A Comparative Study on the Performance of Various Agricultural Crop Insurance Schemes of India with Special Reference to Pradhan Mantri Fasal Bima Yojana (PMFBY)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This study examined the performance of Pradhan Mantri Fasal Bima Yojana (PMFBY) crop insurance scheme in India. To evaluate the performance of the Pradhan Mantri Fasal Bima Yojana in comparison with previous crop insurance schemes of India, data on area insured, gross premium paid, number of farmers benefitted and number of claims paid during 2016-2021 were collected.

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The study employs descriptive statistics and compound annual growth rates to compare the performances of various crop insurance schemes. The determinants of the number of farmers insured under Pradhan Mantri Fasal Bima Yojana were estimated through a multiple regression analysis. In comparison, PMFBY had covered a higher number of farmers thereby protecting an enormous amount of land from unforeseen risks compared to other crop insurance schemes of India. Results of the multiple regression model show that the amount of premium charged from farmers had a significant effect on the number of farmers insured over the time period. The paper also attempts to provide an overall knowledge about various crop insurance schemes of India since the implementation of crop insurance as a tool for mitigating agricultural risk.

1. INTRODUCTION

"Agriculture is the prime source of livelihood for about 58 percent of the total Indian population. It has remained the silver lining of the Indian economy when all the other sectors were hit hardest during the pandemic" (ESI 2021). Though the agriculture sector is resilient to pandemic shocks, it is vulnerable to lots of other risk factors in production, marketing, prices, etc. One of the major mechanisms to cope up with farm risk is by availing of crop insurance (Hau 2006).

After independence, crop insurances majorly focused on eliminating the yield variations and income fluctuations of farmers [1]. This reduction in production risk by availing crop insurance encourages small farmers to take up high-value and risky crops [2]. It is necessary to consider the fact that post-independence also brought in the concept of marginalization due to the division of lands by several land reforms which increased the number of smaller farms in the country. These farms are naturally less diversified. Hence the need for crop insurance is a necessity for them [3]. Over time, crop insurances turned to be a major necessity for covering the cost of cultivation. It was found to have a positive effect on fertilizer and chemical expenses [4]. This aspect of insurance aid is necessary as in countries like China where crop insurance programs increased the welfare of the farmers by covering the physical cost of cultivation [5]. Crop insurances have also shown substantial risk reduction in farms [6]. Some producers even consider agricultural insurances as a trade-off between potential indemnity and producer-paid premium. Such attitude of producers has made them risk-tolerant and also stabilized their future revenue (Zhao and Yue 2018).

Most recent studies have shown that the major concern of farmers has shifted to addressing poor physical conditions of the land, weather fluctuations, and investments. More than one-fourth of cultivating farms experience crop loss due to inadequate rainfall and drought [7]. Hence, Farmers take crop insurance as a mechanism for risk reduction to cushion them against the adverse effects arising from extreme weather conditions (Fahad and Zing 2017). Unlike weather fluctuations, Soil quality is also an important factor in recent days that need to be addressed. Because Farms with Low soil quality are more risk-prone which makes soil quality one of the factors for the need for crop insurance [8]. Apart from these, Insurance also acts as an investment tool to aid farmers in increasing the crop acreage and influences the crop coverage decisions by nearly 70 percent [9]. Hence the study attempts to (1) review the evolution of various crop insurance schemes of India prior to PMFBY and understand the problems associated with them (2) assess the crop insurance schemes of India and to evaluate the performance of the Pradhan Mantri Fasal Bima Yojana (PMFBY) scheme in comparison to previous crop insurance schemes of India and (3) estimate the factors affecting the number of farmers covered under PMFBY scheme.

2. MATERIALS AND METHODS

The study attempts to understand the evolution of various crop insurance schemes through review of literature over the years from databases, including Scopus, Web of Science, etc., To evaluate the performance of the Pradhan Mantri Fasal Bima Yojana, data on area insured, gross premium paid, number of farmers benefitted and number of claims paid during 2016-2021 were collected from annual reports of the Ministry of Agriculture and Farmers Welfare of GOI, Indiastat and PMFBY website. The data were then analyzed using descriptive statistics and compound annual growth rates to compare

various agricultural crop insurance schemes and their performance over the years. Multiple linear regression was employed to analyze the determinants of farmers covered under PMFBY over the period of study.

Compound Annual Growth Rate: The compound growth rate (CAGR) examines the growth in the number of farmers insured, gross premium, farmers benefitted and area insured under PMFBY in India. CAGR examines the tendency of the variable to increase, decrease, or stagnant over a period of time and indicates the magnitude of the rate of change in the variable under consideration per unit of time.

$$Y = ab^t \rightarrow \text{Log } Y = \text{Log } a + t \text{ Log } b$$

Where,

Y = no. of farmers insured, gross premium, farmers benefitted and area insured
t = Time variable or element which takes the value 1, 2, 3… n
b = Regression coefficient a = Intercept value (value of Y when t = 0)

The compound growth rate will be computed by using the formula:

$$\text{CGR} = [\text{Antilog (log b)} -1] \times 100$$

2.1 Coefficient of Variation

Beneficiary and Claim ratio: Beneficiary ratio for a particular program can be calculated by dividing the total number of farmers who benefited from the program by the total number of farmers who were insured via that program. Similarly, in order to determine the claim premium ratio, the ratio of total number of claims paid out to the total amount of gross premiums collected in accordance with a specific plan is estimated.

Multiple regression analysis: The factors affecting the number of farmers insured under PMFBY were identified using a log-log linear type of function:

$$\text{Ln } Y = b_0 + b_1 \text{ Ln Gross premium} + b_2 \text{ Ln Farmers benefitted} + b_3 \text{ Ln Area insured} + \mu$$

where μ = error term and $b_1 \dots b_4$ are the regression coefficients and b_0 is a constant.

3. RESULTS AND DISCUSSION

1. Evolution of Agricultural Insurance Policies:

"Crop insurance is one of the major tools in developing countries that is used to smoothen farm income fluctuations along with minimum support prices, input subsidies, low-interest crop loans, and other mechanisms" [10]. It protects the farmers against natural calamities and cushions the shock of crop loss. The underlying principle of crop insurance is that "the loss incurred by a few is shared among others in an area, engaged in a similar activity". "Similarly, losses incurred in bad years are compensated from resources accumulated in good years" [11]. "Henceforth, Initially the Government of India introduced a Comprehensive Crop Insurance Scheme in 1985 and later improved it into National Agricultural Insurance Scheme in 1999-2000" (Bhende 2005). National Agricultural Insurance Scheme was launched by the National Agricultural Insurance Scheme Corporation of India. NAIS followed the "area approach" where the similar areas are defined as insurance units and all the farmers who availed insurance in the stated area get equal indemnity per unit of the sum insured. Though this scheme has benefitted small and marginal farmers to a great extent, the penetration level of the scheme seems to be poor as only one-fifth of the farmers were insured even after more than two decades of implementation. This might be due to late indemnity payments. Also, the coverage and indemnity were partial towards a few regions and crops [12]. Furthermore, the Area approach itself revealed several problems like the entire block was treated as the similar area for crop cutting experiments, threshold yield was considered to be the normal yield which seldom indicated the proper yield levels of the areas affected by adverse climatic conditions [13]. These limitations under the area approach led to the development of a better crop insurance scheme that is "weather-based".

Weather-based insurance in India was first introduced in 2003 by ICICI Lombard for groundnut and castor farmers of Mahboobnagar district in Andhra Pradesh, followed by the pilot rainfall insurance scheme by IFFCO-Tokio General Insurance (ITGI) in 2004-05 in Andhra Pradesh, Karnataka, and Gujarat. Weather Index-based insurance is less vulnerable to the problems that were inherent in traditional multi-peril crop insurance and benefits both the

insured and the insurer. The most vital benefit for the insurers over the traditional scheme is the prospect of getting timely indemnity pay-outs given that the pay-outs for indexed contracts are inevitably triggered once the weather parameter reaches the pre-specified level (Report of Joint group, GOI, 2004). WBCIS uses rainfall as an index which is easier to measure accurately and, hence, data collection process is more transparent and less laborious. Besides these Low administrative costs facilitate quicker indemnity payments to the insured. Furthermore, WBCIS eliminates the problems of moral hazard and adverse selection [14].

The key disadvantage of WBCIS is that it covers only weather-related risks. Hence, the insured farmer will not get any compensation if the crop loss is due to any other reasons like disease incidence or pest attacks. Furthermore, there was variability observed between the calculated loss value and the actual loss value experienced on the farm [15].

At present, two insurance schemes are functional i.e., Pradhan Mantri Fasal Bima Yojana (PMFBY) and Restructured Weather Based Crop Insurance Scheme (RWBCIS). PMFBY provides "insurance coverage and financial support to the farmers in the event of failure of any of the notified crops as a result of natural calamities, pests & diseases" whereas the RWBCIS aims "to mitigate the hardship of the insured farmers against the likelihood of financial loss on account of crop loss resulting from adverse weather conditions using weather parameters as proxy for crop yields in compensating the cultivators for deemed crop losses" (ICFA, Ministry of Agriculture and Farmers Welfare, 2016). Restructured weather-based crop insurance scheme (RWBCIS) has been introduced with the goal of providing coverage for those crops for which there is no fixed methodology for yield assessment. The scheme was revised based on the PMFBY's premium structure. PMFBY was designed to cover the loopholes of all the previous schemes and also uses the technological advancement of recent days.

The PMFBY scheme operates on an area-based approach and the lowest level of the notified area is called the Insurance Unit (IU), which is calculated on the basis of CCE's. If the actual yield per hectare of the insured crop for the insurance unit in insured season falls short of specified threshold yield, all insured farmers growing that crop in the defined area are deemed to have suffered a shortfall of similar magnitude in yield (ICFA, Ministry of Agriculture and Farmers Welfare, 2016). The PMFBY takes care of systemic or covariate risks linked with weather as well as idiosyncratic losses. None of the previous insurance schemes have offered such comprehensive protection against crop risks as the litmus test of any insurance scheme lies in the quick valuation of crop damages and direct payment of claims to farmers [16,17].

2. Assessment of various crop insurance schemes of India

Table.1 compares the coverage provided by various crop insurance programs from 2000–2001 to 2020–21. In comparison with the number of farmers insured under WBCIS (1.65 lahks), the number of farmers covered by the National Agriculture Insurance Scheme (NAIS) (129.92 lahks) increased during the kharif season of 2008–2009. In a similar vein, the area covered by the National Agricultural Insurance Scheme was much more extensive (176.36 lakh hectares) than the area covered by the Weather-Based Crop Insurance Scheme (WBCIS) (1.78 lakh hectares). During the rabi season, a consistent pattern was established for both the number of insured farmers and the amount of land that was covered. The Weather-based Crop Insurance Scheme (WBCIS) covered 53.99 lahks more farmers in Kharif 2015–16 than the Modified National Agriculture Insurance Scheme (MNAIS) did (48.12 lahks).

Area insured under various crop insurance schemes: The area that was insured under WBCIS (62.94 lakh hectares) was more significant than the area covered under MNAIS (55.30 lakh hectares); however, this tendency was reversed during the rabi season. It was found that more farmers were insured under PMFBY (329.49 lahks) than under RWBCIS (14.01 lakh) during the kharif season of 2018–2019. During the same season, the territory that was covered by PMFBY's insurance (304.42 lakh hectares) was much larger than the area that was covered by RWBCIS's insurance (14.72 lakh hectares). During the rabi season, the same pattern was discovered for the number of farmers and the amount of land insured. As a result, PMFBY had a higher number of farmers and an enormous amount of land was protected under PMFBY compared to other crop insurance schemes.

Table 1. Assessment of different Crop Insurance Schemes in India (2000-2021)

| Scheme	Year	Farmers Insured (Rs. in lakhs)	Farmers Benefitted (Rs. in lakhs)	Gross Premium (Rs. In lakhs)	Claims Paid (Rs. in crores)	Beneficiary Ratio	Claim to Premium Ratio
NAIS	2000-2001	110.8	42.17	239.94	1289.66	0.38	5.37
	2005-2006	167.22	36.68	554.77	1424.75	0.21	2.56
	2009-2010	239.34	90.11	1154.55	5118.11	0.37	4.43
WBCIS	2007-2008	6.709	2.20	145.48	104.15	0.32	0.71
	2011-2012	116.71	63.298	1844.31	1091.43	0.54	0.59
	2015-2016	90.30	75.190	7180.52	5386.41	0.83	0.75
MNAIS	2011-2012	12.29	2.23	286.97	179.50	0.18	0.62
	2013-2015	53.58	17.81	1074.47	1391.97	0.33	1.29
	2015-2016	86.15	40.45	1347.78	1812.20	0.46	1.34
RWBCIS	2016-2017	20.99	17.21	1631.78	1658.29	0.81	1.01
	2017-2018	20.22	15.89	2363.22	1871.82	0.78	0.79
	2018-2019	21.26	13.94	2891.56	2656.21	0.65	0.91
PMFBY	2016-2017	562.71	131.80	20,243.15	15,109.77	0.23	0.74
	2017-2018	507.73	159.04	22,986.39	19,943.71	0.31	0.86
	2018-2019	546.85	151.14	26,214.42	17,359.21	0.27	0.66
	2019-2020	283.60	223.20	32,012.00	25,546.00	0.78	0.79
	2020-2021	393.30	61.80	29,960.55	15,708.29	0.15	0.52
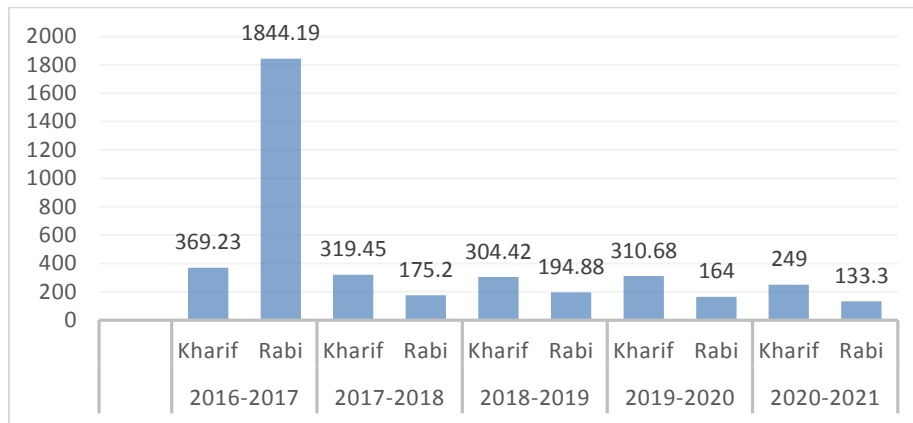
Fig. 1. Season-wise area insured under PMFBY (in lakh hectares)

Gross premium and claims paid: During the Kharif 2015–2016 period, the total gross premium amount collected for WBCIS was 986.56 crore, which was higher than MNAIS, i.e., 807.16 crores. During the same season, the total amount of claims paid out under the WBCIS was more than the total amount of claims paid out under the MNAIS (which was 1127.16 crore). During the rabi season also, the gross premium collection amounts and the claims paid followed a pattern with the same general direction. This concludes that during the 2015–2016 policy year, WBCIS had a greater gross premium amount and higher claims paid out than MNAIS did.

During the 2018–2019 fiscal year, the total amount of gross premiums collected through PMFBY was more than that collected under RWBCIS (13,179.91 crore versus 1,720.99 crores). In a similar manner, the total amount of claims paid out by PMFBY in the same season

was more (Rs. 4179.3 crores) than the amount paid out by RWBCIS (Rs. 935.22 crores). Similar pattern was observed for rabi season too. Thus, as the data suggests, the gross premium collection amount and claims paid were higher under PMFBY than RWBCIS from 2015–2016 to 2020–2021.

The gross premium collected and claim payments made by the PMFBY for the kharif and rabi seasons over the years 2016 to 2021 can be observed from the above Fig. 2. The total amount of claims paid during the kharif season in 2016–2017 was lower than the total amount of claims paid during the rabi season in 2017–2018; Over the years, the figures show that more claims were paid during the kharif season compared to the rabi season in 2017–2018; as a result, the gross premium collection amount was more significant than the total amount of claims paid under PMFBY during Kharif season than rabi.
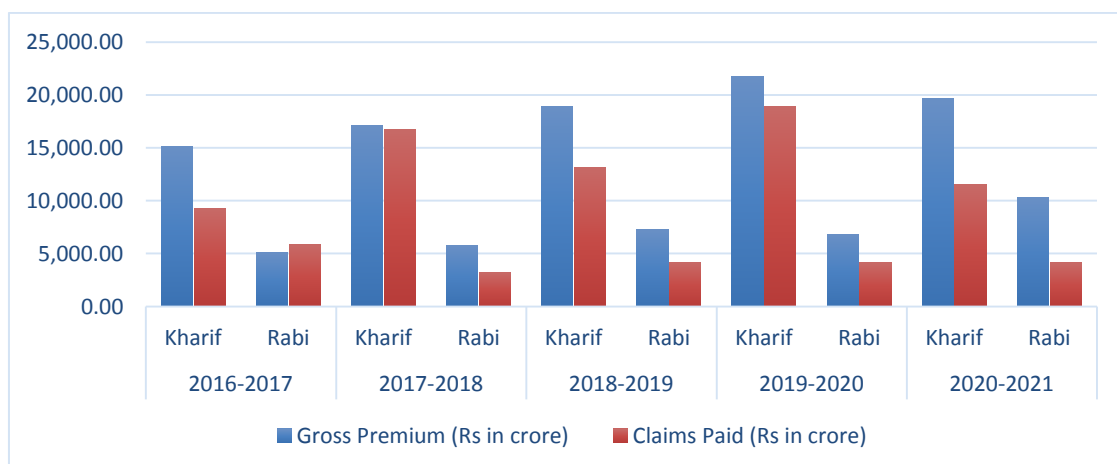
Fig. 2. Season-wise gross premium and claims paid under PMFBY scheme

Table 2. Descriptive statistics of performance of PMFBY

Variable	Mean	Standard Deviation	CAGR	CV	Minimum	Maximum
Farmers insured (In lakh)	578.75	35.48	2.52	6.13	527.12	612.90
Gross Premium (Rs. in crore)	27900.81	4242.72	9.96	15.21	21869.33	32012.00
Farmers Benefitted (In lakhs)	154.68	58.87	-13.89	38.06	61.80	223.20
Area insured (In lakh hectares)	507.01	50.97	-5.83	10.05	433.90	577.23

Table 3. Factors determining the number of farmers covered under PMFBY scheme in India

Particulars	Coefficients	Standard Error
Intercept	716.72	80.61
Gross Premium (in crores)	0.0209**	0.023
Claims paid (in lakhs)	0.786**	0.054
Area Insured (in lakh ha)	1.644*	0.12
Adjusted R Square	0.78	

Beneficiary ratio and claim ratio: The ratios of those who benefit from the various crop insurance plans in India over the course of the scheme's existence, from 2000–2001 to 2020–21 were evaluated. It was found that the ratio was higher under RWBCIS than PMFBY. This was the case even though the beneficiary ratios of all programs were lower than one. From 2016 to 2019, the ratios for RWBCIS ranged between 0.65 and 0.81, whereas the ratios for PMFBY during the same time period ranged between 0.23 and 0.3. "On the other hand, the claim/premium ratios were greater than unity under NAIS (i.e., 5.37, 2.56, and 4.43 during 2000–2001, 2005–2006, and 2009–2010), which indicates that the total amount of claims paid by the insurance companies was greater than the premium collection amount. This can also be seen from the claim/premium ratios which were greater than unity" [18].

Under the WBCIS, the claim premium ratios were more than zero but less than one (ranging between 0.59 and 0.75 during 2007-2016). In the case of RWBCIS and PMFBY, it was discovered that the claim premium ratios were lower than one. Under PMFBY, the ratio was 0.66 in 2018–2019, which was lower than the ratio for RWBCIS (0.91 in 2018–2019). This indicates that the total amount of claims paid by insurance companies was lower than the premium collection amount; as a result, insurance companies received more profits under PMFBY during the period of 2016–2017 to 2020-21 [19].

Table 2. shows the results of the descriptive statistical analysis of PMFBY scheme cumulative for the years 2016-22. Descriptive statistics represents the calculated means and standard deviations for the independent variables namely, number of farmers insured, gross premium, farmers benefitted and area insured. From the table, it can be seen that both the farmers benefitted through claims and the area insured under PMFBY has decreased over the years with a negative CAGR of -13.89 and -5.83 percent, respectively. It can also be seen that claims settled over the years have a higher coefficient of variation of 38.06 percent. Number of farmers insured under PMFBY and Gross premium received for the scheme has increased at a rate of 2.52 percent and 9.96 percent respectively, over the years.

Determinants of farmers covered under PMFBY scheme in India:

Factors that determine the number of farmers covered under PMFBY scheme and the extent of their effect were estimated using a multiple regression model. The results of the model are presented in Table 3. The results indicate that increase in gross premium paid, claims received and area insured significantly increase the number of farmers insured under PMFBY scheme.

4. CONCLUSION

The Government of India has launched various crop insurance schemes intermittently to sustain

the farmers' income levels. As compared to previous schemes, PMFBY has come up with modified features, i.e., one premium, one season; coverage of all kharif and rabi seasons and all annual commercial and horticulture crops; risks covered from the pre-sowing period to the post-harvesting period; use of modern technology for assessment of crop losses, such as drones and GPS; claims paid directly into farmers accounts; three levels of indemnity offered, namely 70 per cent, 80 per cent, and 90 per cent. To make it more successful and farmer-friendly, some new features have been added, such as voluntary participation for all farmers, business allocation to insurance companies for three years rather than one, linking with the Aadhaar card, mandatory requirements for states to pay subsidies on time, and flexibility for states to decide on additional risk coverage; however, we found that PMFBY showed limited success during 2016–17 to 2017–18. However, by including institutions at the village and district levels as well as farmers at various phases of PMFBY implementation, concerns about the state's capacity to conduct trustworthy CCEs must be addressed as there aren't enough qualified experts to manage CCEs which has caused delays in the evaluation and settlement of claims, further undermining confidence in the programme.

The agriculture insurance coverage under PMFBY is still low in terms of farmers insured, area insured, claims paid and farmers benefitted. The beneficiary and claim premium ratios were found to be much lower under the PMFBY as compared to the ratios under the National Agriculture Insurance Scheme (NAIS), Weather-Based Crop Insurance Scheme (WBCIS), Modified National Agriculture Insurance Scheme (MNAIS), and Restructured Weather-Based Crop Insurance Scheme (RWBCIS). The number of insured farmers and the total area insured has declined over the years. This indicated that the PMFBY has failed to achieve its main targets, i.e., increasing the area and the number of farmers insured. Farmers must be made aware of mandatory awareness efforts on the advantages of crop insurance through radio, word-of-mouth, campaigns, and farmer gatherings. Timely implementation can be facilitated by a complex web of connections between state-level committees and district-level committees. A regulatory framework that harmonises the yield and price risk insurance system will guarantee greater participation and stability. Implementing revenue-protection

insurance will enable farmers to safeguard their income in the event of harvest loss, which will promote farmer engagement. To increase resilience against agricultural shocks, the legal environment for insurance companies—both private and rural—must be enhanced.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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