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Demographic Insights and Knowledge Gain among Agricultural Input Dealers in Kerala due to Training Intervention

[1]Meenu Maheswaran, [2]Sulaja OR, [3]Shamna N, [4]Vani Chandran, [5]Anoop RL, [6]Aparna PS and [7]Neethu S Kumar

[1]Assistant Professor (C), Dept. of Agri. Extension, College of Agriculture, Padannakkad, Kerala, India
[2]Assistant Professor, Communication Centre, Mannuthy, Thrissur, Kerala, India
[3,5]Assistant Professor, Dept. of Agri. Extension, College of Agriculture, Padannakkad, Kerala, India
[4]Scientist B, Agricultural Extension, Central Silk Board, Bangalore, Karnataka, India
[6,7]Assistant Professor (C), Dept. of Agri. Statistics, College of Agriculture, Padannakkad, Kerala, India

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Corresponding Author: Meenu Maheswaran

Abstract

Agricultural input dealers serve as key intermediaries in disseminating knowledge and practices related to Integrated Nutrient Management (INM) to farmers. Conduct of INM Training programmes plays a major role in improving the knowledge and skill of input dealers about INM thereby creating a significant change in creating a favourable attitude among them for encouraging farmers to adopt INM. This study assessed the effectiveness of INM training programmes conducted for 90 input dealers across three 15-day training sessions at the College of Agriculture, Padannakkad under Kerala Agricultural University. A pre-post evaluation design was employed, using a pretested 30-item questionnaire covering soil fertility, organic manure management, fertilizer use efficiency, nutrient cycling, and integrated approaches. The results revealed significant knowledge gains post-training, with overall improvement of 116.9%, and topic-wise improvements ranging from 92.6% to 264%, indicating substantial enhancement in participants' understanding, particularly in integrated approaches and nutrient cycling. Correlation analysis showed that younger participants and those with higher education levels gained more knowledge, while participants with lower pre-training scores exhibited the largest gains. ANOVA and Tukey's post-hoc analysis confirmed that educational background significantly influenced knowledge gain. Participant feedback indicated high satisfaction with content relevance, methodology, resource persons, and training duration. The findings demonstrate that structured, interactive, and comprehensive training effectively enhances the knowledge of input dealers, reinforcing their capacity to promote sustainable nutrient management practices among farmers.

Keywords: Integrated Nutrient Management (INM), Training intervention, Knowledge Gain, Agricultural Input Dealers, Kerala, Demographic insights

Introduction

The Integrated Nutrient Management (INM) training programme aims to enhance the knowledge and practical skills of farmers and input dealers on the balanced use of organic, inorganic, and bio-fertilizers for sustainable soil fertility and crop productivity. Such training programmes play a vital role in promoting sustainable agriculture by empowering participants with the tools and understanding necessary for efficient nutrient utilization and long-term productivity. Agricultural sustainability and productivity are increasingly dependent on effective nutrient management practices. Integrated Nutrient Management (INM) represents a holistic approach that combines organic and inorganic nutrient sources to optimize crop productivity while maintaining soil health and environmental sustainability. The success of INM implementation largely depends on the knowledge and skills of agricultural input dealers who serve as crucial intermediaries between agricultural technologies and farmers.

Input dealers play a pivotal role in the agricultural value chain, serving as primary sources of information and agricultural inputs for farmers. Their knowledge and understanding of modern agricultural practices, including INM, significantly influence farming communities' adoption of sustainable agricultural technologies. Therefore, capacity building of input dealers through structured training programs becomes essential for promoting sustainable agricultural practices.

The present study was undertaken to assess the effectiveness of INM training programs conducted for agricultural input dealers and to evaluate the knowledge enhancement achieved through these interventions.

1. To analyze the demographic characteristics of input dealers
2. To assess the knowledge gained by input dealers in different domains as part of INM training
3. To analyze the relationship between demographic characteristics and knowledge gain
4. To evaluate participants' satisfaction with the training methodology

Methodology

The present investigation was carried out at the College of Agriculture, Padannakkad of Kerala Agricultural University.

KAU is the only State Agricultural University in the State of Kerala which is disseminating knowledge to farmers, facilitating transfer of knowledge and technology to farming community through training and capacity building programmes both to farmers and input dealers.

KAU has conducted INM training programme for 37 batches of the input dealers across different centres. For the present study, three batches of trainees have been selected as respondents. A pre-post training evaluation design was employed to assess the effectiveness of the INM training program. Input dealers interested and registered for attending the three INM training programs organized by the college comprising of 90 input dealers (30 in each training session) constituted the sample size of the study.

Three training programs of 15 days each were conducted, with each batch comprising 30 beneficiaries. The training was designed to provide a comprehensive learning experience, including theoretical lectures on INM principles, interactive discussions on practical applications, hands-on demonstrations, case study analyses, and field visits to demonstration plots, ensuring that participants gained both conceptual knowledge and practical skills in integrated nutrient management.

A pretested questionnaire containing 30 multiple-choice questions was developed to cover major aspects of INM. The instrument was prepared by training coordinators in consultation with subject matter specialists and resource persons, addressing topics such as soil fertility management, organic manure application, fertilizer use efficiency, nutrient cycling, and sustainable agriculture practices.

Data collection involved a pre-test administered on the first day before the training and a post-test on the last day to assess knowledge gain. Additionally, demographic information including age, sex, education level, and experience was collected. Descriptive statistics summarized demographic data and correlation analysis was performed to assess relationships between variables, and knowledge improvement was calculated using the formula

Percentage change calculation using the formula:

$$\text{Percentage change in knowledge} = \frac{\text{Post-test score} - \text{Pre-test score}}{\text{Pre-test score}} \times 100$$

The significance level was set at $\alpha = 0.05$.

In addition to descriptive statistics, percentage change, and correlation analysis, further statistical procedures were employed to examine the role of demographic variables in knowledge gain. Specifically, a one-way Analysis of Variance (ANOVA) was conducted to test whether the mean knowledge gain differed significantly across participants with different educational levels (High School, Higher Secondary, Graduate, and Post Graduate).

The null hypothesis (H_0) assumed no difference in knowledge gain among education categories, while the alternative hypothesis (H_1) assumed at least one group mean was significantly different. The ANOVA was carried out at a 5% level of significance ($\alpha = 0.05$). Following a significant ANOVA result, a Tukey's Honest Significant Difference (HSD) post-hoc test was applied to determine pairwise group differences and to identify which education categories varied significantly in their mean knowledge gain. This ensured rigorous identification of specific contrasts beyond the overall group effect detected by ANOVA.

Results And Discussion

I. Demographic Characteristics of participants

Tabe 1: Demographic characteristics of participants

Characteristic	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)	Total (n=90)
Age Distribution				
20-30 years	8 (26.7%)	10 (33.3%)	9 (30.0%)	27 (30.0%)
31-40 years	12 (40.0%)	11 (36.7%)	13 (43.3%)	36 (40.0%)
41-50 years	7 (23.3%)	6 (20.0%)	5 (16.7%)	18 (20.0%)
>50 years	3 (10.0%)	3 (10.0%)	3 (10.0%)	9 (10.0%)
Education Level				
High School	5 (16.7%)	6 (20.0%)	4 (13.3%)	15 (16.7%)
Higher Secondary	15 (50.0%)	14 (46.7%)	16 (53.3%)	45 (50.0%)
Graduate	8 (26.7%)	9 (30.0%)	8 (26.7%)	25 (27.8%)
Post Graduate	2 (6.7%)	1 (3.3%)	2 (6.7%)	5 (5.6%)
Experience				
<5 years	10 (33.3%)	12 (40.0%)	11 (36.7%)	33 (36.7%)
5-10 years	12 (40.0%)	10 (33.3%)	11 (36.7%)	33 (36.7%)
>10 years	8 (26.7%)	8 (26.7%)	8 (26.7%)	24 (26.7%)

The socio-personal characteristics of the respondents in 3 groups showed that the majority were in the 31-40 years age group (40.0%), followed by 20-30 years (30.0%) and 41-50 years (20.0%), while only 10.0% were above 50 years. This indicates that most participants belonged to the young and middle-aged categories, suggesting a dynamic group actively engaged in their professional activities. When comparing across groups, the distribution was fairly even, showing no major age-related skewness.

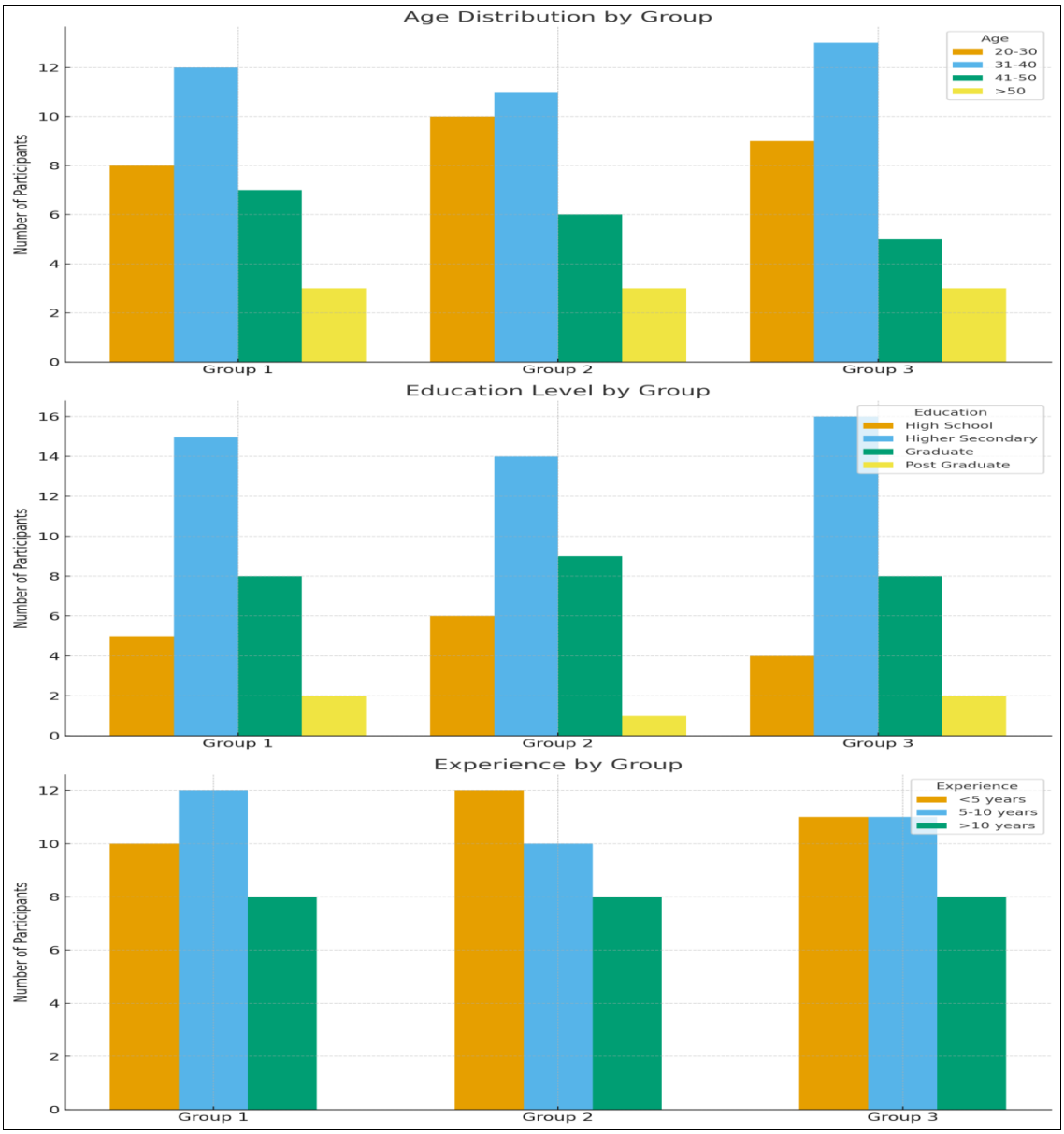

Fig 1: Demographic characteristics of participants

In terms of education, half of the respondents (50.0%) had higher secondary education, while 27.8% were graduates, 16.7% had studied up to high school, and only 5.6% were postgraduates. This shows that the majority had at least higher secondary or graduate-level qualifications, reflecting a reasonably educated respondent pool. Regarding experience, 36.7% each had less than 5 years and 5-10 years of experience, while 26.7% had more than 10 years, indicating a balanced mix of fresh, mid-level, and experienced participants across the groups.

II. Knowledge Level of Input Dealers On Integrated Nutrient Management Before And After Training

Table 2: Knowledge Level of Input Dealers On Integrated Nutrient Management Before And After Training

Training Group	Pre-training Score (Mean ± SD)	Post-training Score (Mean ± SD)	Mean Difference	Percentage Improvement
Group 1	12.43 ± 3.21	29.80 ± 2.15	17.37	139.7%
Group 2	14.67 ± 3.89	28.53 ± 2.87	13.87	94.5%
Group 3	13.20 ± 3.56	29.07 ± 2.45	15.87	120.2%
Overall	13.43 ± 3.55	29.13 ± 2.49	15.70	116.9%

The pre-training and post-training score comparison demonstrates remarkable improvement across all training groups. Group 1 showed the highest absolute improvement (17.37 points) and percentage improvement (139.7%), starting from the lowest baseline score of 12.43. Group 2, despite having the highest pre-training score (14.67), showed the smallest improvement (94.5%), which may indicate a ceiling effect where participants with higher initial knowledge have less room for improvement. Group 3 demonstrated balanced performance with substantial

improvement (120.2%). The reduction in standard deviation from pre-training (3.55) to post-training (2.49) indicates that the training not only improved overall knowledge but also reduced variability among participants, suggesting consistent learning outcomes. The overall improvement of 116.9% represents more than doubling of knowledge scores, indicating highly effective training intervention. The post-training scores clustering around 29 out of 30 (96.7% accuracy) demonstrate near-mastery of the training content across all groups.

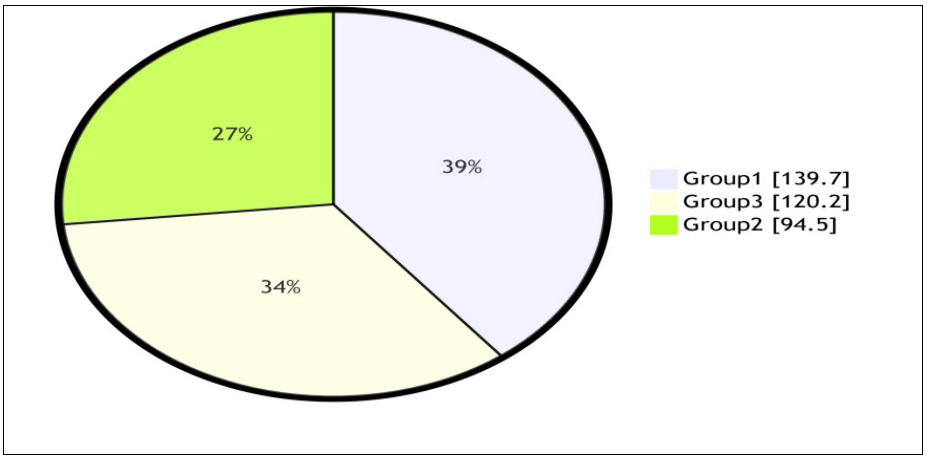

Fig 2: Knowledge Level of Input Dealers On Integrated Nutrient Management Before And After Training

III. Topic Wise Knowledge Analysis in Specific Areas of Integrated Nutrient Management

Table 3: Topic Wise Knowledge Analysis in Specific Areas of Integrated Nutrient Management

INM Topic Area	Pre-training (% Correct)	Post-training (% Correct)	Improvement (%)
Soil Fertility Principles	35.2	89.7	154.8
Organic Manure Management	42.1	91.3	116.9
Fertilizer Application	48.9	94.2	92.6
Nutrient Cycling	28.7	86.4	201.0
Soil Testing	31.5	88.9	182.2
Integrated Approaches	25.3	92.1	264.0

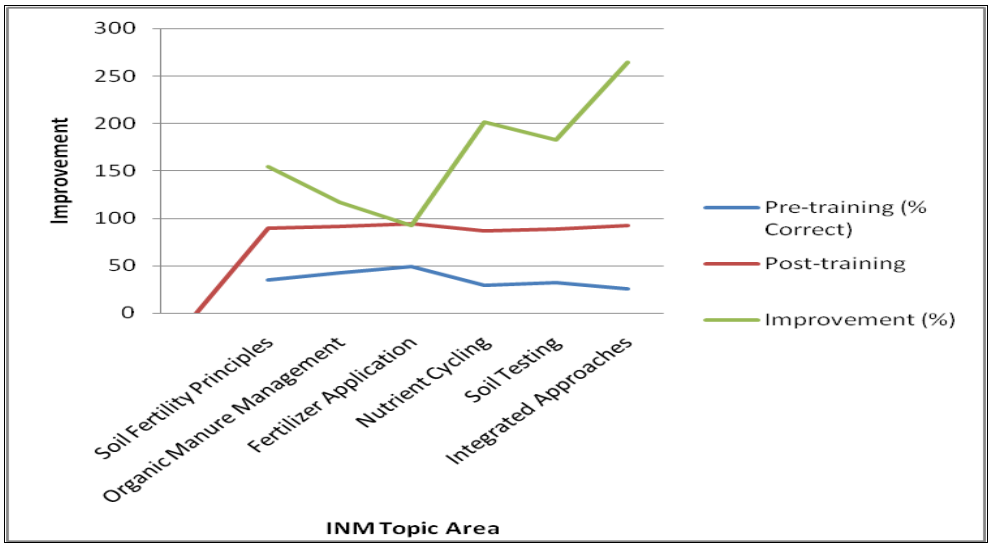

Fig 3: Topic Wise Knowledge Analysis in Specific Areas of Integrated Nutrient Management

The topic-wise analysis revealed significant knowledge gaps in participants' initial understanding and demonstrates the comprehensive effectiveness of the training program across all subject areas. "Integrated Approaches" showed the most dramatic improvement (264.0%), starting from the lowest baseline (25.3%) and achieving excellent post-training performance (92.1%). This finding is particularly important as integrated approaches represent the core philosophy of INM, suggesting that participants initially lacked understanding of holistic nutrient management concepts but successfully mastered them through training. "Nutrient Cycling" and "Soil Testing" also showed substantial improvements (201.0% and 182.2% respectively), indicating that these technical concepts were effectively

communicated despite their complexity. "Fertilizer Application" had the smallest improvement (92.6%) but started from the highest baseline (48.9%), suggesting that participants had some prior knowledge in this area, which is expected given their role as input dealers. The consistently high post-training scores (86.4% to 94.2% across all topics) demonstrate that the training successfully addressed knowledge gaps and achieved comprehensive understanding across all critical areas of integrated nutrient management.

IV. Relationship Between demographic characteristics and Knowledge Gain

Table 4: Relationship between demographic characteristics and knowledge gain

Variable	Correlation with Knowledge Gain	P-value
Age	-0.234	0.026*
Education Level	0.312	0.003**
Experience	0.189	0.076
Pre-training Score	-0.445	0.000***

*p < 0.05, **p < 0.01, ***p < 0.001

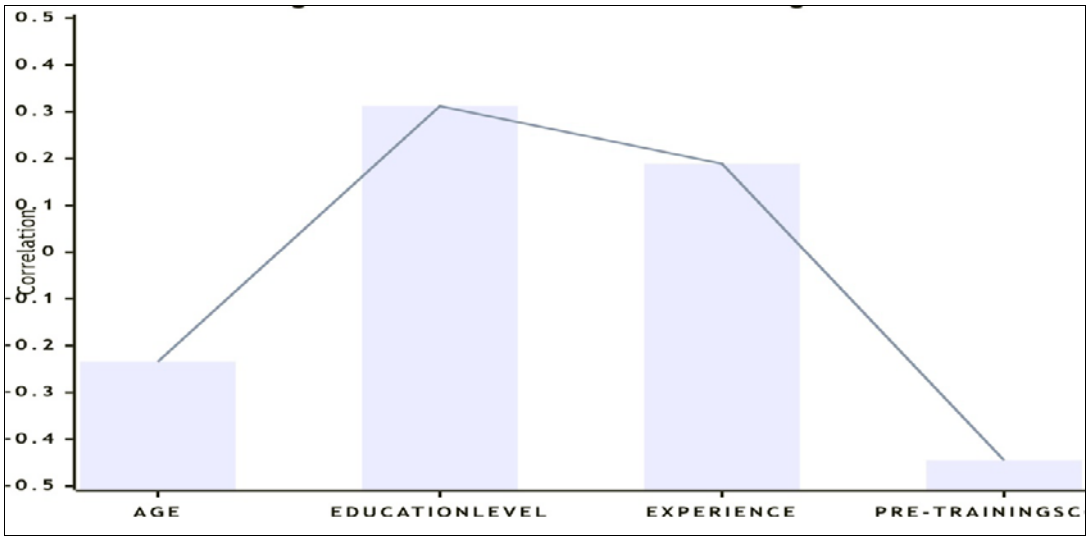

Fig 4: Relationship between demographic characteristics and knowledge gain

The correlation analysis revealed important relationships between participant characteristics and learning outcomes. The significant negative correlation between age and knowledge gain ($r = -0.234$, $p < 0.05$) suggests that younger participants benefited more from the training, possibly due to greater cognitive flexibility and openness to new information. Education level shows a moderate positive correlation ($r = 0.312$, $p < 0.01$), indicating that participants with higher educational backgrounds were better able to assimilate and integrate new knowledge, likely due to enhanced learning skills and conceptual understanding abilities. Experience shows a weak positive correlation ($r = 0.189$, $p = 0.076$) that approaches but does not reach statistical significance, suggesting that while experience may contribute to learning, it is not as critical as educational background. The strongest correlation is the negative relationship between pre-training score and knowledge gain ($r = -0.445$, $p < 0.001$), demonstrating a clear ceiling effect where participants with lower initial knowledge showed greater improvement potential. This finding validates the training's effectiveness in addressing knowledge gaps and suggests that the program was particularly beneficial for participants with limited prior INM knowledge.

V. Education-wise Analysis of Knowledge Gain by input dealers

Kerala is widely recognized for its exceptional educational achievements and high literacy rates, which are reflected across various professional sectors, including agriculture. The participants of agricultural training programmes, such as the Integrated Nutrient Management (INM) training, represent a well-educated cross section of the state's population. Unlike in many other regions, where agricultural extension trainees often possess only basic schooling, Kerala's participants frequently hold higher secondary or graduate-level qualifications. This high level of educational attainment enhances their ability to comprehend scientific principles, adopt innovative technologies, and serve as effective intermediaries in disseminating agricultural knowledge.

A recent study "Effectiveness of certificate course on integrated nutrient management for fertilizer dealers" (Sathiswaran R.,) provides clear data on the qualifications of participants. Among those who did the online INM course, 54% were having graduation or above level of education; the rest had higher secondary (23.33%) or secondary (22.67%) education. Among the offline INM course participants, 58% had graduation or above; the rest similarly were in higher secondary (about 28.66%) or secondary levels (about 13.34%).

In the present study, we examined the influence of education on knowledge gain, a one-way ANOVA was conducted to compare mean scores across four educational categories (High School, Higher Secondary, Graduate, and Post Graduate). The analysis revealed a statistically significant difference in knowledge gain among the groups

($F(3, 86) = 12.81$, $p < 0.001$), confirming that education level played a decisive role in shaping training outcomes.

Table 5: Mean Knowledge Gain by Education Level

Education Level	n	Mean Knowledge Gain	SD (approx)
High School	15	13.03	2.4
Higher Secondary	45	14.98	2.6
Graduate	25	16.97	2.5
Post Graduate	5	18.86	2.1

Table 6: ANOVA Results

Source of Variation	df	F-value	p-value
Between Groups	3	12.81	<0.001***
Within Groups	86		
Total	89		

*p < 0.001 (highly significant)

Post-hoc comparisons using Tukey's HSD test were carried out to identify specific group differences.

Table 7: Tukey's HSD Pairwise Comparison

Comparison	Mean Difference	p-value	Significant?
Graduate vs. High School	-3.94	<0.001	✔ Yes
Graduate vs. Higher Secondary	-1.99	0.006	✔ Yes
Graduate vs. Post Graduate	+1.90	0.361	✗ No
High School vs. Higher Secondary	+1.95	0.034	✔ Yes
High School vs. Post Graduate	+5.84	<0.001	✔ Yes
Higher Secondary vs. Post Graduate	+3.89	0.004	✔ Yes

The post-hoc analysis confirmed that both Graduates and Post Graduates achieved significantly higher knowledge gains compared to High School and Higher Secondary groups. Post Graduates outperformed High School participants by the widest margin (+5.84, $p < 0.001$), while no significant difference was found between Graduates and Post Graduates ($p = 0.361$), suggesting that knowledge gains plateau beyond the graduate level.

These findings demonstrate a clear gradient: higher education levels were associated with greater knowledge improvement from the INM training program. This result complements the earlier correlation analysis ($r = 0.312$, $p < 0.01$), which also indicated a positive relationship between education and knowledge gain. Together, these analyses confirm that participants with higher educational backgrounds are better able to assimilate and apply the concepts of integrated nutrient management, underscoring the importance of tailoring training methodologies to the educational profile of the target audience.

VI. Participants' Satisfaction with the Training Methodology

Table 8: Participants' satisfaction with the training methodology

Satisfaction Parameter	Excellent (%)	Good (%)	Average (%)	Poor (%)
Content Relevance	72.2	23.3	4.4	0.0
Training Methodology	68.9	26.7	4.4	0.0
Resource Person Quality	75.6	21.1	3.3	0.0
Training Duration	63.3	32.2	4.4	0.0
Overall Satisfaction	71.1	25.6	3.3	0.0

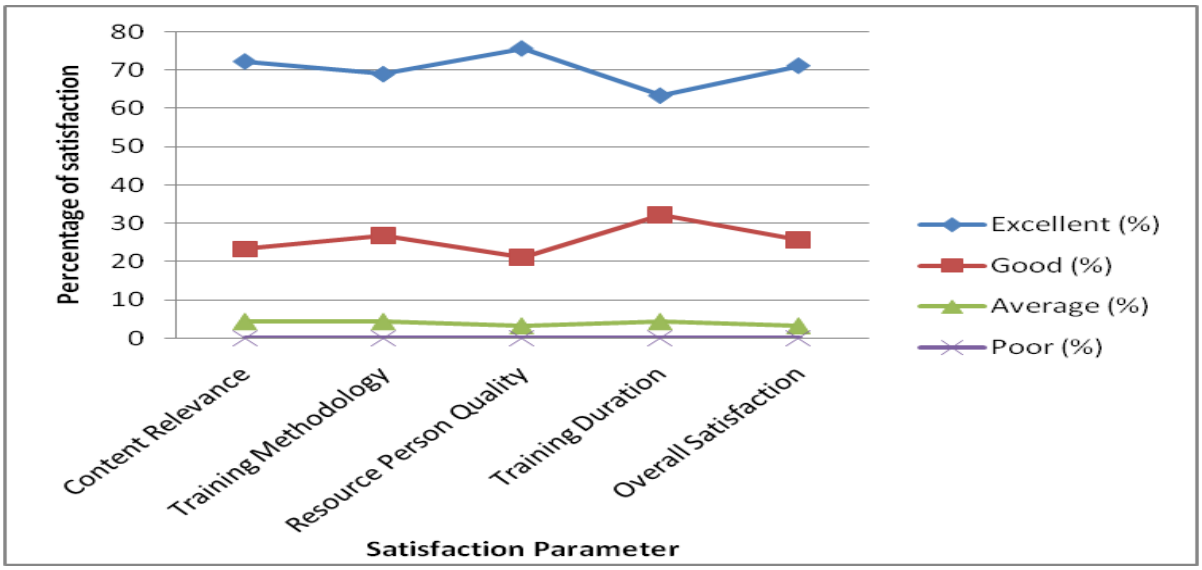

Fig 8: Participants' satisfaction with the training methodology

The feedback shows that the training was highly effective, with 72.2% rating content relevance as excellent and 23.3% as good, while 68.9% rated the methodology excellent and 26.7% good. The resource person received the highest appreciation with 75.6% rating excellent and 21.1% good. Training duration, though slightly lower, still had 63.3% excellent and 32.2% good ratings. Overall satisfaction was strong, with 71.1% rating excellent and 25.6% good. Importantly, no parameter received a poor rating, showing that the program was very well-received and met participant expectations.

Conclusion

The results clearly demonstrate that the INM training program was highly effective in enhancing the knowledge levels of agricultural input dealers. Across all three training groups, significant improvements were observed ($p < 0.001$) with large effect sizes, indicating that the intervention successfully met its objectives.

The overall knowledge improvement of 116.9% reflects

exceptional training effectiveness, driven by a comprehensive curriculum covering all aspects of INM, an interactive methodology combining theory and practical sessions, expert resource persons with extensive field experience, and an appropriate training duration that allowed participants to assimilate information effectively. Demographically, younger participants tended to gain more knowledge, suggesting higher receptiveness to new information, while higher education levels were associated with better learning outcomes. Topic-wise analysis revealed that participants initially had the lowest understanding of integrated approaches (25.3% correct responses) but achieved the highest improvement (264.0%) in this area, highlighting the critical role of holistic training in nutrient management concepts.

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Conflict of Interest
The authors of paper declare no conflict of interest

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