, found positive results in reducing economic inequalities.

Implementation of development interventions remains a major challenge. Although funding for interventions is necessary, their implementation, too, must be studied for impact. Without evaluation of the implementation, additional resources thrown at an already failing program may go to waste. Durlak and DuPre (2008) showed that successful implementation can result in programs that are 3 to 12 times more effective. In this paper, to understand reasons for farmers' distrust in the crop insurance program and its low uptake, we carry out the case study of Marathwada by using the line of approach followed in implementation science. Although implementation science as a branch of social science is relatively new, it is gaining attention. It is the "scientific study of methods and strategies that facilitate the uptake of evidence-based practice and research into regular use by practitioners and policymakers" (Bauer and Kirchner 2020, page 3).

In this paper, we identify the barriers to implementation of the PMFBY program and develop implementation strategies to overcome them. We suggest ways to achieve successful adoption and sustainability of the PMFBY program. The paper studies Karnataka state's implementation methodology regarding PMFBY as a positive deviant. Karnataka is an outlier among states, with a foolproof system implemented for the PMFBY program. Marathwada, a region in the western state of Maharashtra, is also

studied to understand the implementation challenges there and suggest improvements in the crop insurance program's construction and delivery.

The key research questions of this paper include these: What are the reasons for the failure of PMFBY? What is the appropriate modus operandi of a crop insurance program in the Indian context? What are the possible sources of improvement in the resolution of disputes over crop cutting experiments (CCEs), the causes for delays in claim settlement, and the grievance redressal mechanism? We also explore how the challenges in the crop insurance program can be addressed by use of remote sensing and mobile technologies.

The paper is organized as follows: The following section presents a brief history of crop insurance programs in India. Section 3 presents case studies of two drought-prone regions in western India. Section 4 describes the policy, institutional, technological, and program implications of these two case studies for reforming the implementation of crop insurance programs in India. The final section concludes.

2. A BRIEF HISTORY OF CROP INSURANCE PROGRAMS IN INDIA

The frequency of drought has been increasing in recent decades in India, owing partly to climate change (Mallya et al. 2016). Besides the monsoon failure–induced droughts, farmers are exposed other risks such as floods, winds, hailstorms, frosts, and other natural disasters. Although various strategies, including crop diversification, intercropping, and integrated pest management, can help "risk-proof" agriculture, for resource-poor farmers in developing countries, crop insurance remains one of the most cost-effective solutions to farm risk management and poverty reduction (Wenner 2005; Hill and Toreo 2009).

In India, there were many attempts to introduce crop insurance even prior to independence, but such attempts received the required policy impetus only after 1947, when the Indian government commissioned a study to deliberate on the idea of crop insurance. In 1950, two pilot programs in crop insurance were introduced. But states did not take up the programs because of resource constraints. Then, after a long gap, during the third five-year plan period (1961–1966), crop insurance received attention again. In 1965, the government of India drafted a model scheme of crop insurance and circulated it among state governments. However, none of the states favored the scheme because they had to bear a portion of the premium subsidy (Dandekar 1976). In March 1970, a draft bill for crop insurance was designed by an expert committee under the chairmanship of Dr. Dharam Narayan (Members' Reference Service 2015). Based on this model, the Life Insurance Corporation of India (LIC) launched the first crop insurance scheme in 1972 using an individual farm–based approach (Raju and Chand 2009). The scheme covered only cotton (and only a specific variety, Hybrid-4) in Gujarat to start with and later expanded to include groundnuts, wheat, and potatoes in other states, including Maharashtra, Tamil Nadu, and Andhra Pradesh. However, determining the yields of past and current seasons, for each farmer, turned out to be challenging due to the remoteness and inaccessibility of villages and inadequate infrastructure. The scheme managed to cover only about 3,000 farmers by 1978/1979 (Agriculture Finance Corporation 2011). Policy makers pursued several ways to bring about a sustainable solution to mitigate crop loss risks for farmers and suggested the "area" approach (Dandekar 1976), whereby the unit of insurance was the *mandal,* also called a *block*, an administrative division encompassing several villages.

In 1979, the General Insurance Corporation of India, which took over the crop insurance business of LIC, introduced a new crop insurance scheme called the Pilot Crop Insurance Scheme (PCIS), based on the area approach. This scheme was meant specifically to be voluntary for farmers who obtained loans from commercial banks and formal credit institutions. It ran until 1984/1985, covering cereals, millets, oilseeds, pulses, and barley, besides cotton and potatoes, and reaching 623,000 farmers in 13 states.

In 1985, the government of India introduced the Comprehensive Crop Insurance Scheme (CCIS) (Singh 2010). Unlike the PCIS, the new scheme was open to all farmers and mandatory for borrowing farmers. Although originally the sum insured (SI) for the farmer was 150 percent of the crop loan amount, in 1988, it was reduced to 100 percent of the loan, subject to a cap of 10,000 rupees (Rs) per farmer. The premium was kept uniform across the country—2 percent of SI for cereals and millets, and 1 percent of SI for pulses and oilseeds. For smallholder and marginal farmers, the government gave a 50 percent subsidy on the premium. The scheme operated on the area approach, and the indemnity limit was 60 percent, 80 percent, or 90 percent, corresponding to high-, medium-, and low-risk areas. Claim settlement was based on yield. Average yield per hectare for the defined area was determined based on CCEs. If the actual yield of an insured crop was short of the specified guaranteed yield (also called the *threshold yield*—it was 80 percent of the average yield over the preceding five years), all the insured farmers growing that crop in the area were entitled to the insurance money. CCIS saw 16 states and 2 union territories participate. The number of farmers covered under the scheme in its last year, 1999, in the *kharif* (autumn) crop season was 5.58 million (Ministry of Agriculture 2014), with most of them being borrowers, however, and unsatisfactory coverage achieved among nonborrowing farmers. The scheme was operating at a loss because the claim-to-premium ratio was too high.

To address the shortcomings in the CCIS, a new scheme, called the National Agriculture Insurance Scheme (NAIS), was introduced during the *rabi* (spring) crop season of 1999/2000. The

government decided to operate this scheme on an area approach for widespread calamities, and on an individual approach for localized calamities such as hailstorms and landslides, to make loss assessment more realistic and attract nonborrowing farmers. Each participating state or union territory was to ensure that in three years the unit of insurance would be lowered to the village, or *panchayat,* from the block (*mandal*) level. However, this didn't happen until the *kharif* crop season of 2006. SI for borrowing farmers was the amount of the loan availed, but it could be increased to the value of the guaranteed yield and further, up to the value of 150 percent of the average yield. For nonborrowing farmers, the SI was the value of the guaranteed yield, but these farmers, too, were also allowed to increase their SI up to 150 percent of the average yield. Premium rates continued to be administered by the government but were increased for a few crops. The premium was set at 2.5 percent for cereals, millets, and pulses during *kharif*, 3.5 percent for oilseeds, 1.5 percent for wheat, and 2 percent for all other crops. Indemnity rates were kept the same, at 90 percent, 80 percent, and 60 percent, respectively, for low-risk, medium-risk, and high-risk areas. Premiums for smallholder and marginal farmers continued to be subsidized to the extent of 50 percent, to be shared equally between the central and state governments. The premium subsidy was to be phased out over a five-year period; however, a 10 percent subsidy continued to be given until the end of the scheme. The threshold yield, or guaranteed yield, for a crop in an insurance unit was the moving average yield, based on the past three years, in the case of rice and wheat, and the past five years in case of other crops, multiplied by the level of indemnity.

NAIS was implemented in 25 states and 2 union territories. The scheme's appeal was better than that of the previous ones, but it still reported only a limited reach. By 2008, it covered about 16 percent of farmers in the country (Raju and Chand 2009). With the unit of insurance being the block/district and there being large variation in yield between villages in the same block, farmers were not sufficiently compensated and were left disappointed. Farmers were not keen to take out the insurance also because the scheme did not provide cover for loss from natural events that prevented sowing. It covered only risks in the stages from sowing to harvesting.

In 2011, the government modified the NAIS scheme and launched a new scheme, called the Modified NAIS (mNAIS). The unit area of insurance was reduced to the *panchayat* (village) for all major crops (Cabinet Committee on Economic Affairs 2010). The scheme offered indemnity for prevented sowing and postharvest losses too. It assured indemnity of up to 70 percent of loss instead of the earlier 60 percent. The premium was based on actuarial rates, and there was a 70 percent subsidy on the premium, as opposed to 50 percent earlier, to attract nonborrowing farmers. The threshold yield was based on an average of seven years (as opposed to three years in the earlier scheme), excluding a maximum of two calamity years, to ensure that insured farmers got better compensation. However, despite all the tinkering, mNAIS couldn't improve the coverage of crop insurance. According to unpublished data of the Ministry of Agriculture, by 2015, only 20 percent of the country's cultivated land was under any form of crop insurance. A review of scheme features shows that in mNAIS, the premium charged for farmers was higher than under NAIS—at about 8–12 percent of SI. Also of note is that the premium the insurers could charge for a crop under mNAIS was capped at 8–12 percent, resulting in low SI. Thus, in crops with higher actuarial rates,[1] insurance companies reduced the SI based on the premium they could collect. The result was that farmers were not being indemnified to the full extent of the loss and were disappointed again.

India's crop insurance schemes fail for many reasons. The area approach upset farmers because the loss assessment under that approach was far from reality (Raju and Chand, 2009). Further, in spite of the need for fewer CCEs under the area approach, they remained an administrative challenge due to the absence of adequate infrastructure—resulting in delayed claim payments. Another damper was that risks due to localized calamities such as hailstorms, landslides, and postharvest losses were not covered, deterring nonborrowing farmers from signing up for insurance. Other problems included discrepancies in

[1] An *actuarial rate* is the projected value of a future loss shown through an estimate. Insurance companies calculate their actuarial rates to know and prepare for their financial obligations (Farlex Financial Dictionary 2021).

the crop area insured as compared with the net area sown, irregularities in CCEs, and poor technical skills of those implementing the scheme at the ground level (Ministry of Agriculture 2014).

The PMFBY Crop Insurance Program

Pradhan Mantri Fasal Bima Yojana (PMFBY) was launched in April 2016 with the target of covering 100 million hectares—that is, having 50 percent of the country's gross cropped area under crop insurance—by 2018/2019. But even at the end of 2019/2020, the scheme was nowhere near the target—it was reported at 30 percent, compared with 23 percent in 2015/2016, before the launch of PMFBY (Ministry of Agriculture & Farmers' Welfare 2020b). That said, in many ways PMFBY is superior to previous schemes. The premium payable under the scheme is low—1.5 percent (of SI) for *rabi* crops, 2 percent for *kharif* crops, and 5 percent for horticultural and other commercial crops. The balance is paid by the government (Ministry of Agriculture 2016). The list of risks covered is expansive, including localized calamities (loss from the occurrence of hailstorms, landslides, or inundation affecting isolated farms in the notified area); postharvest losses (up to a maximum of 14 days from harvesting); and midseason adversity due to floods, droughts, or prolonged dry spells (that reduce yield by 50 percent). The SI is enhanced and is equal to the scale of finance for the crop as decided by the district-level technical committee, which is the cost of cultivation. It is open to both borrowing farmers (for whom it is compulsory) and nonborrowing farmers. Compensation to the farmer is linked to the shortfall in yield, that is, the difference between the threshold yield and the actual yield. The threshold yield, as announced at the time of launch of the scheme, was the average yield for a crop in a notified insurance unit over the past seven years (excluding a maximum of two calamity years), multiplied by the indemnity level (from 70 percent to 90 percent, corresponding to low-, moderate-, and higher-risk areas). The number of CCEs was also reduced to 4 at the village level and 24 at the district level. To ensure that the yield data are accurate, the scheme suggests video or image capture of CCEs in real time utilizing mobile communication technology with GPS and time stamping.

Now, that's a big leap from where mNAIS stood. But PMFBY doesn't have many happy customers. Although the number of farmers availing of crop insurance through PMFBY rose markedly in the first year, it slipped in the subsequent years. According to Ministry of Agriculture data, in *kharif* 2016, the first season of PMFBY, there was a 30 percent increase in the number of farmers with crop insurance; moreover, the area under insurance coverage saw a significant jump in states including Gujarat, Haryana, Madhya Pradesh, Maharashtra, and Uttar Pradesh—the large agriculture states in India. However, in the following years, due to many issues in the program, it lost the trust of farmers and the public. The total number of farmers covered under PMFBY in *kharif* 2020 was 11.4 million (as of August 10), down from 20.2 million in *kharif* 2019 and 21.7 million in *kharif* 2018, and a much larger number in *kharif* 2017 (Sharma and Damodaran 2020).

The revamped guidelines for PMFBY introduced in February 2020 mandated use of satellite technology for CCEs and offered an states option to choose a district-level value of notional average yield (the value used, together with the minimum support price, to calculate the SI for any crop) (Ministry of Agriculture 2020). The new rules didn't bring any change on the ground, however, because implementing agencies of PMFBY at the state level didn't act upon it. The threshold yield calculation was also changed to help increase payouts for farmers—it became the average yield of the best five of the past seven years multiplied by the applicable indemnity level (Department of Agriculture, Cooperation and Farmers Welfare 2020). However, this change, too, did not receive much appreciation from farmers, who were stressed because of the serious administrative glitches in the PMFBY scheme.

The success of any crop insurance scheme depends on a proper loss assessment and timely payment of claims. PMFBY has faltered on both these counts, which is perhaps why it has not gained sufficient traction with stakeholders. A study done by researchers at the Centre for Science and Environment in 2017 pointed to irregularities in terms of data manipulation under PMFBY (Bhushan and Kumar 2017). The field study in Marathwada that is elaborated in the next section validates the issues raised in that paper. The problem of delayed claims settlements has proved particularly exasperating for

farmers. Payments were delayed by one season and sometimes even beyond a year, pushing some farmers to end their life out of frustration (Nirmal 2019). Per the guidelines of PMFBY, all claims have to be settled by insurance companies within three weeks of the end of the cropping season, but this seldom happens, and insurance companies point fingers to state governments for delayed submission of yield data. Statistics from the Ministry of Agriculture show that for the 2017 *kharif* season, of claims worth Rs 159.48 billion, settlements of only 27 percent had been made by the first week of May 2018 (Nirmal 2018). In that same season, though the cutoff date for submission of the yield data to insurance companies was January 31, 2018, nine states missed that deadline—Chhattisgarh, Haryana, Rajasthan, Tamil Nadu, and Telangana delayed submission by over a month; Andhra Pradesh and Madhya Pradesh overshot the deadline by almost three months; and Jharkhand and West Bengal had not yet provided the yield data as of the first week of May 2018. States attribute the delay in submission of yield data to the challenges in completing CCEs. They reported that there is not adequate institutional and human capacity to complete the CCEs. This problem for states is comprehensible. The mandate of 4 CCEs in each village, for a state with about 28,000 villages, such as Andhra Pradesh or Karnataka, means more than 100,000 CCEs in one season—a herculean task. The agricultural development officers in Haryana went on strike in *kharif* season 2016 to protest the burden of conducting this massive number of CCEs (Bhushan and Kumar 2017).

The level of transparency in the operations of PMFBY has also been low. Farmers are not informed about the premium deduction from their accounts; under PMFBY, banks have the authorization to deduct premiums from farmers' accounts without receiving the consent of the latter. In addition, when farmers grow a crop different from the one for which they took out the loan, they can't claim on the policy despite having paid the premium.

Although the challenges listed above are reported in the media, there has been no systematic analysis of the implementation issues at the grassroots level to guide policy makers in making improvements to the implementation of the PMFBY program.

3. CASE STUDIES OF TWO REGIONS IN WESTERN INDIA

Qualitative methods are very useful in implementation research because they help find answers to complex questions on why an intervention succeeds or fails, from the perspectives of stakeholders. In this section, we present case studies of two regions in western India, Maharashtra and Karnataka, for identifying implementation challenges and proposing possible improvements. The case study approach could be an ideal research method when in-depth investigation is required (Ylikoski and Zahle 2019; Feagin, Orum, and Sjoberg 1991). It is widely used in sociological studies because it contributes to understanding of the research problem in a holistic manner. Whereas quantitative experiments do not bring to the fore all intricate details (Stake 1995), case studies can do that effectively through intensive investigation and multiple streams of data (Yin 2014). Case studies explain the social and behavioral problems, including implementation issues, in the development context and provide policy insights for correcting the implementation of interventions (Crowe et al. 2011). There are several examples of the case study methodology being successfully applied in social and development research. To measure the gender asset gap in Ecuador, Ghana, and India, focus group discussions and key informant interviews were successfully used to gather information on household decision making over asset acquisition (Doss et al. 2008–2011). Case study methods help researchers comprehend the complex issues in a real-life context without the need to manipulate the variables, as is usually the case in experimental designs (Merriam and Tisdell 2009). The present paper employed key informant interviews and stakeholder consultations to gather information for the case studies reported below.

Case Study 1: Karnataka

The Indian state of Karnataka is home to around 6 million farmers. Agriculture is the main occupation for most of the rural population. A large portion of the agricultural land in the state is prone to drought, with only 26 percent of area under irrigation (Bhende 2013). Whereas the southern and coastal parts of the state receive average annual rainfall of more than 2,000 mm (1998–2010 average), many districts, including Bagalkot, Bellary, Bijapur, Chitradurga, Gadag, Koppal, and Raichur, receive average annual rainfall of less than 650 mm. What drove our attention to this state was the claim of Gulati, Terway, and Hussain (2018) that the state has seen success in implementation of PMFBY, attributed to the use of an online portal called Samrakshane, launched by the state government of Karnataka, that recorded all farmer information and presented CCE information digitally to stakeholders. To understand the modus operandi of the online system for crop insurance in Karnataka, it was taken as a case for this paper. Five officers of the Karnataka state government who were involved directly with the execution of the Samrakshane portal were interviewed in person for this paper in August 2018. Before we started discussions with identified key stakeholders, we also interviewed over the phone 10 farmers from farmer unions in the state. When we finished the interviews with farmers, we realized that the awareness level about the PMFBY program was still poor, despite the merits of the Samrakshane portal. Three of the 10 farmers interviewed said they didn't know about the PMFBY program or the portal. Though our sample size was small, it was a set of progressive farmers, and their ignorance about the Samrakshane portal showed the poor reach of the government's initiatives. However, it should be noted that a recent conversation with officials indicated that in *kharif* 2020, the state covered about 1.1 million farmers under the crop insurance scheme, which was 20 percent of all the farmers in the state.

Farmers who were in the know about the crop insurance program said that the major issues during the time before the Samrakshane portal in Karnataka were discrepancies in CCEs and delays in claim settlement. From the selection of the plot for CCE, its allocation to a primary agriculture officer, the officer's carrying out CCE and sending the data to the insurance company, and the insurance company's processing the claim for payment, the process took about five to six months, by which time the next season for sowing had started, farmers said. If the insurance company disagreed with the CCE data submitted by the state government, there was no means to address the concern by rechecking the yield

(because by then the crop would already have been harvested), and this delayed claim settlement further. Across states in India, CCE is a manual procedure and is a laborious process. District- or subdivision-level officials from the revenue or agriculture department of the state government conduct CCEs, harvest the crop from the cuttings, and then thresh, winnow, and weigh it to estimate the yield—this becomes the basis yield for settlement of insurance claims. This manual process can introduce measurement errors. With the introduction of the e-governance portal Samrakshane, however, issues over discrepancies in CCE results, time taken for dispute resolution, and delays in claim settlement were swiftly addressed, farmers added.

In the interview with us, Shakeel Ahmed, joint director of horticulture of the state government of Karnataka, said,

> *In Karnataka, the entire process of CCE is done via a mobile application without manual intervention. Dispute redressal happens instantly as there are videos and photos of the CCE.*

Explaining the process, Adarsh, assistant horticulture officer in the Karnataka Department of Horticulture, said,

> *Each primary worker in the Agriculture Department of Karnataka is handed out a smartphone by the Agriculture Department with a CCE application developed by NIC [the National Informatics Centre, a body set up by the Ministry of Electronics and Information Technology] loaded in it. All CCEs are captured through this mobile application and the data [are] pushed straight into the server along with photos, videos, and GPS coordinates. There may not be Internet connectivity everywhere, but even if offline, the mobile app identifies the GPS coordinates and marks [them] in the pictures. This prevents the worker from faking CCE data.*

Rajiv Chawla, additional secretary, Karnataka, who spearheaded the rollout of the Samrakshane portal, said,

> *The Samrakshane platform lets insurance companies record any objection to the CCE data uploaded by the primary worker. The insurance company is given a login on the portal and a mobile application to view the CCE data. The insurance company can provide reasons for its objection through the mobile app or the portal. This provision in the platform helps prevent any dispute over claims from the insurance company side at a later stage, thus enabling faster processing of [the] claim settlement.*

During the interview, the officers of the Horticulture Department of Karnataka said that the Samrakshane portal was successful in stopping fraud. The portal links to BHOOMI,[2] a database of land records, which verifies farmers' land details and authenticates them at the point of registration itself.

The Samrakshane portal's connection to the BHOOMI database helps in quick plot selection for CCE, too, said Shakeel Ahmed:

> *Samrakshane connects to the BHOOMI and picks plots for each notified crop on a random basis. Since the portal also has [a] database of the primary workers, it allocates the selected plots to the primary workers in that jurisdiction without need for interference by a higher-level officer. This process, … selection of the plot and allocation of it to an officer, earlier, used to take a month's time, but now happens instantly. And, once the*

[2] BHOOMI, an online land records management system, was implemented by the government of Karnataka in cooperation with NIC, way back in 2001. The Revenue Department in Karnataka has computerized 20 million records of land ownership of 6.7 million farmers in the state. All the record-of-rights documents have been verified and certified by the revenue authorities.

CCE data is entered, the system calculates the yield per hectare and the insurance unit-wise yield.

Beginning with *kharif* 2019, the Karnataka state government has also enabled claim settlement through the Samrakshane portal. As the CCE is done, the insurance companies have real-time access to the portal to approve or raise objection, and as this process is completed, the system generates payout data by farmer and insurance companies pay farmers digitally on Samrakshane through the platform of the National Payments Corporation of India. In a recent conversation, Shakeel Ahmed said that in *kharif* 2019, of the total 321,000 records for payment, 99.59 percent were settled successfully through the Samrakshane portal. There are advantages of making payments through the portal, said Rajiv Chawla. It helps identify reasons for nonpayment of claims (whether due to rejection at the insurance company level or because of wrong bank account number or wrong Aadhaar—the unique identity number for residents and passport holders of India), and gives the exact time and date of settlement of the claim by the insurance company, making it easy to calculate interest on any delayed payment (in accordance with new regulations under PMFBY by the government to encourage quick settlement of claims).

Karnataka's journey in PMFBY implementation has lessons for many other Indian states that are facing implementation challenges. It has proved that the use of information technology can effortlessly address disputes regarding the crop loss assessments and avoid delays in claim settlements. It can be used to develop a set of best practices in PMFBY implementation for the country.

Case Study 2: Marathwada

Marathwada, a region in the western state of Maharashtra, is a "typical market" for crop insurance. It falls under the rain shadow area in Maharashtra, where farmers are largely dependent on monsoon rains for agriculture and experience acute poverty and distress in the years of monsoon failure. The region ranks high in farmer suicides. In 2015, at 3,200 such deaths, Maharashtra accounted for one-fourth of all farmer suicides in India, and Marathwada was one of the two regions in the state that saw the most (Talule 2020). What became an additional motive for choosing the Marathwada region for case study is that in 2018 there were several media reports of farmers in the region receiving paltry payments from insurance companies despite losing their entire crop to drought, and accusations that the PMFBY program was turning a scam (Sutar 2018; *Business Standard* 2018). The fieldwork was done in the month of February 2019. We carried out town hall consultation meetings with 146 farmers from Jalna district and 150 farmers from Parbhani district. Major issues that were discussed through the informal interviews during consultations included irregularities in CCEs, reasons for disputes over CCE data, delays in claim settlement, and procedures for grievance redressal. For thorough understanding of the case, we used the data triangulation technique. Besides the town hall consultation meetings with farmers, quantitative data on the number of CCEs were collected from farmers and the district collector's office. Data from secondary sources, including media publications and government press releases, were also used to understand the issues in implementing the PMFBY program.

In *kharif* season of 2017 (that is, monsoon season, June–October), there was monsoon failure in Marathwada. While all farmers from Jalna district had insured their crops, only some received compensation. None of the farmers who attended the town hall meeting (146 farmers) had received any settlement under the PMFBY program. Crop insurance for the season was provided by the company IFFCO Tokio. The amount of premium paid by this group of farmers was about Rs 976,000 (US $13,940). Farmers who assembled for the town hall submitted their proof of premium payment. The proof was examined and validated for authenticity; it was found that all of the 146 farmers had paid their premium through the same commercial bank operating in their area (State Bank of India).

We highlight the life history of selected farmers to illustrate the implementation challenges of PMFBY.

Raisingh Zendusingh Sundrde, a farmer from Rajewadi Village, in Badnapur *taluka* (subdivision) of Jalna district, who was named the best sweet lime farmer in 2016 by the local government, saw his

luck run out in 2017 when the monsoon failed. For the 20 acres split between him and his brothers, he paid a premium of about Rs 32,000 (US $457) for the PMFBY program but didn't receive any settlement for the loss he suffered. During the discussion, he said (in English translation):

> *I borrowed from a money lender at 4 percent monthly interest to pay the premium and I am now neck-deep in trouble. I get suicidal instincts. If I go to the bank to inquire about the insurance settlement, the manager doesn't even look at my face and answer properly.*

Ramdas Shesharao Bhargaje, a farmer who owned 2 hectares of land in Badnapur *taluka* and had insured his mango crop, was also in the same boat as Raisingh:

> *I paid the premium for my crop to IFFCO Tokio through the State Bank of India but didn't get any insurance settlement up to now. Now I don't have money to take care of my family's daily requirements. I borrowed to buy daily needs for my family and now am not able to repay that loan.*

Ranganath Radhaji Sorae, who owns a 3-acre plot in Badnapur *taluka*, lamented,

> *The crop failed, leaving me in distress. I didn't have money to take care of the requirements of my family. I was hoping for insurance money to come to help, but I was left disappointed.*

As a next step of the town hall discussions, on our visit to the branch of the State Bank of India in Badnapur, we couldn't find any explanations for nonsettlement of insurance payments that were due to farmers. However, according to a representative of IFFCO Tokio, a major reason for the nonpayment was that the bank branch didn't send the details of the farmers to the insurance company on time, and this resulted in the insurance company's not processing the papers of the farmers who applied for crop insurance under PMFBY. Therefore, the insurance company had not applied for the government's subsidy on the premium for those farmers. Although government norms mandate that crop insurance payments be settled within 45 days of crop loss assessment, in Jalna, there was no system to ensure that this deadline was met. We found that poor governance in implementation was a clear weakness in the PMFBY program there.

During our second set of town hall consultations, in the Parbhani district with 150 farmers, gross irregularities in CCEs conducted under the PMFBY program were discussed as a major implementation issue. Farmers said that no officer came to their village to do the CCE. To check the claims of the farmers, we accessed the CCE records available through the village agriculture department in Parbhani. Scrutiny of the records revealed that there were CCEs done but not as many as was mandated. There were several violations of the mandated procedures. First, using the CCE mobile app, a total of only 146 CCEs were done during the *kharif* season of 2017, whereas the total number farmers insured was 279,000. Second, in some instances, monitoring of the CCE process was weak. Most CCE forms did not have the signature of the farmers in whose field the CCE was done. Third, there were also no photographs with geotagging of the farms where CCE was conducted. Finally, most of the experiments were performed manually.

In addition, in the original CCE report of Parbhani and Jinthur *talukas*, which we inspected, the date column was blank in most cases. Moreover, in the space where the signature of the officials who were present during the CCE was required, there was only the signature of the *gram sevak* (the lowest-level staff from the village/*panchayat* office). Also missing were the signatures of the *gram sarpanch* (village officer) and police *patil* (officer in charge of the police station in whose jurisdiction the village falls), which are mandatory. The insurance company's representative also had not signed any of the documents.

The district collector of Parbhani had set up a committee to investigate the manipulation of CCEs in that particular season. We accessed this report[3] and found that the committee had indicated missing information in CCE reports and instances of yield data being altered and overwritten. According to the government guidelines for PMFBY program, whereas state revenue department officials are required to do the CCE, the insurance company is required to co-witness it. However, in the case of Parbhani, no notification about the missing signatures was sent to the insurance company, which is Reliance General for this district, and the company chose to remain silent. Our emails to the insurance company on this issue were not answered.

During the Parbhani district town hall consultations, farmers alleged that the insurance company cheated on them by claiming there was no loss for farmers in *kharif* 2017, although the farmers experienced a severe drought, as recorded by the weather data. To verify the claims of farmers, we checked archives of different newspapers (*Firstpost* 2017; *Hindustan Times* 2017; Chatterjee 2017; Venkatesh 2017; Das 2017) and found the claim of drought in *kharif* 2017 to be true. The drought was so severe across districts of Marathwada in the 2017 *kharif* season that it was reported across national dailies. According to a farmer activist, Maulik Kadam, district president of the Shetkari Sanghatana farmers' union, a total of 279,000 farmers in the Parbhani district paid Rs 192.7 million (US $2.75 million) as premium for soybean crop insurance to the insurance company under PMFBY, but none of the farmers were given compensation despite losing their crops to drought. The farmer activist demanded that the government look at satellite images to verify the drought in the 2017 *kharif* season. In the interview, a smallholder farmer said, "We lost our crops. The government knows it. The satellite data has it. Pay us what is due to us." Although the preconditions for implementation of the PMFBY program are written in black and white, the mandated use of smartphones and satellite technology for conducting the CCEs was not followed in Parbhani. Resolving disputes between farmers and the insurance company would have been possible with remote sensing technology–based assessment.

A major problem for farmers in Jalna and Parbhani districts was that there was no grievance redressal system under the PMFBY program. When farmers wanted to report insurers' lackadaisical attitude, they didn't know where and how to go about it. Suryakanth Sakaram Pathange, a farmer from Parbhani, expressed his grief (translated from Hindi): "Where do we go, and whom do we ask? No one is bothered about our plight." In Parbhani, although Reliance General, the company that provided insurance in the 2017 *kharif* season, claimed it had an office in Parbhani in 2017, this could not be verified by our research. None of the more than 150 farmers who attended the town hall discussions at Parbhani had seen the office of Reliance General or its representative at the village in the previous two years. During discussions, farmers indicated that at the end of the cropping season, insurers usually close their offices irrespective of whether payments have been made or not. It also came to light that the insurance companies do not issue policy documents to farmers for the crop insurance coverage. None of the 150 farmers had seen or had a policy document with them to show. The case study in Jalna and Parbhani districts clearly indicated the areas of poor implementation and the reasons for farmers' distrust in the PMFBY program. It showed how the program had failed the farmers in the Marathwada region of Maharashtra state in India.

Summary of Findings from the Case Studies

Although PMFBY is far superior to previous crop insurance programs that India has implemented since its independence in 1947, findings from fieldwork and the case study of Marathwada region highlight severe lapses in the design and implementation of the program. CCE takes a long time to complete, and payment of claims gets unduly delayed. Farmers are kept in the dark about their entitlements under the current insurance policy and are not provided the policy document; information on threshold yield, actual

[3] The report is not publicly accessible. We accessed it from the district collector's office and read through it during the field study.

yield, and claims approved is not disclosed to farmers. Further, there is no grievance redressal mechanism.

Insurance companies do not connect even once with farmers; they do not have a functional office at the village or the block, or *mandal*, level (the level below the district, covering clusters of administrative villages). Crop loss figures often do not reflect actual losses; CCEs can be and often are faked by the officials of the state government, who are colluding hand-in-glove with insurance companies. So it is only understandable that there is complete loss of trust in the crop insurance program among farmers.

Maharashtra and other states of India can examine the model of Karnataka state, a positive deviance in implementation of the program, where the introduction of the online portal Samrakshane has addressed issues faced by farmers with the PMFBY program. Problems including bogus CCEs, disputes regarding the yield data, and delays in claim settlement are not a major challenge in the state due to this digitization approach. Digitization of land records and their linkage to farmers' accounts, real-time reporting of CCE data through smartphones, and an accessible portal for farmers for all vital information regarding the PMFBY program have ensured that the grievances are minimal. Interviews with selected progressive farmers from the state, however, showed that awareness of PMFBY and the Samrakshane portal is still low in the state.

4. IMPLICATIONS OF THE FINDINGS

Based on the case studies presented above, we draw specific institutional, technological, and policy implications for effective implementation of the crop insurance program in India.

Institutional Implications

As the case study in Marathwada showed, there is a need for capacity strengthening of different institutions involved in implementation of the PMFBY program. The government should draw out a comprehensive capacity-building plan and train state government officials and leaders from the villages in the implementation of the insurance program. To build awareness among the rural masses, training on a large scale should be carried out for farmer leaders and extension workers. Training of the officers of the Department of Revenue in conducting CCEs should also be carried out. Staff of the commercial banks implementing the insurance program should also be trained in record maintenance for the program.

The right infrastructure is also important. The government should support insurance companies by setting up automatic weather stations, investing in agrometeorological research, and funding innovative start-ups in picture-based insurance, remote sensing, and machine learning. These technologies should be deployed on the ground to avoid the problems highlighted in Parbhani in relation to CCEs and crop loss assessment.

Insurance companies that do not have the reach and capacity to expand into rural areas should not be empaneled under PMFBY. And for the empaneled insurance companies, it should be mandatory to have an office at the district level and keep it operational until 100 percent settlement is made.

Trust in the insurance provider is an important factor for the success of the PMFBY program, as we found from the town hall discussions in Jalna and Parbhani. In a study conducted in China (Cai et al. 2009), multiple factors suggested that trust, or lack thereof, in government-sponsored insurance products is a major hurdle for farmers' willingness to participate in insurance programs. So it would help if the government appointed a third party to oversee the premium rates asked by the insurance companies under the PMFBY program. Insurance companies should also be mandated to issue policy documents for PMFBY akin to the ones issued for motor vehicle or health insurance, mentioning the coverage and benefits under the policy, and to expand their personnel capacity to process claims and settle them quickly. The Insurance Regulatory and Development Authority of India, the insurance market regulator, should establish specific regulations for insurers empaneled under the PMFBY program. It should oversee the settlement of claims and punish companies for any irregularities in insurance operation or failure to resolve disputes.

There is no specific provision in the Indian Penal Code for insurance fraud, and insurance companies exploit this to their advantage. If strict punishments are developed under law for noncompliance with the contract and/or fraud and breach of trust, by either of the parties to an insurance contract, they will have far-reaching implications. It is beyond the scope of this paper to discuss the weaknesses of the Indian judicial system and how to change it. A strong judicial system is imperative for the crop insurance market to function efficiently. The reckless attitude of commercial banks is clear from the case study in Marathwada. Every bank that deals with premiums under PMFBY should have dedicated staff to handle the portfolio and be penalized for not transferring collected farmers' premiums to the insurer on time.

The state governments should also play their part. They should have an independent budget to provide necessary support to the implementing agencies (insurance companies and banks) and help in awareness creation about the PMFBY program through media campaigns. They should ensure that mobile phones are used to record and report CCEs, including geotags. They should also take steps to digitize land records and keep them updated.

Technological Implications

There are 250,000 village clusters (*panchayats*) in India, and it is not an easy task to complete the mandatory number of CCEs within a short harvesting window with limited human resources (*The Hindu Business Line* 2019). It is estimated that in India 10 million CCEs are performed annually. So it is critical to bring down the number of CCEs to a manageable level. Some examples of functional technology-based approaches are available in the private sector. SatSure, an analytics company of Indian origin, works on advances in satellite technology, machine learning, and big data analytics to identify farm plots that constitute an accurate sample for CCE for a particular village. It has successfully conducted pilot projects in Andhra Pradesh and in 15 countries besides India. It is the only private company engaged by the Department of Agriculture of the Philippines and the Philippine Crop Insurance Corporation for implementation of a satellite-based risk assessment system (Philippine Department of Agriculture 2020). Skymet Weather, a company that provides weather forecasts, and a few other start-ups, too, have been providing remote sensing technology and satellite imagery data for smart sampling to reduce the number of CCEs. It will be useful to understand their models and solutions for effective implementation of crop insurance in India. It will help state governments save costs and also human resources.

States including Karnataka have been reluctant to use remote sensing technology and artificial intelligence, even though these have proven to be effective in reducing the number of CCEs by 30 percent (Gulati, Terway, and Hussain 2018). Instead of random selection, if scientific selection of plots for CCE based on satellite data can be done, then damage assessments can be made more accurate. In a recent study to assess the quality of data collected through remote sensing techniques by comparing them with CCE data captured through a mobile application with geolocation, the state of Odisha, in the eastern region of India, was taken as a case study (Dubey et al. 2019). The study concluded that remote sensing technology and remote sensing–based indexes have the capability to assess the quality and accuracy of CCEs; these technologies were found to have 70–75 percent accuracy.

Several studies have been conducted during the past decade by the Indian Department of Space under the Crop Acreage and Production Estimation project for major crops using satellite spectral data, and there has been some success. The Mahalanobis National Crop Forecast Centre carried out pilot studies of smart sampling techniques for CCEs using remote sensing data in various states during *kharif* season of 2018 and *rabi* season of 2019 (Ministry of Agriculture & Farmers Welfare 2020a). Using this technique, which optimizes CCEs by selecting CCE locations using satellite data, close to 100,000 CCEs were conducted in 96 districts of 9 states for the rice crop during *kharif* season of 2019. The use of satellite technology currently, however, is far behind in India, compared with developed countries.

In Karnataka, the state government is keeping away from using remote sensing technology, arguing that clouds obstruct satellite images during the *kharif* season. These challenges can be overcome by radar satellites (a microwave remote sensing technology) and through artificial intelligence–based algorithms that provide extremely reliable data. Radar-based remote sensing has a high spatial resolution and high temporal resolution; it has the advantage over optical observation of avoiding the obstructions of clouds in mapping and monitoring of Earth. This technology has shown promising results in pilots done by an organization named Remote Sensing–Based Information and Insurance for Crops in Emerging Economies (known as RIICE) across developing countries including Cambodia and the Philippines (Mabalay et al. 2013). It uses the European Space Agency's satellite system Sentinel, which provides free snapshots of the whole of Asia at regular intervals. Sentinel uses a radar satellite, which scans Earth's surface with electromagnetic waves. It can penetrate dense clouds, which means that rice fields can be monitored during the monsoon season, the main rice-growing period.

To reduce costs for insurance companies, and more important, to ensure fewer errors in CCEs and faster claim settlement, it is necessary that the government take advantage of advancements in new technologies. Without adoption of such technologies, the penetration of any indemnity-based crop insurance program, such as PMFBY, will continue to be low.

Policy Implications

Several policy changes at the central and state levels can improve implementation of the crop insurance program in India. A robust implementation methodology is needed for PMFBY. The government of India should go back to the drawing board and sketch one immediately. It should articulate the methodology for execution of the program clearly and indicate the rights and duties of the insurance companies, farmers, and other stakeholders. Deadlines for CCEs and claim settlement, if not followed, can be made a punishable offence. To track adherence to deadlines, the National Crop Insurance Portal can be used for real-time tracking of the implementation and the payments to farmers.

A major flaw in the crop insurance programs of the past as well as the most recent one in India is the absence of monitoring. In 2020, the government of India made a few changes to the scheme, eyeing a reduction in its subsidy outgo (by limiting the central subsidy for premium rates to 30 percent for irrigated crops and 25 percent for rainfed crops) but failed to address the need for supervision of the program. It introduced a two-step process for estimation of crop loss using a deviation matrix, without elaborating how it will work. It prohibited states that delay sending premium subsidies to insurance companies from implementing the program without creating a supervision mechanism, thus making the changes superficial. It would have helped if the government of India had introduced an audit policy for crop insurance programs to plug the loopholes exploited by the insurance companies and others. To oversee the entire process of issuing insurance and settling claims, independent audit teams from state agriculture universities' agricultural extension centers, the latter known as Krishi Vigyan Kendras (KVKs), is necessary. The audit team should track accountability at different levels. The audit team should check (1) whether the states initiate a tendering process for insurance on time (most states invite bids for crop insurance only after the monsoon shows poor progress, and this results in insurance companies' increasing the premium rate in the middle of the season), (2) whether only insurers with a good track record in claim settlement are selected for PMFBY, and (3) whether a good reach in the unit area of insurance gets selected for offering PMFBY. The audit team should also see whether commercial banks submit farmers' data and transfer their premiums to the insurance companies on time, and whether states pay the premium subsidy to the companies on time. The audit teams should also oversee the CCE process. A report jointly prepared by the World Bank and the Global Facility for Disaster Reduction and Recovery, or GFDRR (2011), argued for conducting random audits on 5 percent of all CCEs. It also suggested that for random auditing to be effective, the maximum punishment in the event of detected manipulation of CCEs must be large enough to deter manipulation.

For success in implementation of any intervention, different stakeholders should actively participate, and this is missing in PMFBY. Ensuring buy-in and involvement from stakeholders is important to create a climate for successful implementation. The centrally designed program has failed to take the state governments fully on board. The role of state governments becomes critical in PMFBY because they are the ones who finalize the insurance company for every cluster in the state, pay half the premium subsidy, and conduct CCEs. The officers of the state governments must become ambassadors of the PMFBY program and build awareness among the state functionaries, such as those in the extension system.

Finally, outcome evaluation is also important in making implementation happen. There must be a system in place to study the impact of the intervention on the ground and capture feedback from farmers. This will help bring about changes and refinements in the program to make it compatible with the needs of the community. For example, in the case of Parbhani district, had the farmer feedback been collected, the insurance company would have increased the number of CCEs to capture the varied weather conditions within the same district. The state governments can use KVK scientists to study the impact of the PMFBY program. They can also consider setting up a committee with representatives of insurance companies, state governments, and farmers, to receive feedback and resolve issues raised by farmers.

5. CONCLUDING REMARKS

Crop insurance is essential to help reduce farmers' risk from vagaries of weather events and increase the resilience of crop production systems. When crops are insured, farmers see their income loss reduced and are able to sustain a livelihood from farming even during periods of disaster. However, it has been a struggle for governments across the developing world to implement successful crop insurance programs. This paper focuses on India's new crop insurance program, PMFBY, and identifies gaps in the structure and implementation methodology through a case study of Marathwada, in the state of Maharashtra. False CCEs, irregularities in crop loss assessment, absence of a grievance redressal mechanism, and delays in claim settlement are major issues with this program, the study shows, which are the results of poor implementation. By drawing on farmers' feedback on the program, collected through field-level consultations and key informant interviews, the case studies presented in this paper bring to the fore suggestions for how to win back the trust of farmers and improve the reach of the program.

The need for strong administration and a legal framework to check the vested interests of the parties involved has been overlooked in the PMFBY program, and the paper suggests creating a robust implementation methodology and articulating it well for the understanding of all the stakeholders. It suggests putting in place a system for monitoring implementation through private audit teams, receiving feedback from farmers and other stakeholders, and conducting outcome evaluation. It also urges that the government of India ensure buy-in from the state governments and farmers by involving them at every stage of implementation. This paper also finds selected best practices in implementation of a crop insurance program through a case study of Karnataka state, where mobile technology is used for live capture of CCEs—which helps curb fraud in the CCE process through geotagging of the field where the CCE is carried out. It also highlights how an online portal to connect insurers and farmers can make information on insurance premiums and claims processing available to all, and can swiftly address many grievances of farmers regarding PMFBY. The case study of Karnataka, a pioneer in digitization of land records, brings to light the advantages of digitized land records in keeping farmers from misusing the crop insurance program. The paper argues for use of remote sensing technology to reduce the number of CCEs required and to make crop loss assessments more accurate. The paper indicates that research and scientific advancement in the fields of satellite technology and big data analytics can be used to replace random sampling with smart sampling in the selection of plots for CCE. It suggests use of radar satellites (microwave remote sensing technology) that can see through the clouds and monitor the fields in the monsoon season.

Finally, this paper demonstrates the strength of qualitative methods in implementation research and how it can generate suggestions for refining an intervention as well as increase the probability of that intervention's success. As crop insurance programs are increasingly recognized by developing-country governments as a tool to improve the resilience of crop production systems, the role of right policies and learning from a transparent implementation framework can hardly be overemphasized.

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