Analysis Of Agricultural Insurance Pertaining To PMFBY Scheme: Exploring Dynamics And Future Implications

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Abstract:

This study examines the complex workings of the Pradhan Mantri Fasal Bima Yojana (PMFBY) and its impact on paddy crop-insured farmers during the fiscal years 2021–2022 and 2022–2023. It was carried out across 12 districts in Karnataka. Based on primary data gathered from 500 farmers, the study uses structural equation modelling (SEM) to identify important relationships between Economic Value, Consumption, Anticipated Satisfaction, Perceived Performance, and Purchase Intention. The first SEM model indicates that there is no significant impact on performance, which motivates more research. The incorporation of a temporal dimension using dynamic SEM-2 and delta analysis reveals non-significant variations in satisfaction, indicating potential avenues for enhancement in subsequent iterations of PMFBY. By utilising prospect theory, the research explores the psychological aspects that impact farmers and offers policymakers theoretical insights for improving programs. To protect farmers' long-term well-being, the research provides a road map for resolving problems, boosting PMFBY's effectiveness, and offering insightful counsel for the next policy advancements in agricultural risk management.

Keywords: *Prospect Theory, Dynamic SEM, Delta, PMFBYS, and Paddy crop.*

1.Introduction

In the field of agricultural risk management, crop insurance plans have developed dynamically in India in response to the financial risks farmers face when their crops fail for a variety of reasons, including pests, illnesses, and natural disasters (Azad et al., 2020). The Agricultural Insurance Company signalled a significant change in the insurance industry from private to government-sponsored in 1972. (Raju, (2008)) Government-funded agricultural programmes were able to expand coverage thanks to long-term projects like CCIS, NAIS, and MNAIS. (Jamanal 2019) Differences in farm insurance policies reflect differences in agricultural envi[1]ronments, economies, and legislative frameworks around the world. (Hueth, 1994) The difficulties faced by farmers and the international agricultural insurance systems are prime examples of complex tactics, as premium subsidies are frequently used to increase crop insurance programme participation. (Tsiboe, 2023) Introduced in 2016, the Pradhan Mantri Fasal Bima Yojana (PMFBY) revolutionised agricultural insurance by utilising technology to provide financial aid and risk reduction to farmers facing crop failures caused by pests, diseases, or natural calamities. (Ghosh, 2018) The study was specifically designed to protect farmers' financial security by reducing the financial burden on them in the case of crop failure. PMFBY (Sharma, (2022).) The first crop insurance policy in India is crucial for ensuring food security and encourages rural development.

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This study provides a detailed analysis of the Pradhan Mantri Fasal Bima Yojana scheme, highlighting the implications for farmers who are insured for paddy harvests in 12 Karnataka districts in the fiscal years 2021–2022 and 2022–2023. The study connects the following important variables: consumption, perceived performance, expected satisfaction, economic value, and purchase intention. It uses sophisticated statistical tools, such as structural equation modelling (SEM), to achieve this. The study looks closely at the scheme, with a particular emphasis on how it will impact farmers in 12 Karnataka districts who have insurance for paddy crops in the fiscal years 2021–2022 and 2022–2023.

To establish relationships between significant factors, the study makes use of sophisticated statistical tools like structural equation modelling (SEM). SEM-1, involving 250 participants over two fiscal years, does not appear to have any appreciable impact on output. This prompts a further in-depth analysis with a temporal lens and Dynamic SEM–2. Prospect theory adds a theoretical dimension to understanding the psychological elements influencing farmers' satisfaction.
The study's recommendations and conclusions offer a path forward for improving overall efficacy and satisfaction in the dynamic field of agricultural risk management under the PMFBY project.

2. Literature Review
The Pradhan Mantri Fasal Bima Yojana (PMFBY) literature provides an in-depth analysis of the program's execution, results, and difficulties. Santhi and Sangeetha (2020) projected farmers' availability for the PMFBY scheme. Anticipate farmers' access to the PMFBY initiative by concentrating on variables that affect participation. (Nagesha et al., 2022) investigate the viewpoints of farmers in the Tumkur, Karnataka district, providing insights into their understanding of the PMFBY. (Tiwari et al. 2020) examine the application, efficacy, and impacts of PMFBY on Indian agriculture in their summary. The PMFBY is one of the farm insurance plans offered in India. (Agrawal and Singh, 2020) Examine the creation and efficacy of various farm insurance plans as well as India's PMFBY. This study examines the agricultural insurance schemes that were offered in India in the past. Examining PMFBY's impact on crop insurance in India, raises concerns that despite enrollment success, claims are being processed slowly. (Kumar et al., 2020) analysing its performance and comparing it to other models, PMFBY shows potential for effective risk mitigation. (Joshi, 2019) Examining the contentment of insured farmers in Northern Karnataka, the research examines previous research and provides an overview of PMFBY execution. (Cariappa 2019) This research examines empirical data and recommends a revision of crop insurance in India, noting PMFBY's limited success in compensating farmers for crop losses. (Rathore Assistant Professor & Jyoti, 2017) The study emphasises the inconsistent outcomes of PMFBY implementation in Madhya Pradesh's Datia District. There are minimal levels of farmer awareness and participation. (Vanishree, 2023) This study uses DEA-Prospect Theory analysis to examine paddy cropping efficiency under PMFBY in Karnataka. The results show inconsistent implementation outcomes and variability in scheme performance between districts.
 These study gaps highlight the need for further concentrated studies into important PMFBY features, especially in terms of comprehending its long-term repercussions and proposing customised methods for improvement.

3. Purpose Statement
This study aims to accomplish two goals: first, it will build a thorough model that clarifies complex structural relationships between important components of the Pradhan Mantri Fasal Bima Yojana (PMFBYS); second, it will contribute to theory by incorporating insights from Prospect Theory, emphasising psychological aspects, improving our understanding of farmers' behaviour within PMFBYS, and offering recommendations for useful policy improvements.

4. Research Methods

This study, spanning fiscal years 2021-2022 and 2022-2023, employed Confirmatory Factor Analysis (CFA) and Path Analysis for the initial structural equation model (SEM-1) in 2021–2022. A Dynamic SEM Model-2 was then used to capture intertemporal dynamics by using the Bootstrapping Method. SEM equations that were painstakingly constructed and included twenty-two observable and five unknown variables clarified dynamic relationships for upcoming agricultural risk management plans.

5. Results and Discussion

To investigate the complex relationships between Economic Value, Perceived Performance, Satisfaction (both Consumption and Anticipated), and Purchase Intention within the Pradhan Mantri Fasal Bima Yojana for Farmers (PMFBYS), this study was carried out across twelve districts in Karnataka during the academic year 2021–2022. The objective is to augment comprehension and enable relevant parties to make knowledgeable decisions and customised insurance schemes.

The introduction to SEM constructs establishes the groundwork for comprehending key variables and their relationships:

Economic Value (EV): is a critical component that establishes the insurance market's affordability for farmers and highlights the critical role that perceived economic benefits play in improving the financial security of farmers. Expectations of Satisfaction

Satisfaction Anticipated (SA): evaluates people's pre-purchase anticipation for PMFBYS insurance based on their impressions of its advantages.

Satisfaction Consumption (SC): Gauges post-experience satisfaction, emphasising the direct interaction with the insurer

Intention to Purchase (ITP): measures people's propensity to purchase insurance, which is impacted by experiential, psychological, and financial factors.

Perceived Performance (PP): includes both "claim" and "FSP" (Farmers' Support Programme), and evaluates how well insurance works, especially when it comes to settling claims. Farmers' Share Premium (Performance) highlights how important the subsidy mechanism is in influencing buying intentions and forming opinions about overall performance. Claim settlement is important since it immediately affects farmers' indemnity and has a significant influence on how perceived performance is evaluated.

Table 1. Regression SEM-1

Regression	Estimate	Std Error	Wald Z	Prob>[Z]
Econ_Value → Sati_Anti	0.9437498	0.0763605	12.359132	<.0001*
Econ_Value → Sati_Cons	0.8373691	0.0735468	11.385522	<.0001*
Sati_Cons → Int_To_Purch	0.3737066	0.0700223	5.3369632	<.0001*
Performance → Int_To_Purch	0.2758905	0.1525726	1.8082575	0.0706
Sati_Anti → Int_To_Purch	0.4593168	0.0902457	5.0896267	<.0001*
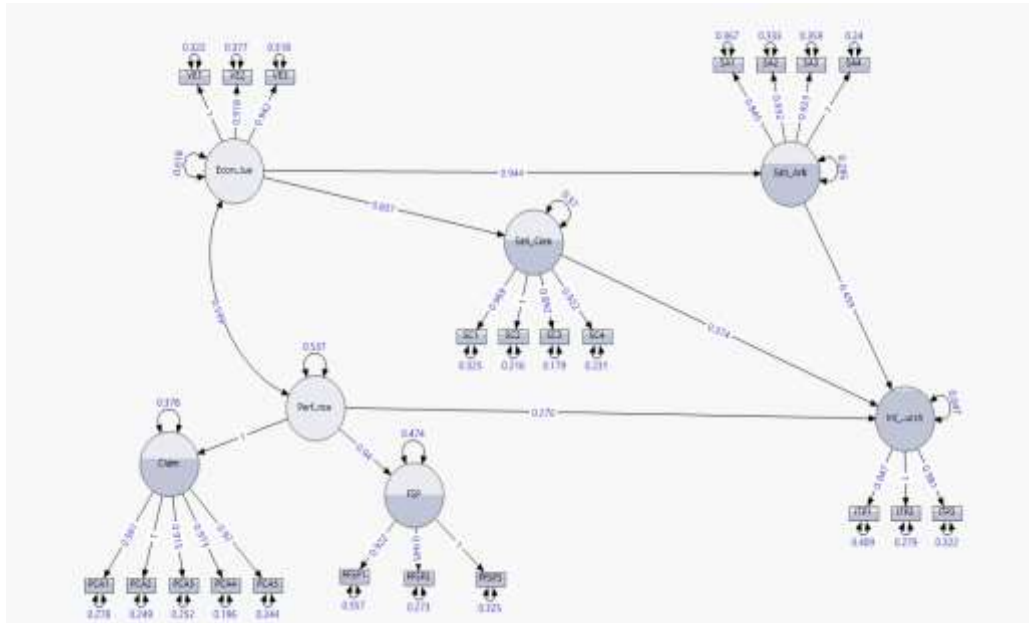
Fig No1: SEM Model

The study's analysis, incorporating Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM-1) are two analytical tools used in this work that explore the complex relationships found in the Pradhan Mantri Fasal Bima Yojana (PMFBYS). With a Root Mean Square Error of Approximation (RMSEA) of 0.0839 and a Comparative Fit Index (CFI) of 0.9312, the CFA results demonstrate that the model fits the data rather well.

Economic Value and Anticipated Satisfaction: Economic Value (EV) and Satisfaction Anticipated (SA) have a highly significant positive relationship, according to SEM data (regression coefficient = 0.9437498). The statistical significance is highlighted by the p-value (< 0.0001) and Wald Z statistic (12.359132). The findings indicate a strong correlation between expected contentment and economic value, with a 0.94-unit increase in pleased for every unit increase in economic worth.

Economic Value and Consumption Satisfaction: Regression coefficient = 0.8373691, as determined by the SEM analysis, shows a strong positive correlation between economic value (EV) and satisfaction consumption (SC). The importance is shown by the p-value (<0.0001) and the Wald Z statistic (11.385522). The findings show that for every unit increase in economic value, customer satisfaction increases by 0.84 units, demonstrating the influence of economic factors on post-experience satisfaction.

Satisfaction Consumption and Intention to Purchase: According to the results of the SEM analysis, there is a significant positive correlation between SC and ITP (regression coefficient = 0.3737066). The Wald Z statistic (5.3369632) and p-value (< 0.0001) emphasise the statistical significance. According to the results, there is a 0.37-unit increase in buy intention for every unit increase in consumption satisfaction, suggesting that consumer satisfaction has a significant impact on purchase intention.

Performance (Claim Settlement and Farmer's Share Premium) and Intention to Purchase: With a regression coefficient of 0.2758905, the SEM results point to a connection between Performance (particularly as it relates to claim settlement and farmer's share premium) and Intention to Purchase. Despite being near conventional significance standards, the p-value (0.0706) indicates some indication of a link. Even if they don't reach conventional significance thresholds, the complex components of Performance, including claim settlement and farmer's share premium, may have an impact on the inclination to buy.

Satisfaction Anticipated and Intention to Purchase: A significantly substantial correlation between Satisfaction Anticipated (Sati_Anti) and Intention to Purchase (Int_To_Purch) has been found by SEM analysis (regression coefficient = 0.4593168). The statistical significance is highlighted by a p-value of less than 0.0001 and a Wald Z statistic of 5.0896267. According to the data, for every unit increase in expected satisfaction, there is a 0.46-unit increase in buy intention.

Summary: Significant coefficients are shown by a thorough analysis of SEM results within the PMFBYS framework, highlighting the influence of perceived performance, satisfaction, and economic considerations on farmers' purchase intentions. Potential directions for additional research are indicated by the marginal significance in Performance. This validated information directs policymakers, insurers, and stakeholders in strategically improving the programme to ensure its efficacy in changing agricultural environments.

### Field Observations: Farmers' Perspectives and Program Challenges

The performance variable is less significant since farmers are dissatisfied with the PMFBY. The certain reasons captured during the field visit are complicated procedures, minimal compensation, and delayed claim payments. Unfavourable prior experiences that erode confidence have an impact on farmers' inclinations to get insurance. Farmers' exorbitant premiums act as a deterrent as well, impeding enrollment and influencing choices for subsequent insurance. Solving these issues is necessary to rebuild confidence in the PMFBY endeavour.

5.2 Dynamic SEM-2

Through the application of Delta Analysis, the PMFBYS can be better understood by incorporating a temporal component into the SEM. This method evaluates small changes and their influence on the overall efficacy of the programme by using both historical and current data. By taking into account the "Delta Effect," policymakers could improve PMFBYS effectiveness and foresee future issues by carefully examining the variable correlations that SEM provides.

Table No 2: Regression Dynamic SEM

Regression	Estimate	Std Error	Wald Z	Prob>[Z]
Econ_Value → Sati_Anti	0.9167048	0.0835841	10.967448	<.0001*
Econ_Value → Sati_Cons	0.7762243	0.0862914	8.9953836	<.0001*
Sati_Anti → Into_To_Purch	0.2634488	0.0811209	3.247608	0.0012*
Sati_Cons → Into_To_Purch	0.2277538	0.061594	3.6976601	0.0002*
Performance → Into_To_Purch	0.4541724	0.1478186	3.0724988	0.0021*
Delta → Performance	0.5772484	0.0571721	10.09668	<.0001*
Delta → Econ_Value	0.6019176	0.0560427	10.740345	<.0001*
Delta → Sati_Anti	0.0161394	0.0648459	0.2488887	0.8034
Delta → Sati_Cons	0.1216492	0.0696665	1.7461656	0.0808
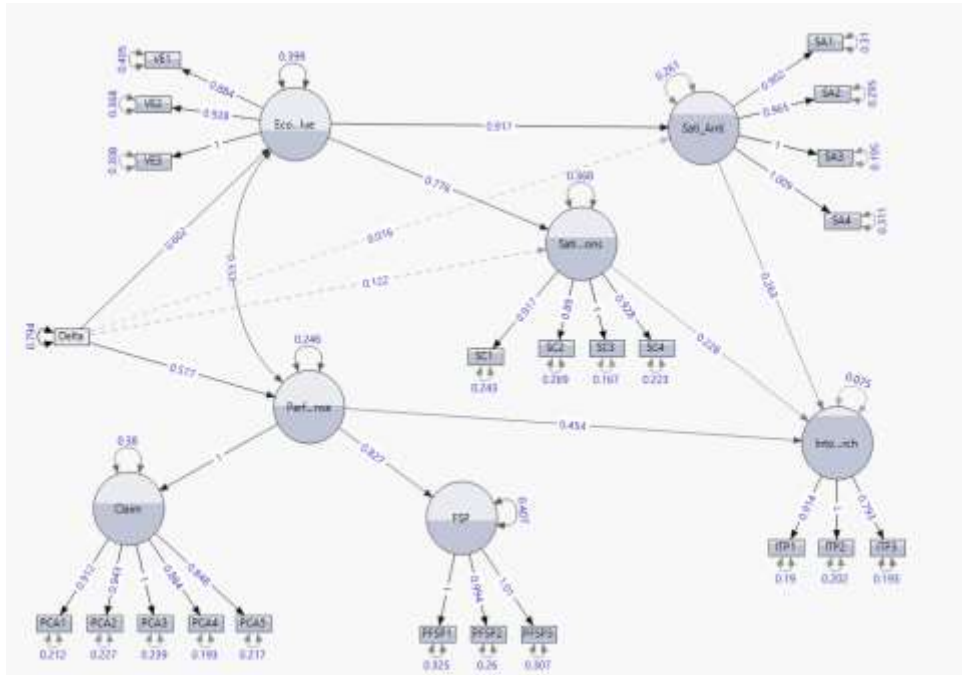
Fig No 2: Dynamic SEM-2 PMBYS for Future Perspective

(**Values:** CFA: The CFI result of 0.9598 and the RMSEA value of 0.0643 suggest that the model fits the data particularly well and that it is appropriate. SEM-1: The RMSEA value of 0.0709 shows that the model is appropriate for the data, and the CFI result of 0.9495 shows that the model fits the data very well.)

A highly significant relationship between Economic Value (Econ_Value) and Anticipated Satisfaction (Sati_Anti) is revealed by the structural equation model (SEM) analysis. This relationship is demonstrated by the following metrics: a low standard error of 0.0835841, a Wald Z statistic of 10.967448, a p-value of <.0001*, and a regression estimate of 0.9167048. When taking into account the delta effect for predicting future events, these findings become extremely important. Basic information about the program's economic impact is determined by examining observed variables for the hidden variable of Economic Value, which includes components such as reasonableness, value for farmers' money, and assistance for economically backward projects. In addition, observed variables for the latent variable of anticipated contentment—such as speedy purchasing, simplicity of connection, appropriate insurance selection, and complaint resolution—offer insights into participants' expected levels of pleasure.

The delta effect, which indicates that changes in economic value over time have a considerable impact on participants' predicted satisfaction, further supports the strong association between economic value and anticipated contentment. A positive delta impact indicates that improvements in economic value-related aspects should increase expectation fulfilment.

A highly substantial relationship between Satisfaction Consumption and Economic Value in the PMFBYS is revealed by the SEM investigation. Regression estimate of 0.7762243, Wald Z statistic of 8.9953836, low standard error of 0.0862914, and p-value <.0001* demonstrate how participant satisfaction and perceived economic value interact dynamically within the programme.

A strong association between satisfaction consumption and buy intention under PMFBYS is shown in the SEM investigation. Regression estimate (0.2277538), Wald Z statistic (3.6976601), p-value (0.0002*), and low standard error (0.061594) highlight how crucial it

is to comprehend customer participation with the insurance programme. The latent variable Intention to Purchase indicates how participants' experiences and future commitment to the programme are greatly impacted by their satisfaction with PMFBYS and the timely resolution of complaints.

The delta impact in this relationship over time needs to be taken into account in future projections. A positive delta effect indicates a correlation between increases in Satisfaction Consumption indicators and an increase in the intention to purchase insurance. Policymakers can carefully enhance pleasure consumption components that strongly align with a higher desire to purchase in order to support the PMFBYS's long-term viability and efficacy.

The latent variable Performance, which comprises claim settlement and Farmer's Share Premium, and the intention to purchase under the PMFBYS show a highly significant link, according to the SEM analysis. The importance of understanding the interactions between these latent variables is highlighted by the regression estimate of 0.4541724, standard error of 0.1478186, Wald Z statistic of 3.0724988, and p-value of 0.0021*. Some of the performance qualities that have been observed are claim settlement efficiency, time required, helpfulness in claim settlement, adequate risk protection, market value, transparency, affordability, and overall helpfulness for payment.

When examining the relationship created by time intervals for future prediction, the delta effect is crucial. A positive delta effect suggests that there is a proportional rise in the intention to purchase insurance as performance characteristics alter or improve over time. This implies that participants' intentions to engage with the PMFBYS in the future are significantly impacted by improvements in many Performance areas, such as more economical and effective claim settlement.

A highly substantial correlation between PMFBYS performance and the latent variable Delta is revealed by the SEM research. The regression estimate of 0.5772484, the Wald Z statistic of 10.09668, the standard error of 0.0571721, the p-value of <.0001*, and the overall significance highlight how crucial it is to understand how changes or fluctuations throughout time, represented by Delta, affect Performance characteristics. The dependent variable in this SEM model, delta, has a strong connection with performance, suggesting that variations over time have a significant impact on the overall functionality and efficacy of the PMFBYS.

Delta's effects on performance are highly significant, meaning that changes or advancements throughout time have a major impact on performance.

6. Theoretical Construct:

6.1 Prospect theory's theoretical predictions regarding insurance PMFBYS

Researchers Daniel Kahneman and Amos Tversky developed the theory of prospects, an innovative concept in the field of behavioural economics, in 1979 to clarify decision-making in the face of uncertainty. According to the hypothesis, an effect known as loss aversion occurs as individuals compare gains to losses and believe that earnings are more valuable than losses. The idea of prospects is useful in the context of the PMFBYS, an agricultural insurance programme introduced by the Indian government. Prospect theory's incorporation sheds important light on the complex decision-making procedures farmers employ to gauge their level of satisfaction and propensity to buy crop insurance.

6.2 Theoretical Contributions with Practical Implications:

Farmers assess possible outcomes to a reference point, which is typically their expectations or existing status, and are more sensitive to perceived losses than gains. When assessing farmers' satisfaction and propensity to buy crop insurance, Prospect Theory integration might provide valuable insights into their decision-making processes. The theoretical framework includes:

1. Reference Points in Agricultural Decisions: According to Prospect Theory, people evaluate results by using a point of reference. Regarding farmers, the average yield in their area or their customary agricultural methods may serve as the reference point. The information provided about adopted and not adopted districts establishes different reference points for irrigation technology, pest control management, and crop diversification.

- In accepted districts (Mysore, Mandya, Uttara Karnataka), the implementation of advanced irrigation technologies has resulted in a 20% increase in crop yield, with a 15% rise in farmers opting for insurance in AY2022.
- The lack of widely used sophisticated irrigation techniques has resulted in a 10% decrease in crop productivity in non-adopted districts (Balari, Vijayapura, Devanagere, Uttara Karnataka), and only 10% of farmers are currently covered during AY2022.

2. Framing Effects and Insurance Decisions: Decisions are influenced by framing effects, according to prospect theory. Adoption of crop insurance is encouraged and satisfaction levels are raised when sophisticated agricultural methods are presented positively. Negative framing deters in districts that have not been adopted..

- Effective pest and disease management strategies have increased paddy crop productivity in the adopted district of Mysore by 15%, and 20% of farmers have signed up for crop insurance.
- Pest management methods are less common in the districts that were not accepted (Balari, Vijayapura, Devanagere, Uttar Karnataka), which results in a 12% decrease in agricultural yield. In Fiscal Year 2022, just 8% of farmers are insured.

3. Loss Aversion and Insurance Adoption: According to prospect theory, people are more likely to be adverse to losses than to be inspired by comparable advantages. Due to the lack of advanced agricultural practices, farmers in regions that have not implemented crop insurance may be more sensitive to perceived losses in crop output and financial stability. Their happiness may suffer as a result of this increased loss aversion, which may also make them more likely to choose crop insurance.

- Crop diversification techniques that have been successfully implemented in adopted districts (Mysore, Hassan) have improved soil fertility by 25%, increased crop output by 30% in the year 2021, and increased farmer insurance by 25% in the year 2022.
- The absence of widespread implementation of crop rotation in 2023 has resulted in a 15% drop in soil fertility, a 20% decrease in crop output, and just 15% of farmers are insured in the districts that have not implemented it (Balari, Vijayapura, Devanagere, Uttar Karnataka).

4. Temporal Dimension and Future Perspectives: Prospect Theory also considers the temporal dimension of decision-making. Farmers who have experienced the positive outcomes of adopting advanced techniques may anticipate further gains in the future, enhancing their satisfaction and reinforcing their intention to continue purchasing crop insurance. On the other hand, farmers in not adopted districts might fear future losses, leading to lower satisfaction and an increased willingness to consider insurance.

7. Suggestion:

To increase crop insurance on PMFBYS, launch incentive schemes to encourage creative farming in districts that have not been embraced, and provide funds and training. Run educational efforts that encourage positive comparisons by showcasing instances of achievement in the regions that have been embraced. Maintaining long-term involvement requires constant monitoring, flexible tactics, and support.

8. Conclusion:

This thorough study examines the dynamics of the Pradhan Mantri Fasal Bima Yojana (PMFBY) across 12 Karnataka districts and provides insights into its effects on farmers who are insured for paddy crops. Utilising cutting-edge statistical techniques like Delta Analysis and Structural Equation Modelling (SEM), the study examines variables like Economic Value, Consumption and Expected Satisfaction, Perceived Performance, and Purchase Intention.

For the fiscal year 2021–2022, the preliminary SEM model (SEM–1) shows no discernible impact on performance, necessitating additional research. By comparing previous and present data sets, SEM-2 adds a dynamic element. It reveals non-significant variances in satisfaction and identifies areas that should be improved in future PMFBY iterations.

Using prospect theory to investigate psychological influences on farmers' decision-making, the study highlights the need of comprehending future ramifications beyond historical and contemporary dynamics. Theoretical contributions shed light on the temporal dimension of decision-making, framing effects, loss aversion, and reference points in agricultural decision-making. These insights can then be used to inform long-term engagement strategies, incentive programmes, training initiatives, and communication plans that aim to increase farmer satisfaction and crop insurance uptake.

Within the PMFBY, perceived performance, economic value, and satisfaction all affect farmers' intentions. Farmers' perceptions of performance are more affected by temporal changes (Delta) than by satisfaction, but the dynamic nature of their experiences emphasises the necessity of ongoing monitoring and adjustment for the programme to be successful over time.

This research offers stakeholders and policymakers a road map by presenting doable recommendations for resolving problems, raising satisfaction, and boosting the PMFBY's effectiveness. The research offers insightful information for future policy improvements in the constantly changing sector of agricultural risk management, especially in light of the critical role that agricultural insurance programmes play in farmers' resilience.

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