Research on World Agricultural Economy
https://journals.nasspublishing.com/index.php/rwae

ARTICLE

Increasing Role of Women in Agriculture: Unveiling Perceived Impact of the Pradhan Mantri Fasal Bima Yojana (PMFBY) Scheme Using Multivariate Regression Approach

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ABSTRACT

Crop Insurance (CI) is one of the most effective tool for managing risks associated with agriculture. In India, agriculture contributes significantly to its economy and according to the government report sector is transiting through a revolution of feminization. Additionally, literature on the agriculture sector reveals that female participation boosts agricultural productivity and food security. The paper examines the perceived impact of CI scheme PMFBY on female farmers across four major states of India, including Kerala, Madhya Pradesh, Rajasthan and Uttar Pradesh. Using a sample size of 455 female farmers and MLR models, along with Pearson correlation and descriptive statistics, we evaluated the perceived impact of the scheme. We introduced ten independent predictors - satisfac-

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ARTICLE INFO
Received: 28 August 2024 | Revised: 28 October 2024 | Accepted: 29 October 2024 | Published Online: 12 December 2024
DOI: https://doi.org/10.36956/rwae.v5i4.1278

CITATION
Vaishnav, H., Divi, S., Minampati, V.R.R., et al., 2024. Increasing Role of Women in Agriculture: Unveiling Perceived Impact of the Pradhan Mantri Fasal Bima Yojana (PMFBY) Scheme Using Multivariate Regression Approach. Research on World Agricultural Economy. 5(4): 620–636. DOI: https://doi.org/10.36956/rwae.v5i4.1278

tion, transparency, increase in agriculture income, knowledge of PMFBY, awareness campaign, overall satisfaction, risk coverage satisfaction, compensation satisfaction, benefits and transparency satisfaction. Our empirical findings indicate that there are positive and negative predictors that impact the perception of the scheme among the female farmers. But, major findings reveal that overall satisfaction, risk coverage and compensation related to the scheme were concerns. The predictors such as satisfaction, transparency, increase in agriculture income, awareness campaign, and potential benefits positively influenced the perception of female farmers. Hence, the paper highlights various policy problems and identifies elements that could be taken into account to enhance the scheme's effectiveness specially among the female farmers.

Keywords: PMFBY; Female Farmers; Crop Insurance; Transparency; Satisfaction; Awareness; Impact; Gender; Multi Linear Regression (MLR); Agriculture and Allied Sector

1. Introduction

India's agriculture sector is crucial for sustainability and economic growth as it has the second-largest arable land resources globally. This sector also provides employability to 54.6 percentage (%) of the population. Further, agriculture and allied sectors contributed 18.6% to India's Gross Value Added (GVA) in 2021–22. According to the Ministry of Agriculture and Farmer Welfare (MoAFW), the total area under cultivation in India is 42.35% of the total geographical area [1]. In this scenario were country's dependence on agriculture sector is high, climate change plays a crucial role. Including India, this factor directly and indirectly impacts the agriculture and allied sectors (A and AS) globally. This risk is transmitted along the supply or value chains, affecting the efficiency and sustainability of the entire chain and the livelihoods of chain actors [2]. Due to the climatic abnormalities in India, farmers have faced low production and income losses. As observed in **Table 1** from the agriculture statistics released by MoAFW in April 2023, highlighed that the agriculture production of the country has a compound annual growth rate (CAGR) growth of 1.9% from 2010–11 to 2021–22, and the production of food grains has seen a 1.04% year-on year growth from 2020–21 to 2021–22.

Further, it is estimated that the agriculture production in India will experience a 25% decrease by 2050, and between 10% to 40% by 2100 [3, 4]. The other contributing factors include inadequate irrigation management, poor socioeconomic conditions of farmers, inadequate infrastructure and investment, low land holding among the farmers, low level of modern agriculture practices and technology adoption.

Additionally, there is significant revolution observed in A&AS, where participation of females is leading to increasing 'Femininization' in the sector. The study uses the definition of female as women working above age of 15 which is in accordance to the Periodic Labor Force Survey (PLFS) 2023 This phenomena is also because of the increase in rural to urban migration of the counterparts. The same has been observed from the agriculture census 2015–16 data which shows a rise in female operational holdings from 13% in 2010–11 to 14% in 2015–16, mostly widows. Out of total rural female population, 73.2% work in agriculture as cultivators or farm labourers, with women comprising over 42% of the agricultural labour force [5]. Thus, due to significant role of the women in the sector, it has become necessary to keep them as the pivot for policy initiatives at the centre. This has been realised by the MoAFW which has mandated 'Gender Mainstreaming' in the states, requiring the implementing agencies to allocate at least 30% of their budget to support women farmers through various schemes such as State Extension Programmes, National Food Security Missions, Oilseed and Oil Palm Missions, Agricultural Mechanization Sub-Missions, and Horticulture Integrated Development Missions. Additionally at the global, the annual meeting of World Economic Forum (WEF) highlights the significance of female in global agriculture output and food security stating that if women in the sector get access to land, financial and technological services in rural areas it will reciprocate in increase of around 20–30% in agriculture output and food security

Table 1. Growth of Agriculture Production in India from 2010–2011 to 2021–2022.

Year	Production in Million Tonnes	% of Year-on-Year Growth (YoY) Production in Million Tonnes	CAGR in % (2010–11 to 2021–22)
2010–11	244.5		1.90%
2011–12	259.29	7.67	
2012–13	257.13	2.45	
2013–14	265.04	−0.42	
2014–15	252.02	−4.34	
2015–16	251.54	0.64	
2016–17	275.11	4.31	
2017–18	285.01	4.98	
2018–19	285.21	2.28	
2019–20	297.5	2.49	
2020–21	310.74	2.18	
2021–22	315.72	1.04	

Source: E&S Division, DA&FW • Fourth Advance Estimates.

Though literature reveals that there is a major gender mainstreaming observed in India and the increase in participation of females in A and AS can boost agriculture production and aid in achieving food security. But, there are multidimensional factors, both structural and socio-economic, presenting as challenges faced by the female workforce in India's agricultural sector. The major challenges faced by women in the agricultural sector include limited access to land ownership, barriers to easily access financial resources, lack of access to modern agricultural tools, and low physical strength. Further, the dual responsibility of managing both family and farm limits the women participation in all farm activities [6–9].

These major challenges is justified by the document released by the Government of India (GoI) titled "Women Farmers in the Country" which highlights that country's major crop insurance (CI) scheme (PMFB) on an average has only 15.6% of female enrolled in 2020–21 and for the major income support scheme (PM-KISHAN) in 2020–21 registered 25.1 % of female beneficiaries compared to 74.9% male beneficiaries [10]. Moreover this report further highlighted the regional disparities which underlines state-level barriers. Moreover, though women contribution is more but are considered primary for labour-intensive jobs, while men retain decision-making roles. This leads to undervaluation of women's contributions in sector. Also, in some cases were women leading the farming activities but due to patriarchal and gender stereotyping and social norms faces limited access to credit facilities and market services [11, 12]. Further, the climate change phenomena disproportionately augments these challenges and increases women vulnerability [8, 9].

2. Literature Review

There has been a significant increase in available literature on the CI in India. These literature highlights the considerable evolution that the CI scheme in India has experienced and challenges faced by the farmers while availing and operation of CI. Thus, to provide a necessary overview on CI in India, we started focusing on the literature on the necessity of CI and related schemes in India. Further, we moved the focus towards CI scheme (Pradhan Mantri Fasal Bima Yojana) and its impact on gender (female farmers) which is the central theme of the paper. Additionally, the review process included the literature on motivational components, challenges, gender and CI scheme, impact assessment of PMFBY scheme, variables used, analysis and the related findings.

2.1. Motivational Components of CI in India

The initial literature provided the basic evolution of the CI in India, highlighting the need for CI in India [13–15]. The author also provided a well-documented evolution of CI schemes from pre independent era to PMFBY and their challenges. Further, the authors discovered that

the factors for necessity for CI include climatic variability [16], disease and pest outbreaks [17], price fluctuation [18], fragment landholdings [19], rise in input cost [13]; and the significance of CI include risk mitigation [20], income stability [21], credit facilitation [13] and many more.

2.2. Challenges of CI in India

As CI is an efficient tool for mitigating the risk associated with agriculture [20], still there are numerous adversities associated with CI schemes in India. One of the major challenges is the awareness and adequate knowledge, are crucial factors which limits the participation in government programme. This creates a directly proportional impact on the programme [14, 21]. Another factor is the cost of premium and inadequacy in the compensation that results in the dissatisfaction among the farmers [13, 18–20]. Also, infrastructure (weather, data, systems) and technological challenges hamper the adoption of the schemes and its perceived impact among the farmers [16, 17]. Further, the policy frameworks are inconsistent and unclear which hinders the effective functioning of the CI programme [18], and inefficient multi-stakeholder collaboration which leads to confusion and inefficiencies in the implementation of the programme which impacts the perception among the primary stakeholders [13, 21]. Here, there are several considerable factors which may not be covered, as the most critical one are included. The next section specifically discusses CI and gender perspective in India.

2.3. Gender and CI in India

Women contribution is substantial in agriculture sector which is often undervalued and unrecognized in India [22, 23]. Despite of their contribution as workforce in sector, women face limited access to resources and services such as credit and insurance [23, 24]. Due to gender disparities in India, female farmers often do not own land and has limited awareness related to CI schemes [22, 24]. The cultural and social limitations restrict the women in decision-making and mobility which effects their ability to engage with financial institutions and access to financial services like insurance [23]. Additionally, the operational and regulatory guidelines of the schemes require land ownership proof for participation in the particular scheme, excluding women who work on family farm but do not hold land title deeds [22]. The influencing power of women in policies and programs is minimal due to their under-representation in farmer's organization [22]. Hence, in spite of being a significant workforce in agriculture sector, the role of women is limited to labourers and not farmers [25]. The role of women is critical in the supply chain of food security and for the success of CI schemes in India. So, inclusive policy framework design will support more accessibility, greater financial stability and empowering in rural [17, 22–25] .

2.4. Perceived Impact of CI in India

2.4.1. Determinants for Assessing of Perceived Impact

Among the various measures, such as satisfaction, awareness, transparency and many more, are considered as subsets for evaluating the overall impact by the research fraternity. This section addresses influencing factors which help in enhancing the effectiveness and perception of CI among Indian farmers, especially female farmers. According to Duhan, 2017 awareness is fundamental in decision making and decreasing the overall impact of income loss for farmers due of CI, and awareness influencing satisfaction [22, 26]. Further, inefficiency in transparency for index-based insurance products and claim assessment process leads to dissatisfaction and reducing the impact of CI scheme [13–19]. The risk coverage and aligning the insurance index of actual losses with reasonably adequate payouts reduces risk and increases the satisfaction among the farmers [19–27].

The social impact of CI based on factors such as household loan outstanding, farm input cost reveals that these factors had a negative impact on the farmers [28]. The effect of CI on the farm yield is heterogeneous among different type of farmers [29]. Comprehensive CI Scheme (CCIS) scheme was examined based on its impact on the credit flow to the small which showed a significant increase in credit flow per hectare and per farmer. Thus, evaluating various dimensions and prospects on which the CI landscape in India is evaluated to highlight the level of perceived impact these schemes.

2.4.2. Measurement and Methods for Assessing the Perceived Impact

Mostly quantitative methods of econometrics models and descriptive statistics have been used to examine the perceived impact of CI in India. The mixed methods approach, deploying case studies (a qualitative method) alongside econometric models such as difference-in-difference (DiD) and propensity score matching (PSM) to check on the applied aspect and impact of weather index insurance as a tool to manage the risk of drought [30]. The use of thematic analysis (qualitative method) via focus group discussion and applied descriptive statistics to summarize the common issues of CI among the farmers [31]. The factor analysis for correlational relationship between the observed variables namely crop loans, insurance and agriculture growth [32]. The investigation of the farmers' perceptions for CI scheme in Gujarat by applying Pearson Correlation and multivariate regression analysis which were determined through demographic and economic variables [33]. Similarly, other studies also implied Pearson and multivariate regression analysis to evaluate various factors influencing the farmers perception on insurance insurance [34–38]. Majority of these studies focused on either satisfaction, economic and social factors to pinpoint the level of perceptions or satisfaction among the farmers for CI schemes or weather-based insurance of varied geographies.

The use of multi linear regression (MLR) analysis in which the model suggest that financial adjustments could enhance the reach and effective of PMFBY scheme [39]. Further, the study uses variable such as subsidies, claim paid, and farmers premium in MLR shows that famers premium has significant impact than the other two variables (subsidies and claim paid) [15]. The impact of PMFBY on the beneficiaries in Srikakulam district of Andhra Pradesh (A.P.) was examined using MLR on thirteen (13) independent variables which highlights that key variables, such as mass media utilization, disaster occurrence, and training, were positively significant, underlining the need for awareness and training to strengthen scheme benefits for farmers [40]. Thus, these studies indicates that MLR has been frequently used to evaluate the impact the CI schemes in India through variables such as awareness and financial factors.

2.5. Pradhan Mantri Fasal Bima Yojana (PMFBY)

PMFBY is a collaborative program initiated in 2016 which is currently in the eight year of execution. It involves insurance companies, the Department of Agriculture, Cooperation and Farmers Welfare, MoAFW, GoI, and the relevant state government. It is designed to provide CI to farmers and is coordinated with multiple other agencies. The basic aim of the program is to provide financial aid to farmers that suffer from crop loss or damage due to natural calamities such as hailstorms, droughts, floods, cyclones, excessive and untimely rains, disease outbreaks, and pest infestations. The PMFBY is the third largest CI plan globally in terms of its premium size. The program includes field crops such as cereals, pulses, oilseeds, and certain annual commercial commodities. Nevertheless, the Restructured Weather Based CI Scheme (RWBCIS) specifically covers horticultural crops, especially fruit and vegetable crops.

Currently, PMFBY 2.0 (2021–2025) is under execution and its basic objective is to offer insurance protection to farmers by detecting inconsistencies in the area of land cultivated at the individual farm level. The other objective of the scheme is to provide timely calculation and payment of compensation to farmers based on the level of crop damage through digitalization and necessary changes in implementation guidelines. The updated premium subsidy framework would incorporate a cap on insurance fees for Kharif Food & Oilseeds crops, Kharif and Rabi Annual Commercial/Annual Horticultural crops, and 5% of the Sum Insured (SI) or Actuarial rate. The policy provides coverage for the farmer's personal assets, including their residences and belongings, as well as other assets that contribute to their means of earning a living. Additionally, it offers coverage for the farmer and their family members in the event of accidental death or disability. It also provides accidental insurance protection for the children of farmers' who are attending school or college, and covers the cost of education fees for pupils in the event of a parents' death. Already, the Union Cabinet has approved the reorganisation of the PMFBY and the implementation of modifications to its existing regulations.

3. Methodology

3.1. Research Design

To research on our hypothesis the study uses the mixed-method research design, specifically a sequential exploratory approach [41]. This approach is useful in policy evaluations, such as social and agricultural programs, as it allows for triangulation and validation of findings. This dual approach helps identify the effectiveness of a scheme and its reasons for non-participation or challenges faced by beneficiaries [41–44]. The study was divided in two parts the first part qualitative phase of data were collected using in-depth interviews to develop a factors, through which we developed a new survey tool (questionnaire). The study focuses on four states of India namely Kerala, Madhya Pradesh, Rajasthan and Uttar Pradesh, from the nineteen states who have implemented the PMFBY scheme. The states were selected based on the geographical location covering the major part of India. Initially, we selected six states which also included Gujarat and Maharashtra, but after confirming through government records and literature, we found that these states have recently withdrawn from the programme.

3.2. Data Collection

In the first phase of the research, we conducted in-depth interviews of around thirteen (13) experts in the field of agriculture, insurance and administration. The results of the in-depth interviews helped in framing a robust questionnaire for the data collection on field. The thirteen (13) experts were selected using coinvent sampling method. Moreover, the secondary resources of YouTube and PMFY scheme were also used to extract videos and interviews related to the progress and performance of the scheme. The secondary sources were used to strengthen the collected factors from phase one. The first phase of the research was conducted from 05 October 2023 to 23 November 2023. This was an important phase which created the right foundation for the second phase of the empirical research.

The survey tool was divided into five parts, where the first part collected the basic demographical details having eleven questions including name, age, education, category, income, etc. The second part assessed the basic knowledge related to the scheme which had total of eight binomial questions. The third part focused on understanding the various sources through which awareness is created and the knowledge of farmers related to PMFBY scheme. The third part used the three and five Likert scale for factors - awareness and knowledge, respectively. The fourth part examined the satisfaction and perception of the farmers using five Likert scale, comprising twenty one questions. Further, the next part of the questionnaire focused on the impact of the scheme on the farmers which included eight questions. The final part of the questionnaire compared the PMFBY 1.0 guidelines with PMFBY 2.0 guidelines.

The second phase of the study was conducted from 5 December 2023 to 12 January 2024. During this phase, two stage cluster sampling was initiated. In the first stage, states were identified by grouping them into clusters of zones, including east, west, north, central, and south. In the second state of cluster sampling district were identified based on earlier approach. Further selection from each cluster, resulting in the selection of five districts from each state. So, the study tried to have comprehensive coverage from the selected states. Additionally, to identify the blocks and villages in the selected district were selected based on convenient /purposive sampling method. Convenient or Purposive sampling method is to select participants based on their availability, accessibility, or specific characteristics, aiming to gather rich, relevant data from individuals who meet predefined criteria [45, 46]. During the course of the study, total of 455 females were surveyed from the selected states.

The survey tool was transformed in 'Google Forms', in two languages including Hindi and English. The field investigators team of 4 people was used in each state for data collection. Winarni et al. (2021) emphasis on the inconsistency of data using of google forms [47] but Jo and Gebru (2020) highlighted that it inconsistency can be removed by clear guidelines and robust validation [48]. A pilot was conducted in Kerala by the authors for seven days in December 2024 because of which the challenges due to the use of google forms, questions were identi-

fied. These challenges were mitigated using right interventions, such as data collection workshop for the field investigator, internet challenges, at least one author accompanying the research investigation team on the field and daily meetings following the data collection process.

3.3. Demography of Respondents

The data was collected from four states in which highest number of respondents were from Kerala with 252 respondents, followed by 124 respondents from Madhya Pradesh (MP), 43 respondents from Rajasthan and lowest 36 respondents from Uttar Pradesh (UP), over five districts of the each state, the exception was Rajasthan where only three districts were covered (**Table 2** & **Figure 1**).

The results in **Figures 2–4** suggests that the data was collected from all strata of the society which includes education, caste and ownership of land. The level of education varied across states, with Kerala having the highest percentage of respondents with higher secondary and graduation qualifications. Madhya Pradesh displayed a balanced distribution, with a notable proportion of respondents having either no education or postgraduate and above qualifications. Rajasthan had high proportion of respondents with no education, whereas Uttar Pradesh displayed similar trends to Madhya Pradesh (**Figure 2**). Further, considering the caste distribution in Rajasthan, the ST respondents were the highest, whereas in Kerala and UP the dominance of OBC respondents was prominent; and in MP, the respondents were disturbed evenly across all caste categories including general, OBC, SC and ST (**Figure 3**). Most of the respondents in the study across the states owned their land with shared crop tenants being the second highest group across the selected states (**Figure 4**).

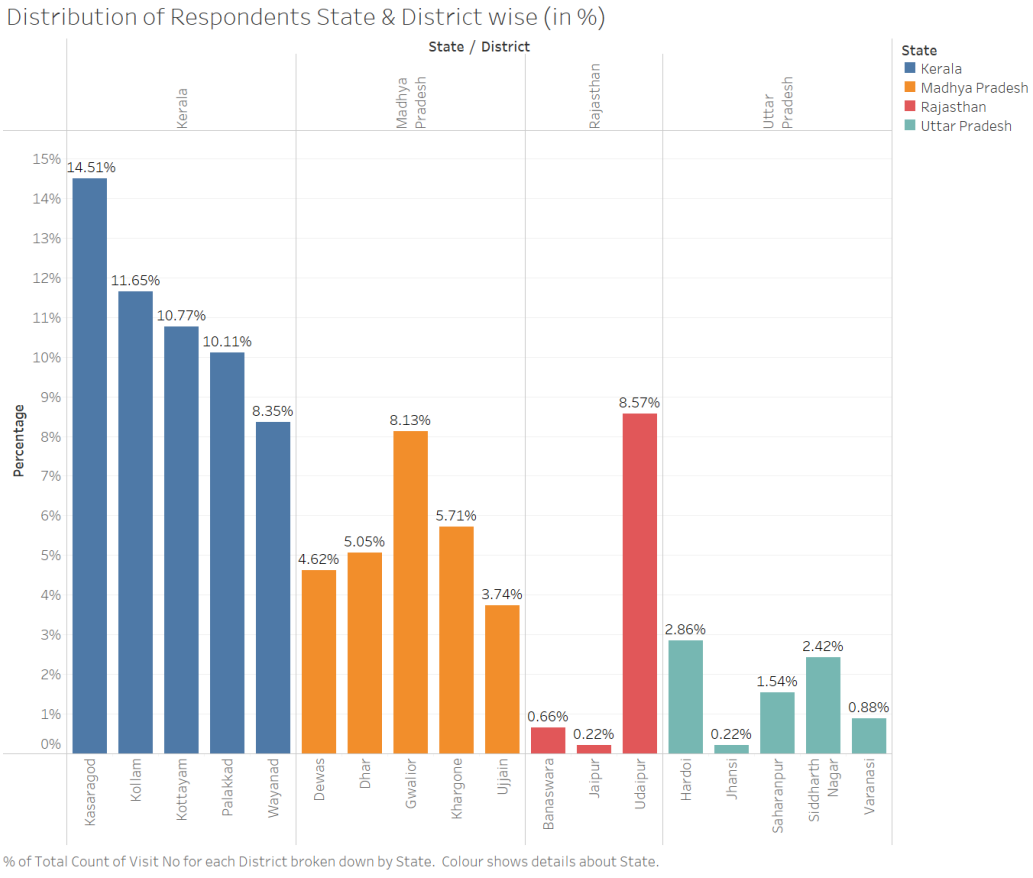

Figure 1. Distribution of Respondents from selected states and their district (in%).

Source: Compiled by Authors using Tableau.

Table 2. State and district-wise distribution of respondent.

State	District	No of Respondents	Total Each State
Kerala	Kasaragod	66	252
	Kollam	53	
	Kottayam	49	
	Palakkad	46	
	Wayanad	38	
Madhya Pradesh	Dewas	21	124
	Dhar	23	
	Gwalior	37	
	Khargone	26	
	Ujjain	17	
Rajasthan	Banaswara	3	43
	Jaipur	1	
	Udaipur	39	
Uttar Pradesh	Hardoi	13	36
	Jhansi	1	
	Saharanpur	7	
	Siddharth Nagar	11	
	Varanasi	4	
Total number of respondents			455

Source: Compiled by Authors using Tableau.

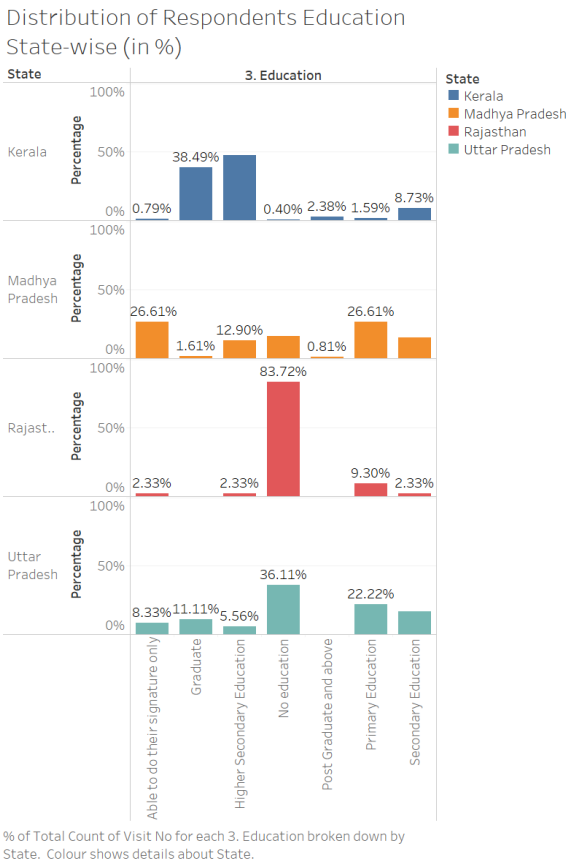

Figure 2. State-wise distribution of respondents as per their education levels.

3.4. Measures

The independent factors in our study include income level growth, PMFBY related knowledge, awareness campaigns, satisfaction, risk coverage, compensation, and transparency. To assess the perceived impact of the PMFBY scheme on farmers, the study measures these characteristics through five Likert scale and binomial questions. Every variable is defined and measured in the following manner:

Income Level Growth: **Measured by the Self-reported Increase in Farm Income after the implementation of the PMFBY plan**.

H1. *Increase in agriculture income post PMFBY scheme has positive impact on famers perception related to the scheme.*

Assessment of Knowledge Regarding the PMFBY

Conducted by asking questions about farmers' comprehension and awareness of the PMFBY scheme's specificities and advantages.

H2. *Complete knowledge related to PMFBY scheme has positive impact on famers perception related to the scheme.*

Evaluation of awareness efforts

Assessed the efficacy of awareness efforts about the PMFBY program as perceived by the farmers

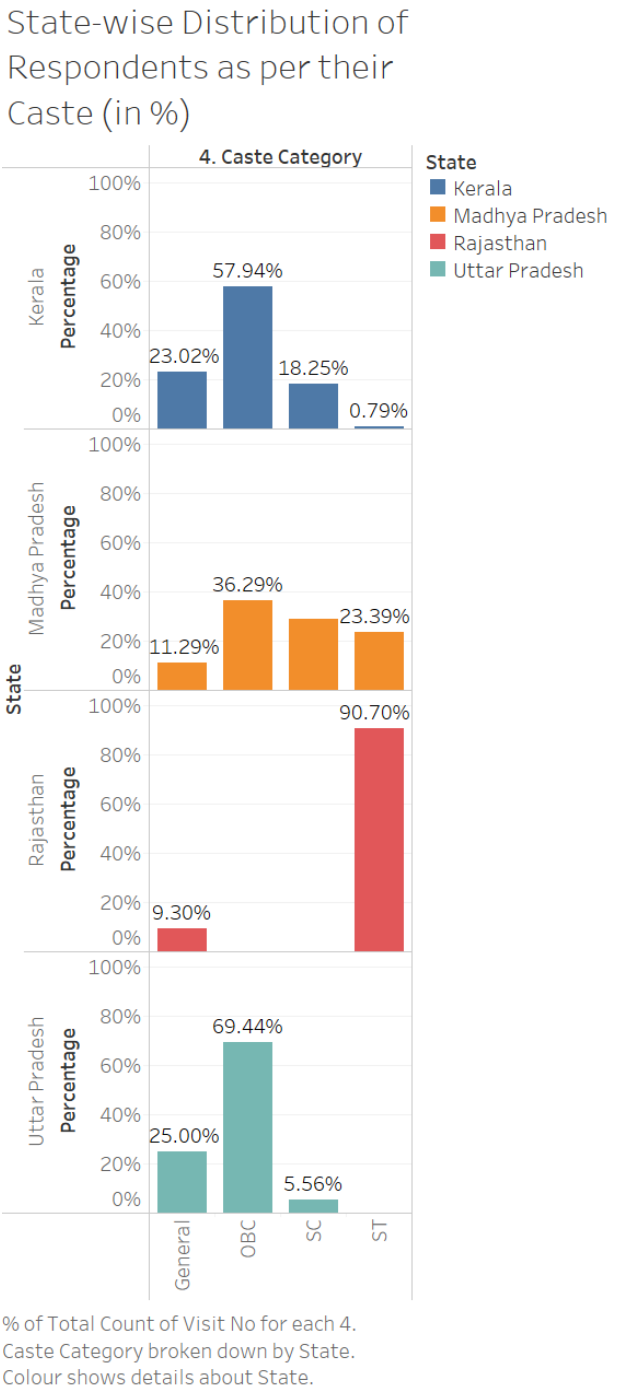

Figure 3. State-wise distribution of respondents as per their Caste.

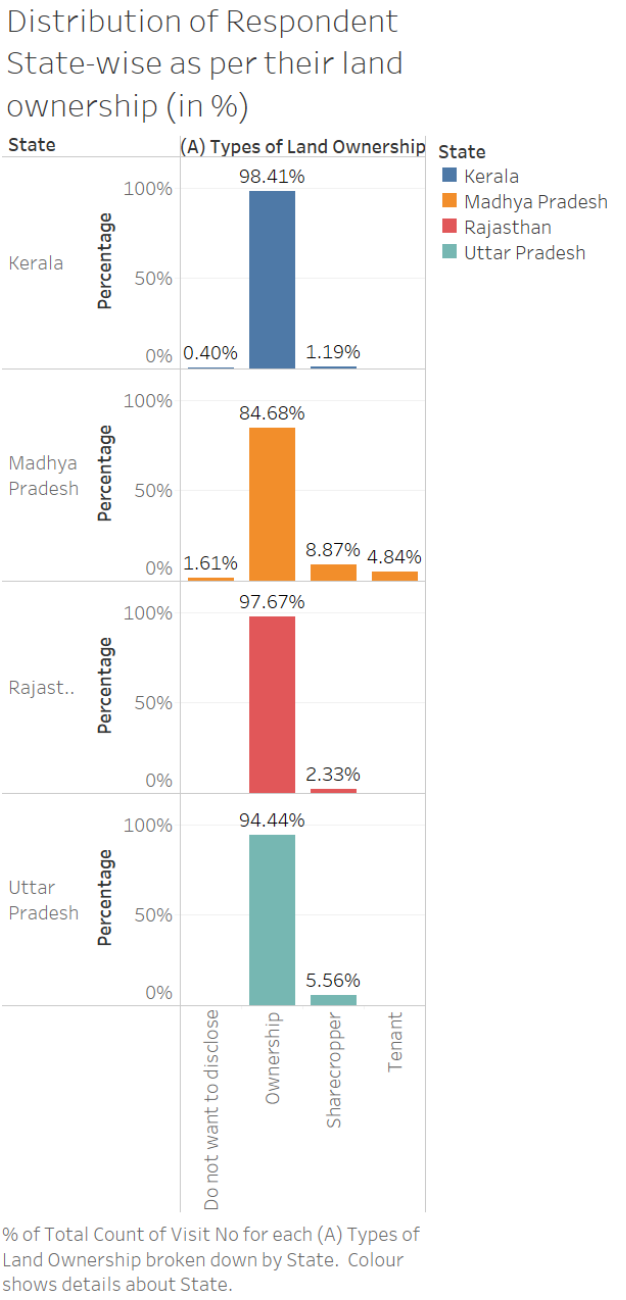

Figure 4. State-wise Distribution of Respondents as per their Land Ownership.

H3. *Awareness related to the PMFBY scheme has a positive impact on farmers perception of the scheme.*

Satisfaction:

Assessed based on general contentment with the PMFBY plan.

H4. *Overall satisfaction related to the PMFBY scheme has a positive impact on farmers perception of the scheme.*

Risk Coverage

Understood by looking at the level of satisfaction of PMFBY guidelines covering various risks.

H5. *Satisfaction related to risk coverage under the scheme has a positive impact on farmers perception of the scheme.*

Compensation

Examined through how satisfied the farmers are with the compensation they have received till now.

H6. *Compensation transferred under the PMFBY have positive impact on the farmer perception of the scheme.*

Transparency

Assessed based on perceived clarity and availability of information regarding the PMFBY plan.

H7. *Accessibility and Transparency offered by PMFBY scheme has positive impact on the farmer perception of the scheme.*

3.5. Model and Estimators

As the main aim of this study is to measure the perceived impact of PMFY scheme on the female farmers. The factors were identified based on the literature review and inputs from the qualitative phase of the study. Thus, to identify correlation between multiple factors, statistical technique of multiple linear regression model was employed which assess the relationship between one dependent variable and multiple independent variables [48–50]. This statistical technique allows to quantify the effect of each independent variable on the dependent variable while controlling the effects of other variables.

The multiple linear regression equation derived from our model is as follows:

Impact = $3.037 + 0.049 \times (X_1) + 0.582 \times (X_2) + 0.198 \times (X_3) + 0.217 \times (X_4) + 0.004 \times (X_5) + 0.256 \times (X_6) - 0.049 \times (X_7) + 0.018 \times (X_8) + 0.094 \times (X_9) + 0.127 \times (X_{10})$

where:

X_1 = Awareness

X_2 = Satisfaction

X_3 = Transparency

X_4 = Increase in Agriculture Income

X_5 = Knowledge of PMFBY

X_6 = Awareness Campaign

X_7 = Overall Satisfaction

X_8 = Risk Coverage Satisfaction

X_9 = Compensation Satisfaction

X_{10} = Benefits and Transparency Satisfaction

The above equation shows that each coefficient indicates the anticipated alteration in the perceived influence of the PMFBY scheme for a one-unit modification in the related independent variable, while keeping all other variables constant. The presence of positive coefficients for factors such as satisfaction, awareness campaign, transparency, and rise in farm revenue suggests that higher values of these variables are linked to a greater perceived impact of the PMFBY plan. On the other hand, the negative coefficient for overall satisfaction indicates that a higher level of overall satisfaction is linked to a drop in the perceived impact. However, this effect is not statistically significant. This model offers useful insights into the key aspects that significantly impact farmers' perceptions of the PMFBY scheme.

4. Results

First, the farmers (female) perception of impact was measured through using descriptive statistics of the dependent and independent variables. Descriptive statistics offer a comprehensive analysis of the distribution and average values of the main variables in the survey, providing valuable insights into farmers' perspectives on different facets and comprehensive overview of PMFBY scheme.

The descriptive analysis results from **Table 3** shows that female farmers perceive a moderately high positive impact of the scheme, as reflected by a mean score of 3.225. Awareness of the existence of the scheme is rated positively, with a mean of 3.167, while satisfaction is rated at a mean of 3.183, reflecting general contentment. Transparency is similarly viewed as positive, with a mean of 3.162.

However, the perceived financial benefits—increasing income—score low at a mean of 0.339, indicating low perceived financial benefit. The knowledge of the guidelines of the scheme also scores low, with a

mean of 0.025, which indicates that there is a need for the improvement of dissemination. Overall, satisfaction, risk coverage, and transparency yield slightly negative mean scores: 0.061, 0.016, and 0.109, respectively. This means generally, awareness and risk coverage, and satisfaction are areas that need policymakers' attention.

Table 3. Descriptive statistics analysis.

Variable	Mean	Std. Deviation	Min	25%	50%	75%	Max
Impact	3.225	0.772	1.026	2.733	3.233	3.745	5.499
Awareness	3.167	0.737	0.847	2.676	3.186	3.676	5.521
Satisfaction	3.183	0.787	0.856	2.674	3.187	3.707	5.696
Transparency	3.162	0.789	0.892	2.682	3.189	3.652	5.558
Increase in agricultural income	0.339	0.043	0.220	0.309	0.341	0.371	0.464
Knowledge of PMFBY	0.025	0.027	−0.050	0.007	0.027	0.043	0.082
Awareness campaign	0.287	0.041	0.161	0.257	0.287	0.316	0.413
Overall satisfaction	−0.061	0.027	−0.145	−0.080	−0.060	−0.042	0.027
Risk coverage satisfaction	0.016	0.031	−0.069	−0.005	0.016	0.038	0.109
Compensation satisfaction	0.104	0.040	−0.004	0.073	0.104	0.134	0.226
Benefits and transparency satisfaction	0.109	0.041	−0.001	0.078	0.108	0.137	0.233

Source: Compiled by Authors.

Table 4 unveils the correlation between the independent and dependent variables shows the Pearson correlation coefficients amongst the independent and dependent variables. Satisfaction, transparency, and awareness are strongly associated and positively correlated, having values of 0.770, 0.829, and 0.782 respectively. The correlation of satisfaction and transparency also comes out to be very strong and positive. As a matter of fact, all the variables on satisfaction and benefits reflect a positive correlation with the dependent variable, impact, reflecting thereby that these variables may influence the perceived effectiveness of the PMFBY scheme.

The MLR analysis is used to understand the relationship between dependent and independent variables [51–55]. The MLR results of the study is presented in **Table 5**, indicates that key independent variables are significant drivers of perceived impact for the PMFBY scheme. Variables surrounding satisfaction, transparency, agricultural income rise, awareness campaigns, and benefits are statistically significant, positively influencing perceived impact, as depicted by the coefficients and p-values. Satisfaction is the most prominent, with a coefficient of 0.582 and a p-value less than 0.001, enhancing perceived impact among female farmers.

In contrast, awareness, PMFBY knowledge, overall satisfaction, satisfaction with risk coverage, and compensation are negative predictors that contribute minimally to the dependent variable, suggesting potential refinements in the model. Results imply that policymakers should emphasize satisfaction, transparency, and targeted awareness campaigns to improve perceived impact. Awareness campaigns should highlight tangible benefits so female farmers are not only informed but also recognize real benefits. Insights from the model underscore that satisfaction, transparency, and awareness are essential for enhancing the scheme's perceived impact, supporting PMFBY's success and aligning financial benefits as a core element.

4.1. Robustness

Here, we checked the robustness of the our MLR model of perceived impact on the female farmers considering the PMFBY scheme. We assessed the various variables of the perceived impact through Goodness of Fit (GoF) (**Table 6**), and check the homoscedasticity (**Table 7**). The GoF is useful to know how the developed model fits into the data and one of the common measures is R^2 which is referred as percentage of variance

Table 4. Correlation analysis of perceived impact of PMFBY using pearson correlation method.

Variable	Impact	Awareness	Satisfaction	Transparency	Increase in Agricultural Income	Knowledge of PMFBY	Awareness Campaign	Overall Satisfaction	Risk Coverage Satisfaction	Compensation Satisfaction	Benefits and Transparency Satisfaction
Impact	1.000	0.782	0.870	0.829	0.340	0.0261	0.285	−0.0597	0.0169	0.1031	0.1085
Awareness	0.782	1.000	0.861	0.811	0.340	0.0261	0.285	−0.0597	0.0169	0.1031	0.1085
Satisfaction	0.870	0.861	1.000	0.908	0.340	0.0261	0.285	−0.0597	0.0169	0.1031	0.1085
Transparency	0.829	0.811	0.908	1.000	0.340	0.0261	0.285	−0.0597	0.0169	0.1031	0.1085
Increase in agricultural income	0.340	0.340	0.340	0.340	1.000	0.0261	0.285	−0.0597	0.0169	0.1031	0.1085
Knowledge of PMFBY	0.0261	0.0261	0.0261	0.0261	0.0261	1.000	0.285	−0.0597	0.0169	0.1031	0.1085
Awareness campaign	0.285	0.285	0.285	0.285	0.285	0.285	1.000	−0.0597	0.0169	0.1031	0.1085
Overall satisfaction	−0.0597	−0.0597	−0.0597	−0.0597	−0.0597	−0.0597	−0.0597	1.000	0.0169	0.1031	0.1085
Risk coverage satisfaction	0.0169	0.0169	0.0169	0.0169	0.0169	0.0169	0.0169	0.0169	1.000	0.1031	0.1085
Compensation satisfaction	0.1031	0.1031	0.1031	0.1031	0.1031	0.1031	0.1031	0.1031	0.1031	1.000	0.1085
Benefits and transparency satisfaction	0.1085	0.1085	0.1085	0.1085	0.1085	0.1085	0.1085	0.1085	0.1085	0.1085	1.000

Source: Compiled by Authors.

explained [56, 57]. Further, adjusted R^2 and standard error or estimate are other statistical measures that are reported routinely in the GoF [58].The value closer to 1 for R2 means better fit predictors [56]. The homoscedasticity checks the level of variance across the range of predictor variables. In the paper, the univariate ANOVA which is a crucial for validity of results and sees the error variance of the datapoints of the dependent variables are homogenous across the data sets [58, 59].

Thus, study uses both the statistical method provided in **Tables 6** and **7** which indicates that the MLR model provides statistically significant explanation of the variability of the dependent variable, but there is a scope to improve in illustrating the remaining variance. The GoF shows that there is moderate variability (nearly half) in independent variable while explaining the model. Whereas, the homoscedasticity through ANOVA validate the model significance with higher F-value and low p-value. This suggest that there is relationship between the predictors and dependent variable which is not due to random chance.

4.2. Limitations of the Study

There are several short-comings to the study which must be considered. Firstly, the data collection has been done directly from the actual stakeholders which may have higher level of biasness due to social desirability bias [60] for questions related to income-level and satisfaction. Secondly, the study focuses only on the female farmers perceived impact which means the larger application of the study to majority of farmers is still restricted. Though there is femininization of agriculture sector going on but still agriculture in India is male dominated. Thirdly, the MLR assumes the presence of linearity and additivity among the variables, this may not take into the consideration the existing real-world agriculture context of India [61]. Fourth, the regional agriculture polices, climate condition and other social factors may have perceived impact on the scheme which is not considered [62]. Finally, the study uses cross-sectional data which captures the causality for the particular time period only unlike the longitudinal studies [63].

5. Conclusions

The major aim of this study is to explore the perceived impact of the PMFBY scheme by female farmers across four states in India for PMFBY scheme (CI scheme). For this purpose the study design uses a mixed methods approach and was done in two phases. The first phase was qualitative phase which helped in the de-

Table 5. Multi linear regression analysis of perceived impact of PMFBY.

Variable	Coefficient	Std. Error	t-Value	P>|t|	95% Confidence Interval
Constant	3.037	0.111	27.355	0	[2.819, 3.255]
Awareness	0.049	0.064	0.766	0.444	[−0.077, 0.174]
Satisfaction	0.582	0.053	10.899	0	[0.477, 0.687]
Transparency	0.198	0.062	3.174	0.002	[0.075, 0.321]
Increase in agricultural income	0.217	0.053	4.121	0	[0.113, 0.321]
Knowledge of PMFBY	0.004	0.034	0.11	0.912	[−0.063, 0.071]
Awareness campaign	0.256	0.051	5.043	0	[0.157, 0.355]
Overall satisfaction	−0.049	0.035	−1.4	0.162	[−0.118, 0.020]
Risk coverage satisfaction	0.018	0.038	0.482	0.63	[−0.057, 0.092]
Compensation satisfaction	0.094	0.051	1.839	0.067	[−0.006, 0.195]
Benefits and transparency satisfaction	0.127	0.051	2.488	0.013	[0.027, 0.226]

Source: Compiled by Authors.

Table 6. Residuals statistics to identify the GoF.

Residuals Statistics [a]					
	Minimum	**Maximum**	**Mean**	**Std. Deviation**	**N**
Predicted Value	1.2148	4.9291	3.2444	0.69488	3008
Std. Predicted Value	−2.921	2.424	0.000	1.000	3008
Standard Error of Predicted Value	0.007	0.050	0.013	0.005	3008
Adjusted Predicted Value	1.2155	4.9326	3.2444	0.69485	3008
Residual	−2.61732	1.94373	0.00000	0.38175	3008
Std. Residual	−6.853	5.089	0.000	1.000	3008
Stud. Residual	−6.868	5.091	0.000	1.000	3008
Deleted Residual	−2.62938	1.94495	−0.00003	0.38239	3008
Stud. Deleted Residual	−6.922	5.112	0.000	1.001	3008
Mahal. Distance	0.008	50.327	2.999	3.361	3008
Cook's Distance	0.000	0.054	0.000	0.002	3008
Centered Leverage Value	0.000	0.017	0.001	0.001	3008

Source: Compiled by Authors.
[a] Dependent Variable: Impact.

velopment of intervention tool for micro-level data collection which was done in Indian states of Kerala, Madhya Pradesh, Rajasthan and Uttar Pradesh. On a sample size, 455 female farmer respondents interviewed simultaneously. The geographical distribution of respondents among four states was higher in the state of Kerala and further stratification of respondents reveal that it covered respondents from all the strata of the society, namely age, income, education, caste and type of the farmers. The Likert scale of five was used to identify the perceived impact of the PMFBY scheme (dependent variable) and independent variables were identified from the first phase of the study.

Our core results uses key drivers (mentioned in models and estimators section) of perceived impact of PMFBY scheme which were derived from the qualitative phase. The correlation analysis using Pearson method unveils that there is a strong positive correlations between satisfaction, transparency, and awareness, with satisfaction and transparency significantly affecting the perceived impact of the PMFBY scheme.

The outcome from the MLR for perceived impact of the PMFBY scheme is positively influenced by factors such as satisfaction, transparency, increase in agriculture income, awareness campaign, and benefits and transparency satisfaction among female farmers. However, factors such as overall satisfaction, compensation satisfaction, awareness, and knowledge of PMFBY

Table 7. ANOVA statistical test to validate the relationship between dependent variables and predictors.

ANOVA [a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**p-Value**
1	Regression	1451.968	3	483.989	3317.782	<0.001 [b]
	Residual	438.216	3004	0.146		
	Total	1890.184	3007			

Source: Compiled by Authors.
[a] Dependent Variable: Impact.
[b] Predictors: (Constant), transparency, Awareness, Satisfaction.

have a negative influence. Furthermore, the descriptive statistics reveal that female farmers have a relatively high perception of the impact of the scheme, and a positive outlook of scheme awareness and satisfaction. Nevertheless, the perceived impact of monetary benefits are not substantial, and knowledge regarding the scheme is limited. The overall satisfaction, risk coverage, and transparency are somewhat unfavourable, suggesting concerns which requires attention from the policy makers.

The important finding is the MLR model implied was assessed on its robustness by using GoF and homoscedasticity. The results reveal that there is a moderate variability in the independent variable and it was substantiated though higher f-values and lower p-values suggesting a relationship between predictors and dependent variable. Thus, through three level analysis of descriptive statistics, Pearson correlation and MLR, it was found that factors such as overall satisfaction and awareness of the scheme is at a lower end and could be enhanced to have more perceived impact of the scheme.

Also, reflecting on the limitations of the study would have been thorough by including longitudinal data. The major breakthrough of the study lies is identifying the predictors and MLR modelling, which although have moderate variability with perceived impact of the scheme should be further examined. As a future direction, the methodology could be applied to a micro level analysis of the predictors, and some changes to the predictors could be a explored further.

Author Contributions

Concept development and data collection, V.H.; paper development and data cleaning, S.D.; concept development and data analysis, M.R.R.M.; development of the paper and literature review, A.C. All authors have read and agreed to the published version of the manuscript.

Funding

This work was supported by the Indian Council of Social Science Research 'Special Call for Short Term Empirical Research 2023'. Collaborative Study No - 20/CRP-2023-264/PMFBY/SCD.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Acknowledgements

We acknowledge and express our gratitude to all the farmers, government officials, otherstakeholders, research staff and field investigators from the states of Rajasthan, Uttar Pradesh, Madhya Pradesh and Kerala because of whom the herculean task could be accomplished smoothly.

Conflict of Interest

The authors declare that they have no conflict of interest.

Abbreviations

1. %—Percentage
2. A&AS—Agriculture and its allied sector
3. A.P.— Andhra Pradesh
4. CAGR—Compound Annual Growth Rate
5. CCIS—Comprehensive Crop Insurance Scheme
6. DiD—Difference – in – Difference
7. GoF—Goodness of Fit
8. GoI—Government of India
9. GVA—Gross Value Added
10. MoAFW—Ministry of Agriculture and Farmer Welfare
11. MLR—Multi Linear Regression
12. NABARD—National Bank for Agriculture and Development
13. PLFS— Periodic Labour Force Survey
14. PMFBY—Pradhan Mantri Fasal Bima Yojana
15. SI—Sum Insured
16. WEF—World Economic Forum
17. YoY—Year-on-Year Growth

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