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Adoption of Digital innovation in Crop Insurance - A Data Analytics based benchmarking study of Samrakshane portal in Karnataka

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Abstract. Agriculture in India is prone to a lot of uncertainties and different types of risks. Crop insurance is a mechanism hedge against such contingencies. Though many governments in the past had introduced various crop insurance schemes, the penetration rate was shallow, and there were no private players. Thus, the current Govt introduced PMFBM, which can be a game-changer. Karnataka went a step ahead and implemented an end to end technology platform – Samrakshane - to promote and manage the crop insurance. Samrakshane, being an innovative technology platform enabling the complete automation of crop insurance adoption. The objective of this study is to understand and measure the innovation adoption impact of the crop insurance scheme. In this short paper, we present a conceptual outline of our ongoing research.

Keywords: Samrakshane, Agri-insurance, Digital Innovation, E-Gov portal.

1 Introduction

Agriculture is the most climate sensitive sector, and India is among the most vulnerable countries in South Asia, due to the dependence of the majority of its population on this sector for their livelihood [1]. Agriculture contributes to 22 percent of GDP, provides 58 percent of employment, sustains 69 percent of population, produces all the food and nutritional requirements of the nation, important raw materials for some major industries, and accounts for about 14 percent of exports [1]. The agricultural activity is carried out on 60% of the total land area of India, 60% of which is dependent on seasonal rains for its irrigation [2]. Thus, agricultural sector is recognized as a national priority by the government of India and constitutes a politically articulate and powerful constituency wooed by practically political parties of all hues. Agriculture is inherently a risky venture. Agricultural risk and fluctuations pose the biggest threat to the large majority of Indian farmers who have small and marginal land holdings (less than 5 acres of land). Risks in agriculture can be classified as:

- Idiosyncratic risks that usually affect only individual farms or firms (e.g., plant and animal pests and diseases, illnesses of the owner or laborers);
- Covariate risks that affect many enterprises simultaneously (e.g., major droughts or floods, fluctuating market prices).

The high propensity of covariate risks in rural areas is a major reason that informal risk management arrangements break down and that formal locally based financial institutions are hesitant to provide commercial loans for agriculture [3, 4]. Jaffee and Siegel [5] list all possible sources of risk potentially affecting agricultural value chains. They identify seven categories: weather-related risks (especially those related to hail and wind damage and to high humidity or excess rain), natural disasters like floods, tsunami, earthquakes can affect agricultural supply chains for multiple growing seasons and/or production cycles, biological and environmental risks refer to presence of certain plant pests or livestock diseases, market-related risks existing for inputs and outputs and for the critical services that support supply chains, such as finance and logistics, agricultural supply chains increasingly face risks related to logistics and infrastructure, managerial and operational risks, which are closely associated with human judgment and response, public policy and institutional risks also have systemic impacts on decision making and productivity, as well as on market options. Traditionally developing countries have been using long-standing tools like interventions by governments, management of strategic food reserves, implementation of price stabilization schemes, heavily subsidized crop insurance, and credit guarantee programs for managing risks. These approaches to risk management can be further articulated as ex-ante or ex-post strategies.

1.1 Agricultural Risk Management: Individual & Institutional

One of the key objectives (globally) of agricultural risk management is stabilisation of the incomes of farmers. It is not only the low income of the farmer, but the fluctuations in income that cause hardships by affecting the stability between income and consumption requirements during the periods of crop loss or failure. This stabilisation, at an individual farmer level can happen through various ways – (i) managing the agricultural supply chain, (ii) extending the market, (iii) agricultural research (individual experimentation and innovation), (iv) crop insurance. Risks related to logistics and infrastructure are addressed by improving the distribution network for the supply of inputs, and improving the agricultural extension system. Market related risks are mitigated through support/ procurement prices provided by the government. Crop insurance, as a risk management alternative, provides cover only against yield risk and hence income fluctuations arising from fluctuations in yield. Where income variability is due to price fluctuations or due to untimely or irregular supply of inputs and information, crop insurance is not the solution. Therefore, crop insurance serves as a means to mitigate weather related risks, natural disasters, and biological and environmental risks. The financial and other capabilities involved in the first three ways of risk management mentioned above may be daunting for small and marginal farmers. Therefore, crop insurance is, seemingly, important for stabilisation of incomes of small and marginal farmers

[6]. Crop Insurance is an ex-ante action that may transfer certain risks to other parties (i.e. insurance agencies). Another perspective of managing risk, consists of risk minimising practices generally adopted by farmers are diversification of resources - vertical, horizontal and temporal—and adjustments within the cropping systems. The vertical diversification refers to the broader baskets of agricultural assets, i.e. animal / poultry farming that the farmer adopts to mitigate his crop-related risks. The horizontal and temporal aspects refer to both spatial and crop diversification, and these are widely used in semi-arid regions. The studies by the International Crops Research Institute for the Semi-Arid tropics (ICRISAT) has proved the superiority of crop diversification over spatial diversification in reducing the income instability of farmers. However, even the usefulness of crop diversification was limited as it failed to adequately protect the farmers from risk. Adjustments within the cropping system, e.g. inter-cropping of sorghum and pearl millet, also proved ineffective as was evident from the positive and significant correlation between their yields. Since the risk minimising practices are largely related to the yield of the crops, crop insurance serves as an important risk mitigation mechanism. It has a more important role to play in countries where traditional strategies (e.g. price stabilisation schemes, supply chain management etc.) to manage risks are inefficient or ineffective. Crop insurances may, further, be of two types – multiple risk or specific risk. The fact that multiple-risk crop insurance is not a commercially viable proposition and that its existence depends on liberal subsidies from the government is further underlined by the situation in Australia. Farm incomes in Australia are notoriously volatile. The insurance of crops is undertaken by large insurance bodies in the private sector which offer insurance cover against specific risks such as hail and fire. Lloyd and Mauldon recount the failure of various attempts made in Australia to introduce multiple-risk insurance on a commercial basis [6]. Besides, contributing to income stabilisation, the provision of insurance may enable the farmers to adopt riskier innovations e.g. modern agronomic practices, riskier crops. An indirect benefit of crop insurance may be on the agricultural labour market where the incomes of labourers may stabilise as small and marginal farmers will no longer be compelled to join the ranks of agricultural labourers and push down the wage rate following a failure of crops. Given that crop insurance has an important role to play in the agricultural sector of developing countries, it is important to understand its impact on farmers. The effectiveness of crop insurance in India has been a bit dubious, given the very low rate of its adoption by farmers. Further, from an insurance agencies' point of view, Binswanger [7] points to the information asymmetry, moral hazard and adverse selection problems faced by them. The indexed approach minimises the transaction costs based on the individual basis. Incentive and information problems which are similar to both credit and insurance services act as severe obstacles to actuarial calculations. Hence, not many private insurance companies are keen to provide farmers cover for their crop yield.

1.2 Indian Scenario

In India, the efforts to introduce crop insurance date back to the years immediately after attaining independence when some state governments evinced an interest in introducing the scheme. But the schemes, since 1985 when the Comprehensive Crop Insurance

Scheme (CCIS) was launched, have not been gaining the expected traction among the farmers. The Gross Cropped Area (GCA) covered under crop insurance - touched 28% in 2016-17, then dropped to 26% in 2017-18, has remained far below the target of 50% projected by 2018-19 [8]). This is despite several attempts at changing the schemes – from individual based (72-78) to area-based (79-84 : Pilot Crop Insurance Scheme-PCIS); making Crop Insurance mandatory for the loanee-farmers since 1985 ; fully subsidized scheme (97-98 - Experimental Crop Insurance Scheme – ECIS); share crop-pers were covered for the first time in NAIS– 1999 -2016 ; farm income , rather than cost of cultivation, was insured (2003-04 : Farm Income Insurance Scheme – FIIS) ; WBCIS based on the deviation in the rainfall (2007 – till date) ; Private sector was encouraged to participate and immediate partial payment to affected farmers was introduced (Modified NAIS , 2010-16) and finally PMFBY wherein Premium rates were lowered(2.5 % to 1.5% for Kharif , rabi – remains at 2%) and use of technology was emphasized and covered more risks such as prevented sowing and post-harvest losses.

1.3 Crop Insurance Implementation

A recent survey by the Comptroller and Auditor General of India (CAG) revealed that the coverage of farmers, particularly small and marginal ones, under the insurance schemes was very low compared to the population of farmers as per Census 2011, the report said[9]. Duplicate claims by some farmers, manipulation in Crop Cutting Experiments (CCE), laxity in the exercise of due diligence by the bankers in the verification of documents pertaining to the identity and the Record of Rights (RoR), have been reported to have plagued the execution of the crop insurance schemes in India. To address these challenges the PMFBY Guidelines emphasize the “adoption of new technology for early loss assessment and better administration of scheme” [OPERATIONAL GUIDELINES, PMBFY, pp.48]. Technology initiatives like the Crop Insurance Mobile App¹ are being attempted. It is widely expected that deployment of ICT, as part of e-Governance, would significantly influence the effectiveness and efficiency of administration of the Crop Insurance Schemes in realizing their key objectives and the potential to impact the lives of millions of farmers while safeguarding the interests of all the stakeholders.

The crop insurance scheme with a noble intention to protect farmers can succeed only if operational guidelines are strictly followed and cut off dates are not extended frequently as was done in Kharif 2016. One of the reasons for high actuarial premium rates quoted by the reinsurance companies was the extension of cut off dates. Moreover, timely submission of yield data of CCEs and payment of premium subsidy to insurance companies will smoothen and fasten the process of claim settlements as done by Tamil Nadu in Rabi 2016-17, Tamil Nadu when they experienced one of the worst droughts.

¹ <http://digitalindia.gov.in/content/crop-insurance-mobile-app> visited on 17-01-2018, This Mobile App can be used to calculate the Insurance Premium for notified crops based on area, coverage amount and loan amount in case of loanee farmer. It can also be used to get details of normal sum insured, extended sum insured, premium details and subsidy information of any notified crop in any notified area.

There were allegations of data manipulations while conducting CCEs like the yield of groundnut of Rajkot district in Gujarat in Kharif 2016.

The litmus test of any crop insurance scheme, therefore, depends on quick assessment of crop damage and payment of claim into farmers' bank account. The infrastructure to make this scheme fully operational is still inadequate. Timely submission of yield data by State government to the insurance companies is necessary so that they can finalise the claims expeditiously and pay the claims to farmers. The Indian crop insurance scenario has been beset with several problems such as lack of transparency, high premium, delay in conducting crop cutting experiments and non-payment/delayed payment of claims to farmers and delay in payment of the premium subsidy by the governments to the insurance company.

Although the policy w.r.t. Indian crop insurance schemes have undergone several changes over the last 3 decades, there has been little attention given to the process aspects (cost and efficiency) of the various schemes. Therefore, the transparency, accountability and efficiency of the administrative processes of the crop insurance schemes have not seen as much improvement or reforms, as the specific features and benefits of the schemes.

1.4 Technology Adoption in Crop Insurance Implementation in Karnataka

Karnataka has been among the leading states in the adoption of crop insurance. The state has achieved significant increase in the enrollment of farmers in the crop insurance scheme- from 8.72 lakh farmers in Kharif 2015 to 20 lakh farmers in Rabi 2017. Though, the idea of automating the crop insurance scheme using ICT is not new, Karnataka developed an end-to-end software application, christened SAMRAKSHANE, meaning 'Protection', with many advanced features and was ahead in the implementation of such a software. This technology platform developed by National Informatics Centre (NIC), Karnataka, was rolled out in June 2016. Samrakshane, is a unified portal, and provides comprehensive support to the state Agriculture and Horticulture departments in managing the entire value chain of crop insurance under both Modified Weather-Based Crop Insurance Scheme (MWBCIS) & Prime Minister Fasal Bima Yojna (PMFBY) – from enrolment of farmers to the final payout of insurance claims through a unified portal [10]. It enables enrolment of crop insurance through multiple channels - the banks for the loanee farmers, and the Raitha Sampark Kendras (RSK) & Village Level Entrepreneurs (VLE) at the Citizen Service Centers (CSC), for the non-loanee farmers. Samrakshane is an e-governance tool to create a transparent, accountable, at the same time farmer friendly system of administration of the crop insurance schemes, with a great promise and potential to usher in radical change benefitting not only farmers, but all the key stakeholders – the insurance agencies, banks and the government. This paper aims to study the technology adoption success of the crop-insurance schemes enabled by the digital initiative SAMRAKSHANE. Of late, Karnataka has also gone ahead and made compulsory use of mobile phones while conducting the CCE. In order to address the insurance process issues from farmers' point of view, and take care of the problems faced by the private sector insurance agencies.

2 Study Objectives:

The objectives of this study would be to understand and measure the innovation adoption impact of the crop insurance scheme as outlined below:

- Adoption success metrics at the level of individual farmer and village level entrepreneur (cost of service, quality of service, personal development, feeling of protection).
- Adoption success metrics at Community level (e.g. crop sustainability, crop diversification, agronomic practices, income stability).
- Adoption success metrics on Governance (efficiency and effectiveness).
- Recommendations for process improvements to enhance adoption success (enrollment, claims, proposal verification and validation, additional data capture).
- Recommendations for technological innovations in Crop cutting experiments.
- Recommendations for successful adoption of digital technology innovations for

3 Methodology for Measuring Innovation Adoption Success

We propose to adopt a robust assessment strategy for adoption success evaluation [11]. The evaluation would be done at two levels –

3.1 The broader impact of Crop Insurance on the farmer community:

This Community impact is an outcome-oriented measure for Government impact, and would consist of data collected at a citizen level. The impact indices would help to understand

1. The farmers (i.e. their profiles, incomes, and farming techniques etc.) who benefit from the scheme
2. The crops (i.e. their sustainability, diversification etc.) that are supported by the scheme
3. Allied community developments (i.e. feeling of protection, development based on achievement of aspirations etc.) due to crop insurance availability

3.2 The specific impact of the software application (Samrakshane portal) on governance processes through two kinds of measures –

1. Efficiency gains e.g. time taken for enrolment of Loanee / Non-loanee farmers in the scheme; time taken for claims process etc.
2. Effectiveness gains e.g. Reduction in errors in due diligence and verification of farmer records; Reduction in manipulations e.g. duplication in land records, benami enrolment; Reduction in Crop cutting experiment manipulations; Penetration of scheme; Quality of governance (transparency, accountability, participation etc)

The evaluation would be conducted in two parts as depicted in Figure 1 below. The first part of the study would consist of the use of Data Analytics on the database built by the Samrakshane project.

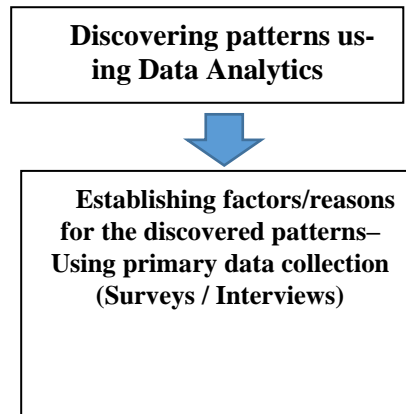


Figure 1: Method of Adoption Success Evaluation

Some indicative Analytics techniques that can be used are the following. However, the appropriate techniques will be decided upon accessing the Samrakshane historical data stored.

1. Descriptive (based on Statistical Analysis)

- Farmer profile (region, caste community, economic background)
- Crop profiles (area, season, insured amount, premium paid)
- Insurance Unit profiles

2. Prescriptive (based on Optimization)

- Trend Analysis of yield in a particular region for a particular crop can give an expected range, which can be used to identify any ambiguity during Crop Cutting Experiments.
- These techniques would also help the government arrive at scientific figures for indemnity levels, average yields, threshold yield, sum insured, premium rates, seasonality discipline, coverage of risks and exclusions etc.

3. Predictive (based on Machine Learning)

- Propensity of farmers / crops in enrolling for crop insurance / making insurance claims.

The second part of the study (as shown in Fig 1) would consist of study of factors/reasons for the discovered patterns. This part of the study would be done based on primary data collected (i.e. Surveys / Interviews) from farmers, VLEs and RSKs, bank officials, and insurance company employees.

4 Research Progress and Expected Outcomes

The project began in April 2019 with an extensive literature survey along with contacting state officials for traces data of the portal. The objective of the literature review was to understand the types of risk faced by the farmers and the development of crop insurance schemes in India. We understood from the survey that the agriculture in India, kind of gamble and prone to multiple types of risks. Though the agriculture crop insurance to hedge against risks of farming was introduced right after the insurance, a serious step towards the implementation was took place after 1985. However, the adoption rate was shallow, and there were no private players in the crop insurance market. Thus, the current Govt introduced PMFBM, which can be a game-changer. Karnataka went a step ahead and implemented an end to end technology platform to promote and manage the crop insurance. In the literature review section, we have traced the entire evaluation of crop insurance to date.

Once we understood landscape, we scheduled meeting with NIC, Karnataka and the horticulture department to understand the intricacies of the Samrakshane platform and nature of agriculture in the state. We had regular interaction with state departments, and the department was very cooperative in supporting our research. Projects investigators continuously held various meetings with state horticulture and agriculture department officials to understand the crop insurance digital solution platform Samrakshane. The both the department were involved in the implementation of the Samrakshane portal.

Subsequently, team requested National Informatics Center, NIC to provide us with the crop insurance raw data, up to the individual level enrolled to Samrakshane platform. The department honoured our request and facilitated us with the complete raw data of three years' (nine seasons). The contained around 80,00,000 enrolments during this period, with more than 40,00,000 unique land parcels being insuring. We have performed preliminary descriptive/exploratory data analysis this entire dataset, and the same is provided in the second chapter.

We had observed different types of adopters. Some of them are early adopters but didn't turn up in the later years. Some of them have adopted in the later years and stayed back. There some formers who have enrolled in all the three years. The preliminary data analysis also shows patterns in terms of agro-climatic regions and crops.

Thus, as the next step, we had plans of visiting the fields to explore these different patters by interacting with the farmers directly. We had scheduled the visits in late March 2020 till May 2020, during the academic break. However, due to the pandemic, we couldn't interact with the farmers, and the field work has been halted from March 2020. Hopefully, we will be able to restore the data collection from September 2020.

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