



QUANTITATIVE ANALYSIS OF CROP INSURANCE EFFECTIVENESS: A CASE STUDY ON PMFBY OF ODISHA FROM 2020-21 TO 2024-25

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Abstract

India's agriculture faces a number of uncontrolled challenges, including crop failure, monsoon, floods, and drought. It is necessary to protect farmers against natural disasters and ensure that appropriate credit procedures are followed in subsequent growing seasons. Objective: the study examines the correlational relationship between the farmers insured and benefited in Odisha.

***Methodology:** the study used statistical tools like F, t and Pearson Correlation test for verifying the data from 2020-21 to 2024-25 of Odisha as well as India.*

***Findings and conclusion:** The study discovered that, at the 0.01 percent and 0.05 percent significance levels, there is a positive correlation between the insured and benefitted farmers in Odisha, with an increase in the benefits obtained by farmers (R square 0.98, F value 121.56, t value 10.09). In order to satisfy the need to combat both natural and man-made disasters in Odisha, the report also suggests expanding the PMFBY program to the last mile, encompassing the non-viable and reorganized group.*

***Keywords:** Agriculture production, PMFBY, Agricultural Insurance, Odisha, Correlation Relationship.*

Introduction

In India, the vast majority of people rely on agriculture as their main source of income and their primary means of subsistence. More than 18% of the GDP comes from agriculture, which also employs more than 60% of the workforce. However, outdated equipment and a variety of natural disasters continue to plague Indian agriculture. To help farmers deal with their unpredictable circumstances, the government has put in place a number of crop insurance programs that make it simple for farmers to file claims and pay for their losses. When things are unclear, agricultural insurance is crucial. India's agriculture is negatively impacted by a number of uncontrolled circumstances, including crop failure, monsoon, floods, and drought, it is necessary to protect farmers against natural disasters and ensure that appropriate credit procedures are followed in subsequent growing seasons. Throughout the nation, the government has implemented several agricultural programs to protect farmers from unforeseen circumstances. Through a variety of insurance plans and policies, the risks associated with natural disasters and monsoon failures are appropriately managed. The government has established a number of programs, including the Modified National Agriculture Insurance Scheme (MNAIS), Restructured Weather Based Crop Insurance Scheme (RWBCIS), National Agriculture Insurance Scheme (NAIS), and Pradhan Mantri Fasal Bima Yojana (PMFBY). Therefore, PMFBY is now Odisha's main insurance program out of the four mentioned above. In several underdeveloped Indian states as well as across the country, the government has taken steps to ensure the program's success.

The Pradhan Mantri Fasal Bima Yojana (PMFBY), which is optional for farmers and covers important commodities including oilseeds and paddy, is the main force behind agricultural insurance in Odisha. In an effort to boost coverage, the state administration often extends enrolment dates, such as those for



Rabi and Kharif. Delays in claim settlements and the need for increased awareness, especially in drought-prone areas, are obstacles to providing a crucial safety net against climate-related losses.

Significance of the Study

1. In order to protect farmers from risk factors such as flood, drought, fire, monsoon failure, crop failures, etc., agriculture insurance is always necessary.
2. The study focuses on the usefulness of government programs like the Pradhan Mantri Fasal Bima Yojana (PMFBY) for farmers.
3. The purpose of the study is to examine the number of farmers who were benefitted and those who were insured. This research highlights the necessity of verifying the linear relationship between the insured and the beneficiaries of the PMFBY plan.

Objectives of the Study

1. To investigate the linear relationship between the insured and benefiting farmers for the 2020–21 to 2024–25 timeframe.
2. To determine how the factors under PMFBY in Odisha relate to one another between 2020–21 and 2024–25.

Hypothesis

H₀: There is no discernible difference between the population correlation coefficient and ($\rho = 0$). Farmers who are benefitted and those who are insured do not significantly correlate.

H_a: There is discernible difference between the population correlation coefficient and ($\rho \neq 0$). Farmers who are benefitted and those who are insured do significantly correlate.

H₀: $\beta_1 = 0$, PMFBY insurance not benefitted in Odisha.

H_a: $\beta_1 \neq 0$, PMFBY insurance is benefitted in Odisha.

Review of Literature

Government of India (2025), Stabilising farm income against uncontrolled climatic conditions is the main goal of agricultural insurance programs like the Pradhan Mantri Fasal Bima Yojana (PMFBY). According to research, PMFBY serves as an essential safety net, especially for small and marginal farmers who are most at risk from crop failure and monsoon changes.

Correlation analysis is frequently used in empirical assessments of PMFBY to gauge the scheme's efficacy. There has been a notable increase in participation nationwide, with farmer enrolment increasing by 32% between 2022–23 and 2024–25 PIB (2025). Recent research has shown a significant positive association between the number of farmers insured and the total benefits paid out in regional contexts such as Odisha, supporting the notion that greater coverage results in a more resilient agricultural loan system.

Jyotishree & Anshuman (2024), The research points to a "trust deficit" and operational bottlenecks that impede overall effectiveness notwithstanding statistical accomplishments. Research conducted in the Khurda area of Odisha shows that although knowledge is generally high, farmers frequently encounter difficulties including complicated paperwork and postponed claim payouts.

Methodology

The Department of Agriculture Cooperation and Farmers Welfare, Government of India, verified the report made by insurance companies, LAMPs, and cooperatives, which provided the data used in this study for the years 2020–21 to 2024–2025. Additionally, Indiastat.com is used to aggregate the data.



The state of Odisha in particular is the focus of the testing and analysis. There are two primary hypotheses in this research work. One hypothesis tests the linearity between the variables and another hypothesis test the slope of the beta variable when $\beta_1 = 0$ and $\beta_1 \neq 0$. The regression model fitted for testing farmers benefited: $y = \beta_0 + \beta_1 x + u$, here we focus on β_1 , i.e., Farmers Benefited. β_0 , represents the intercept value. i.e., farmers insured. The hypothetical condition is tested using Excel data analysis tool by using ELSTAT and SPSS.

Result of the study

Table 1: Central Tendency Measure (Mean) of PMFBY(Throughout India for the period 2020-21 to 2024-25).

	2021 – 2022	2022 – 2023	2023 – 2024	2024 - 2025
Farmers insured	18.76	19.56	19.28	18.45
Area insured	20.90	18.40	18.42	14.13
Sum insured	158.91	249.37	201.90	102.03
Farmers share in premium	139.69	159.66	188.21	126.72
Gross premium	811.03	188.95	218.28	203.94
Reported claims	819.01	238.25	177.37	236.03
Paid claims	618.73	237.25	147.22	269.95
Farmers benefited	4.18	5.68	7.06	8.13

Sources: Authors own calculation using GM based on data from 2020-21 to 2024-25.

The Pradhan Mantri Fasal Bima Yojana Scheme's central tendency measure (Geometric Mean) from 2020–21 to 2024–25. According to the mean value, farmers' insurance premiums were at their greatest in 2022–2023 (19.56 lakhs), while their premium share was at its maximum in 2023–2024 (194.12). The average number of farmers who benefitted during 2024–2025 was 8.13 lakh in India. Between 2020 and 2021, the average value of reported and paid claims peaked (Table 1). This indicates that the situation where farmers profit has improved since the epidemic.

Table 2: Correlation Analysis For Farmers Insured And Farmers Benefited

H0: There is no discernible difference between the population correlation coefficient ($r = 0$). Farmers who are insured and those who benefit do not significantly correlate.

H_a: There is a substantial difference between zero and the population correlation coefficient ($r \neq 0$). Farmers who are insured and those who benefit have a strong linear connection.

Years	Particulars	Testing	FI	FB
2021 – 2022	FI	Pearson Correlation	1	0.787***
		Sig. (2-tailed)		0.000
		N	26	26
	FB	Pearson Correlation	0.787***	1
		Sig. (2-tailed)	0.000	
		N	26	26
2022 – 2023	FI	Pearson Correlation	1	0.879***
		Sig. (2-tailed)		0.000
		N	25	24
	FB	Pearson Correlation	0.879***	1



		Sig. (2-tailed)	0.000	
		N	24	24
2023 – 2024	FI	Pearson Correlation	1	0.889***
		Sig. (2-tailed)		0.000
		N	27	25
	FB	Pearson Correlation	0.889***	1
		Sig. (2-tailed)	0.000	
		N	26	25
2024 – 2025	FI	Pearson Correlation	1	0.910***
		Sig. (2-tailed)		0.000
		N	24	21
	FB	Pearson Correlation	0.910***	1
		Sig. (2-tailed)	0.000	
		N	21	21

Sources: Authors own calculation based on data from 2020-21 to 2024-25.

Note: *** At the 0.01 level (2-tailed). FI – Farmers Insured & FB – Farmers Benefitted

The aforementioned table shows that, throughout the whole period spanning from 2020–21 to 2024–25 across India, there is a strong positive connection between the two variables, Farmers Insured and Farmers Benefitted. For each of the four periods, the positive correlation value is $r = 0.787, 0.879, 0.889,$ and $0.910,$ respectively. Thus, it is evident that there is a substantial linear relationship between the two variables and thus the alternative hypothesis is accepted. As a result, PMFBY is very helpful to farmers and can offer safety precautions during uncertain times (Table.2).

Table 3: Simple Regression Model of Farmers Insured and Benefitted under PMFBY for the period 2020-2021 to 2024-2025.

$H_0: \beta_1 = 0,$ PMFBY insurance not benefited in Odisha. $H_a: \beta_1 \neq 0,$ PMFBY insurance is benefited in Odisha.

Regression Statistics	
R Square	0.98
Adjusted R Square	0.96
Standard Error	1.29
Observation	4

Sources: Authors own calculation based on data from 2020-21 to 2024-25.

The Statistics in Table 3 gives the overall goodness-of-fit measures: $R^2 = 0.98.$ Correlation between y and x is $0.98 (R^2).$

Table 4: Analysis of Variance between Farmers Insured and Farmers Benefitted under PMFBY in Odisha for the period 2020-2021 to 2024-2025.

	Df	SS	MS	F value	P value
Regression	1	209.98	208.87	121.56	0.00 ***
Residual	2	2.97	1.67		
Total	3	212.95			

Source: Authors own calculation based on data from 2020-21 to 2024-25



Note: R Square = 1 - Residual SS/ Total SS = 1 - 2.97 / 212.95 = 0.98 , *** 0.01 percent significance level.

Table 5: Interpret Regression Coefficients Table on Farmers Insured and Farmers Benefited under PMFBY in Odisha for the period 2020-2021 to 2024-2025.

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	2.06	1.26	1.49	0.24	-3.39	7.01
FB	1.08	0.10	10.09	0.00	0.69	1.21

Sources: Authors own calculation based on data from 2020-21 to 2024-25.

Note: The regression model for farmers benefited, $y = \beta_0 + \beta_1 x + u$, here we focus on β_1 , i.e., Farmers Benefited. β_0 , represents the intercept value. i.e., farmers insured. And the "Coefficient" gives the least squares estimates of β_0 and β_1 (Farmers Insured and Benefited in Odisha from 2020-21 to 2024-25).

Analysis of the Result

1. The fitted line is $y = 2.06 + 1.08 * x$ (Table 5).
2. The slope coefficient has estimated standard error of 0.10 (Table 5).
3. The slope coefficient has t-statistic of 10.09 (Table 5).
4. The slope coefficient has p-value of 0.00 (Table 5).
5. The 95% confidence interval for β_1 is (0.69, 1.21). (Table 5).
6. There are 4 observations and 2 regressors (intercept and x) so in inference we use $T(4-2) = T(2)$. (Table 5).
7. Statistically significant relationship, $F=121.56$, $p=0.00$ (Table 4).
8. A measure of the fit of the model is $R^2 = 0.98$ (Table 3).
9. The standard error of the regression is 1.29 (Table 3).

Findings

1. According to the report, PMFBY is an effective program in several Indian states.
2. More farmers have profited from it than from the earlier programs.
3. The two variables, farmers insured and farmers benefitted under PMFBY, along with a fair farmers share in premium and gross premium, were determined to be positively correlated by the study.
4. Using a positive regression model, the plan worked in Odisha.

Recommendation: According to the study, certain plans are not feasible and have to be redesigned to accommodate farmers' needs during both natural and man-made disasters in Odisha.

Conclusion: The Pradhan Mantri Fasal Bima Yojana (PMFBY), one of the government's flagship programs, is featured in the report. It is administered across India, with the exception of a few extremely rural regions. With the right area covered and premium distribution to farmers, the new program was significantly more advantageous than its predecessors. A structured compensation during natural disasters is guaranteed by the weather-based crop insurance scheme. Although certain areas are now restricted and unviable, there is a positive association between the insured and benefitted farmers. In order to improve inclusivity in agricultural output and farmers' standards of life, it should be necessary to extend the program to the final mile.



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