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RESEARCH ARTICLE

Efficacy of farmer FIRST Programme on knowledge and adoption of rice technologies in Khordha, Odisha

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Abstract

The present study evaluates the effectiveness of the Farmer FIRST Programme (FFP) in enhancing farmers' knowledge and adoption of rice-based technologies, with a focus on the Pratikshya rice variety, aromatic rice (Kalajeera) cultivation and fodder cultivation in Khordha district of Odisha. Unlike traditional top-down extension models, FFP introduced by the Indian Council of Agricultural Research (ICAR) in 2016 emphasizes on participatory technology development and dissemination. The objective was to assess the programme's impact on knowledge acquisition and technology adoption by small and marginal farmers. An ex-post facto research design was employed and data were collected from 154 respondents (77 FFP beneficiaries and 77 FFP non-beneficiaries) across four adopted villages from Begunia block using a structured and pre-tested interview schedule. Statistical analyses including frequency, percentage and Z-test were conducted using SPSS. The findings revealed a significantly higher level of knowledge and adoption frequency among FFP beneficiaries compared to non-beneficiaries. About 40.25 % of beneficiaries exhibited high knowledge levels against 23.37 % among non-beneficiaries, while only 18.18 % of beneficiaries achieved high adoption scores, in contrast to none among non-beneficiaries. The programme's interventions such as varietal substitution in rice, scientific aromatic rice (Kalajeera) production and year-round fodder cultivation were more widely adopted among the beneficiaries. The results underscore the programme's success in enriching knowledge and fostering meaningful adoption of location-specific technologies. To ensure sustainability and wider impact, it is essential to enhance extension support, strengthen market linkages and promote capacity-building initiatives.

Keywords: aromatic rice; farmer FIRST programme; Khordha; knowledge; pratikshya rice

Introduction

Agriculture continues to be the principal source of livelihood for a large segment of the Indian population with around 86 % of farmers are classified as small and marginal, cultivating only 47 % of the total agricultural land (1). Traditional extension approaches such as the Training and Visit (T&V) system are characterized by a top-down and supply-driven model. These models have often struggled to effectively disseminate innovations due to poor contextualization and minimal farmer involvement (2, 3). Sustainable agricultural development requires active farmer participation and local knowledge integration, rather than reliance on external, top-down solutions (3). Regenerating agriculture depends on empowering farmers to become innovators and decision-makers in their own environments (4, 5). To address these limitations, the ICAR introduced the FFP in 2016, with an objective to bridge the gap between research institutions and farming communities by ensuring participatory technology development, adaptation and transfer (6, 7). The study demonstrated that the scientist-farmer interface under the FFP significantly improved knowledge, skill enhancement and technology adoption in the rainfed agro-ecosystem of the North West Himalayan region (8, 9). The study found that participatory, farmer-centered approaches under FFP increased the relevance of agricultural technologies and led to higher adoption rates among farming communities. Overall, these findings underscore the effectiveness of FFP in bridging research–extension gaps and fostering sustainable, locally adapted agricultural practices (10, 11).

The study revealed that the mean knowledge index of FFP farmers (51.31) was 65 % higher than that of non-FFP farmers, highlighting the effectiveness of the FFP. There was no significant difference in knowledge levels between male and female farmers, indicating the programme's equal impact across genders. A significant difference was observed between FFP and non-FFP farmers of both genders, while individual knowledge items showed no significant variation (12).

Majority of respondents (73.34 %) had a medium level of knowledge about basic crop production techniques, followed by

15.83 % who had a low level of knowledge and only 10.83 % had a high level of knowledge about basic crop production practices (13). The present study assesses the effectiveness of FFP and evaluates its impact on knowledge and adoption behaviour related to Pratikshya rice variety, aromatic rice (Kalajeera) cultivation and fodder cultivation—three key innovations under the crop-based module of FFP in Khordha district. Pratikshya is a high-yielding, improved rice variety known for its adaptability to the agro-climatic conditions of Odisha, offering better resistance to pests, diseases and contributing to enhanced productivity for small and marginal farmers. Kalajeera is a short-grained, aromatic rice variety prized for its unique aroma and grain quality, providing farmers opportunities for value addition and higher market returns. Promotion of year-round fodder cultivation helps to address chronic fodder shortages and enhance livestock productivity, rural incomes and sustainable agriculture. The present study was carried out with the objectives to —

(i) assess the level of knowledge regarding technologies related to Pratikshya rice, aromatic rice (Kalajeera) and fodder cultivation among farmers under FFP.

(ii) analyze the extent of adoption of crop-based module technologies by FFP beneficiaries.

Material and Methods

Study area

The study was conducted in four adopted villages—Brahmapura, Bramhapurapatana, Govindpur and Gopalpur—located in Begunia block of Khordha district, Odisha. These villages were selected owing to their status as sites where the FFP implemented its crop-based module interventions, particularly promoting the cultivation of the Pratikshya and Kalajeera rice varieties and round the year fodder cultivation. These villages represent key locations where targeted demonstrations, training and participatory research activities were carried out under the programme, providing an ideal setting for evaluating the impact of the intervention on farmers' knowledge and adoption of these specific production technologies.

Research design

An *ex-post facto* research design was adopted to assess the effectiveness of FFP interventions. This design was suitable as no manipulation of the independent variables (programme participation) could be done and impact can be assessed.

Sampling technique and sample size

In this study, 'beneficiaries' are the farmers who participated in FFP interventions by receiving training, technical support and access to improved technologies such as the cultivation of Pratikshya and Kalajeera rice varieties, along with fodder production. Conversely, 'non-beneficiaries' are farmers from the same villages who did not participate in the programme activities and serve as the control group to evaluate the differential impact of the FFP on knowledge enhancement and technology adoption. Purposive sampling was used to select the FFP beneficiaries, while simple random sampling was employed for selecting an equal number of non-beneficiaries from the same locale to ensure comparative analysis. The total sample comprising 154 respondents, calculated using the Yamane formula (14), with 77 FFP beneficiaries and 77 non-beneficiaries. The formula was applied to determine the total sample size for both groups (14).

$$\text{Yamane Formula;} \quad n = \frac{N}{1+Ne^2}$$

Where,

n = Sample size

N = Population size

e = Margin of error (0.05)

Data collection tools

Data were collected through a structured and pre-tested interview schedule. The schedule included modules for assessing knowledge levels and extent of technology adoption. Knowledge was measured using 31 validated items developed in consultation with experts and refined through item analysis. These items covered the domains of rice varietal characteristics, aromatic rice (Kalajeera) cultivation practices, year-round fodder production techniques, pest and disease management, post-harvest processing and soil health management.

Knowledge test construction

Initially, 65 items related to technologies under FFP were compiled. Based on expert validation, 31 items were finalized. These were administered to 60 non-sample respondents. The "Item Difficulty Index" and "Item Discrimination Index" are key psychometric parameters used during test construction and validation to assess the quality of each item in the knowledge test. Item difficulty index reflects the proportion of respondents who answer an item correctly, typically expressed as a percentage or fraction. An item difficulty value close to 1 (or 100 %) indicates an easy question, whereas a value close to 0 signifies a difficult question. In test construction, items with moderate difficulty (usually between 0.3 to 0.8) are preferred because they effectively differentiate between respondents of varying knowledge levels by neither being too easy nor too difficult. The item discrimination index measures how well an item distinguishes between high and low performers on the overall test. It is calculated by comparing the performance on the item among the top scorers and bottom scorers. A higher discrimination index (usually above 0.3) indicates that the item is good at differentiating knowledgeable respondents from less knowledgeable ones. Items with low or negative discrimination indices may be ambiguous, misleading or not aligned with the test objectives and are typically excluded. Items with a difficulty index of 30 - 80 and discrimination index of 0.30 - 0.50 were retained, as these ranges are widely accepted in educational and behavioural research for ensuring items are neither too easy nor too difficult and can effectively distinguish between respondents of varying knowledge levels (Supplementary Table 1). The final knowledge test included multiple-choice, true/false and fill-in-the-blank questions (Supplementary Table 2). A correct answer received a score of 1 and 0 for an incorrect one. The cumulative score represented the respondent's knowledge level (15).

Reliability and validity of the knowledge test

The reliability of the test was established using the split-half method. The Pearson correlation coefficient was 0.72 and the Spearman-Brown coefficient was 0.84, confirming high internal consistency. Content validity was ensured by expert consultation and literature review.

Measurement of adoption

Adoption was operationalized as the degree to which respondents had adopted recommended rice-based technologies. Adoption levels were categorized as; fully adopted with score 3 - complete use of recommended package, partially adopted scored as 2 - incomplete or partial implementation, not adopted with score 1 - no use of recommended practices (16). Respondents' adoption levels were categorized into low, medium and high based on mean and standard deviation (SD) scores.

Statistical analysis

The collected data were coded and analyzed using SPSS Version 26. Descriptive statistics (frequency, percentage, mean, SD) and inferential statistics (Z-test) were applied to evaluate knowledge and adoption differences between the two groups.

Results and Discussion

A significant difference was noted in knowledge levels regarding crop-based module technologies between FFP beneficiaries and non-beneficiaries (Fig. 1, Table 1). A notably high percentage of FFP beneficiaries (40.25 %) demonstrated a high level of knowledge in comparison to 23.37 % of non-beneficiaries, pointing to the programme's success in spreading information. The number of beneficiaries with low knowledge (5.19 %) was less as compared to non-beneficiaries (16.88 %), further affirming the programme's effectiveness in narrowing the knowledge divide (17).

The proportion of respondents with medium-level knowledge in both groups indicates that farmers may possess a foundational understanding of agricultural practices. However, meaningful involvement such as attending training sessions, participating in field demonstrations and joining exposure visits in structured initiatives like the FFP is essential to further strengthen their knowledge base. The findings strongly suggest that the FFP has played a significant role in enhancing farmers' knowledge within the crop-based module. The mean knowledge score (Table 2 and Fig. 2) among beneficiaries was 9.77 (SD = 3.67) compared to 7.41 (SD = 3.28) for non-beneficiaries. The computed z-value of 5.676, which exceeds the critical value at the 0.01 significance level, confirms that participation in the FFP has a statistically significant positive effect on farmers' knowledge (8). The improved knowledge can be attributed to targeted interventions and support provided by the programme, which emphasizes scientific cultivation practices for rice and fodder production.

Adoption of technologies under crop-based module

The FFP beneficiaries exhibited a significantly higher rate of technology adoption compared to non-beneficiaries. The following results highlight the adoption percentages across key practices:

Varietal substitution in rice

71.40 % of beneficiaries adopted improved rice varieties, whereas only 41.50 % of non-beneficiaries did so.

Scientific production techniques for aromatic rice (Kalajeera)

76.60 % of beneficiaries implemented scientific methods, in contrast to just 16.80 % among non-beneficiaries.

Round the year fodder production for cross-bred milch cow

59.70 % of beneficiaries adopted fodder cultivation, whereas only 13.00 % of non-beneficiaries did so.

Fig. 3 clearly indicates the positive impact of FFP in promoting the adoption of improved agricultural technologies among participating farmers.

Categorization of adoption intensity

The adoption levels were further analyzed and categorized based on the average adoption scores of respondents (Table 3). The mean adoption score among FFP beneficiaries was 7.79 (SD = 1.34), while non-beneficiaries recorded a lower mean score of 5.31 (SD = 1.26). This result clearly indicates a greater intensity of technology adoption among FFP participants (10).

Interpretation of results

The strong difference in both knowledge and adoption levels between the two groups highlights the effectiveness of the FFP in enhancing farmer capacity and promoting technology uptake. The higher scores among beneficiaries suggest that programme interventions—such as direct support, on-field demonstrations and hands-on training—played a significant role in driving adoption.

Table 1. Categorization of respondents according to their knowledge about technologies of crop-based module

Parameter	Categories	FFP beneficiaries (n_1 = 77)		Categories	FFP non-beneficiaries (n_2 = 77)	
		f	%		*f*	%
Knowledge on crop-based module technologies	Low (up to 6.09)	4	5.19	Low (< 4.13)	13	16.88
	Medium (6.09 – 13.45)	42	54.54	Medium (4.13 – 10.69)	46	59.74
	High (>13.45)	31	40.25	High (>10.6)	18	23.37

FFP beneficiaries**:** Mean = 9.77, SD = 3.67; FFP non-beneficiaries**:** Mean = 7.41, SD = 3.28.

Table 2. Difference in knowledge about rice technologies of FFP among respondents

Parameters	Categories	Mean	SD	Z-value
Knowledge on crop-based module	FFP beneficiaries	9.766	3.677	5.676**
	FFP non- beneficiaries	7.415	3.282	

Table 3. Categorization of respondents based on adoption level of FFP crop-based technologies

FFP beneficiary			FFP non-beneficiary			Total		
Categories of adoption	Frequency	%	Categories of adoption	Frequency	%	Categories of adoption	Frequency	%
Low (<6.45)	19	24.675	Low (<4.052)	13	16.883	Low (<4.75)	20	12.987
Medium (6.45 – 9.13)	44	57.143	Medium (4.052 – 6.57)	64	83.117	Medium (4.75 – 8.34)	101	65.584
High (>9.13)	14	18.182	High (>6.57)	0	0.000	High (>8.34)	33	21.429

FFP beneficiaries: Mean = 7.792, SD = 1.341; FFP non-beneficiaries: Mean = 5.311; SD = 1.259; Total: Mean = 6.551, SD = 1.797.

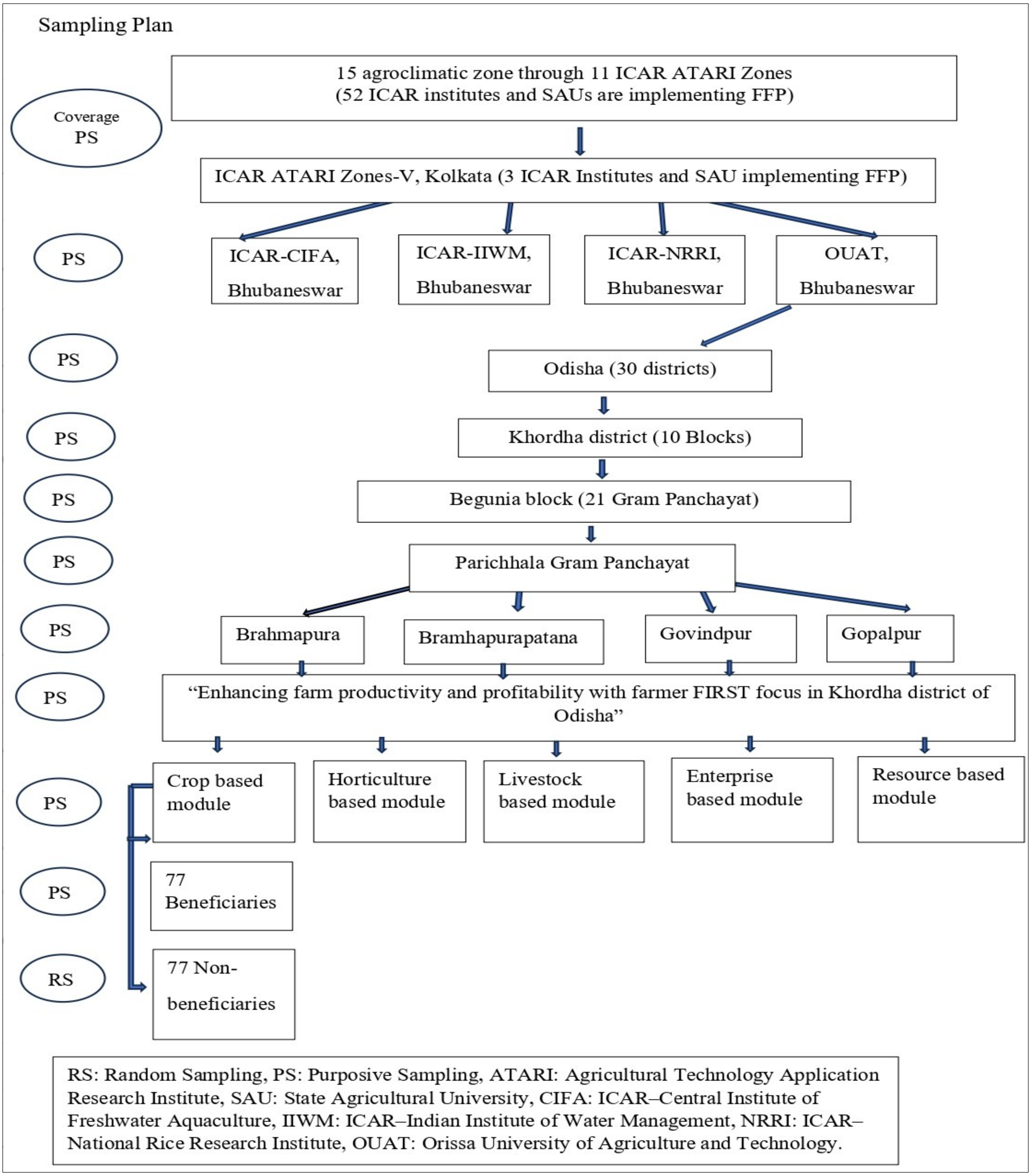

Fig. 1. Sampling procedure.

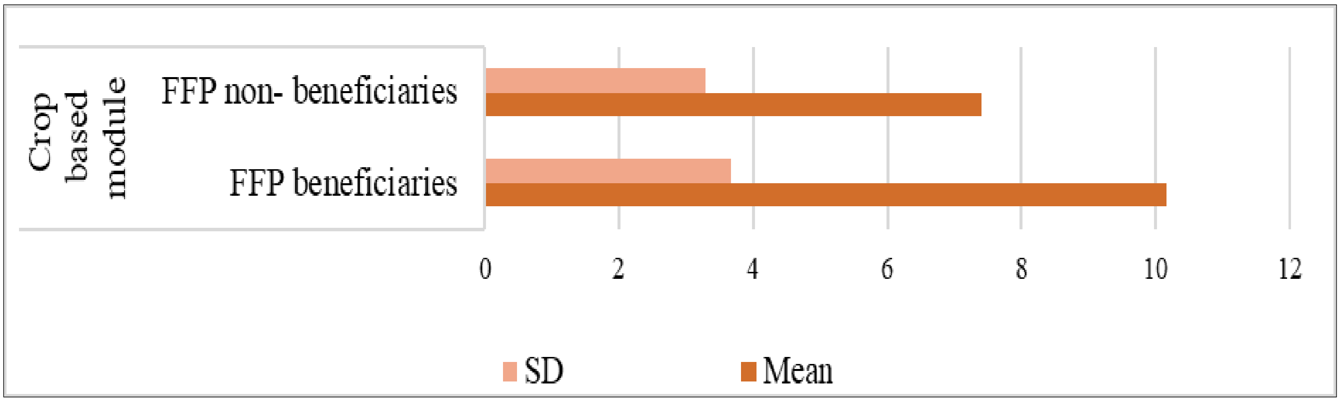

Fig. 2. Difference in knowledge about rice technologies of FFP between FFP beneficiaries and FFP non-beneficiaries.

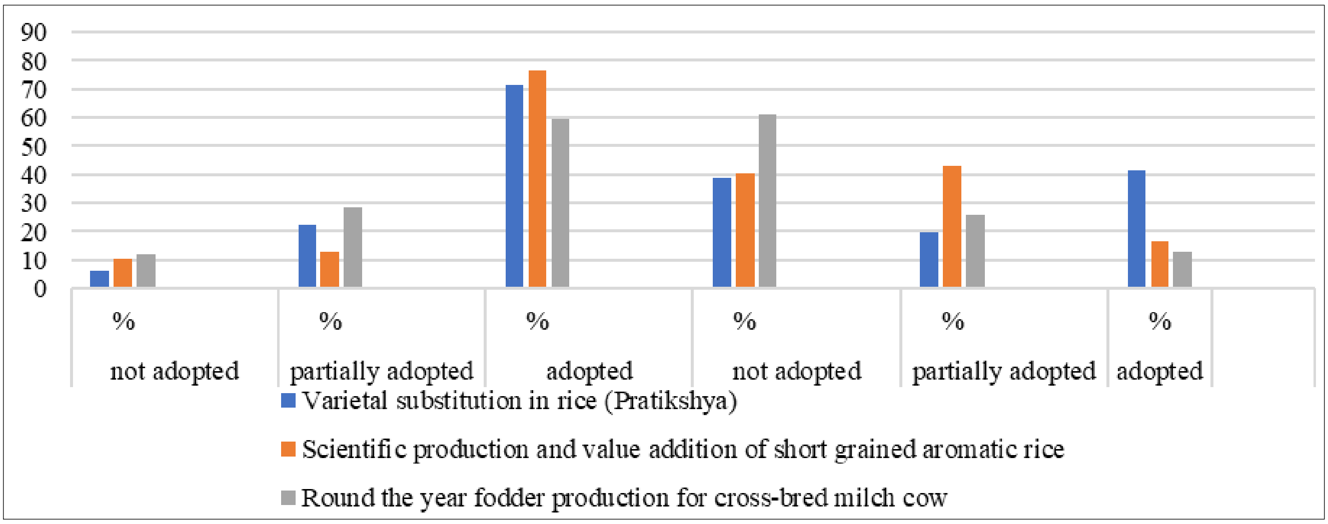

Fig. 3. Distribution of respondents based on adoption of technologies.

Notably, the relatively higher SD among beneficiaries in both knowledge and adoption scores indicates variability in impact, which implies that while many farmers benefited substantially, others may require more customized support. This underscores the need for tailored extension strategies to ensure uniform benefit distribution across diverse farming contexts (5).

Recommendations for enhanced adoption

- Organize regular training sessions and field demonstrations to strengthen farmers' understanding and confidence in applying improved technologies.
- Integrate ICT tools (such as mobile alerts, voice calls and instructional videos) to deliver continuous technical support and timely reminders following major training events, thereby promoting sustained adoption.
- Monitor and evaluate adoption behaviour periodically to identify gaps and tailor interventions for groups showing lower engagement or uptake.

Conclusion

The findings of this study highlight the positive impact of the FFP on the improvement in knowledge and adoption of crop-based technologies among small and marginal farmers. Beneficiaries demonstrated higher awareness and uptake of scientific practices, reflecting the programme's participatory and hands-on approach. This success underscores the value of farmer-centric extension strategies in driving technology dissemination and behavioural change. Continued support and tailored training are essential to sustain these gains and further empower farming communities toward sustainable agricultural development.

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Authors' contributions

The research work was conceptualized and the methodology was designed by MP in collaboration with SD. BPM contributed to the development of research methodology, data validation and manuscript refinement. AD supported the statistical analysis, interpretation of findings and visualization of results. KKS was responsible for drafting manuscript and ensuring coherence in the discussion. All authors actively participated in reviewing, editing, reading and approving the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

Ethical issues: None

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Additional information

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