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Kirkpatrick Model Assessment of Nutmeg Farming Training in North Maluku

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ABSTRACT

Nutmeg, a strategic export commodity for Indonesia, faces challenges in productivity and quality due to farmers' limited knowledge of proper cultivation techniques. This study assessed the effectiveness of technical training in nutmeg cultivation using the Kirkpatrick model. Conducted in four North Maluku locations between September and November 2022, the study involved nutmeg farmers and agricultural extension workers. Level-1 evaluation (participant feedback) was gathered through questionnaires, while Level-2 (learning outcomes) utilized pre- and post-test assessments. Data analysis with SPSS (t-test) revealed overall participant satisfaction and a significant knowledge increase. However, some participants showed decreased knowledge post-training, highlighting a need to identify causes and improve training effectiveness. The Kirkpatrick Model proved valuable for evaluating technical training in nutmeg farming and can guide future agricultural evaluations.

Keywords: Farmer, Kirkpatric, nutmeg, technical training

INTRODUCTION

Nutmeg is a highly valued spice crop that is widely used in culinary and medicinal applications. It is native to the North Maluku Islands of Indonesia (Van Gils & Cox, 1994) and is one of the country's most important agricultural exports (Hafif, 2021) (Purba et al., 2021). North Maluku plays a key role in Indonesian nutmeg production, with a 2023 output of 6,106 tons grown on an area of 70.533 hectares (BPS, 2024). The nutmeg tree (*Myristica fragrans*) produces two valuable products: the nutmeg seed, which is used as a spice, and the mace, which is a lacy covering of the seed that is also used as a spice (Gordon, 2020).

Nutmeg is a highly nutritious and antibacterial spice. According to a study by (Okiki et al., 2023), it is rich in fat, protein, and carbohydrates, which can provide the body with energy. Additionally, nutmeg contains a variety of vitamins and minerals, such as calcium, potassium, phosphorus, magnesium, iron, and ascorbic acid, and has low levels of zinc, thiamine, niacin, and riboflavin. Furthermore, nutmeg powder is high in alkaloids, phytates, tannins, oxalates, flavonoids, and terpenoids, and low in saponins, antioxidants, and protease inhibitors. The content of these essential nutrients must be maintained through good cultivation practices and good handling practices.

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Despite favorable growing conditions in the region, productivity and quality remain suboptimal (Assagaf et al., 2021). The research has shown that the low productivity and poor quality of nutmeg are a result of farmers' lack of knowledge and skills. To improve this, the study suggests that technical training is necessary to enhance farmers' understanding and abilities in nutmeg cultivation (Sulistiono et al., 2022). Technical training emerges as a crucial intervention to enhance farmer capabilities and consequently, nutmeg production outcomes (Masta & Janjhua, 2020).

Effective technical training is crucial for cultivating and handling nutmeg in Indonesia. The country's tropical climate and high humidity provide ideal growing conditions for the crop, but farmers still need guidance on the best practices for planting, care, and harvesting of the trees (Sulistiono et al., 2022). Proper pruning, fertilization, and pest management are essential for optimal nutmeg yields (Lubbe & Verpoorte, 2011). Additionally, technical training is also important for processing the nutmeg and mace, which involves drying, cleaning, and grading the spices to ensure high quality and market value.

In addition to its economic importance, nutmeg also plays a significant role in the cultural and social fabric of the North Maluku Islands and other regions of Indonesia where it is grown. The technical training tailored to these regions' unique cultural and social contexts can help ensure that nutmeg cultivation is sustainable and equitable for all stakeholders. However, access to technical training is not always easy for farmers and processors in Indonesia, particularly in remote or underdeveloped areas. There is a need for more effective and accessible technical training programs to support the sustainable cultivation and processing of nutmeg in Indonesia. The evaluation must be carried out systematically and continuously for improvement for the success of training, it is necessary to carry out a training evaluation (Septriani et al., 2022). This is where the Kirkpatrick model can be used to evaluate the impact of the training programs and identify areas that need improvement (Chernbumroong et al., 2022).

The Kirkpatrick Model is a widely used framework for evaluating the effectiveness of training and education programs (Kirkpatrick & Kirkpatrick, 2007). Developed by Donald Kirkpatrick in 1959, the model suggests that 4 levels of evaluation should be considered when assessing a training program: (Level-1) Reaction, (Level-2) Learning, (Level-3) Behaviour, and (Level-4) Results. The Kirkpatrick model can be used to evaluate the impact of technical training on nutmeg processing by assessing the effectiveness of the technical training program at each of these two levels. This study aimed to assess the effectiveness of technical training in nutmeg farming in Indonesia using up to Level-2 (Learning) of Kirkpatrick model.

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METHODS

This cross-sectional study assessed the effectiveness of technical training in nutmeg cultivation and handling through a one-day program organized by the North Maluku Assessment Institute for Agricultural Technology (AIAT North Maluku) between September and November 2022. The training, conducted by experienced extension professionals, targeted nutmeg farmers and agricultural extension workers across four North Maluku locations: West Halmahera, Tidore Islands City, Ternate City, and South Halmahera. Data was collected from 211 training participants.

Following Kirkpatrick's model, Level-1 evaluation (participant reaction) utilized a questionnaire administered

post-training. The questionnaire was designed based on general guidelines for technical training and consisted of three sections. In the first section, participants were asked to rate the overall quality of the training using a five-point scale, ranging from "Excellent" to "very poor." The second section of the questionnaire included ten questions related to the participants' attitudes towards the training objectives, which were rated on a five-point Likert scale from "strongly agree" to "strongly disagree." However, only 6 items were considered valid. The final section consisted of open-ended questions, which provided an opportunity for participants to provide feedback on useful aspects of the training and other relevant information.

Level-2 evaluation (learning outcomes) involved a pre- and post-training assessment using a 12-item multiple-choice test, validated by the North Maluku nutmeg research team. Scores were standardized to a 100-point scale. Data analysis was performed using SPSS version 25, employing a t-test to compare mean pre- and post-test scores.

The second level of evaluation (Level-2), utilizing the Kirkpatrick model, to evaluate the learning outcomes of the technical training program, a pre-test and post-test assessment was conducted. The pre-test was administered prior to the training and the post-test was administered at the conclusion of the training, to measure changes in knowledge, understanding, and application of good cultivation and handling practices for nutmeg products. The difference between the pre-test and post-test scores was used to estimate the impact of the training. The assessment was in the form of a written test consisting of 12 multiple-choice questions (MCQ), each worth one point for a total of 12 points. To standardize the scores, they were divided by 12 and multiplied by 100, resulting in a scale with a maximum range of 100. The content validity of the assessment instrument was established through review and evaluation by the North Maluku nutmeg research team. Participants were given 20 minutes to complete the test. Data was entered and analyzed using SPSS version 25, and a t-test was used to compare the mean difference between the pre-test and post-test scores.

RESULTS AND DISCUSSION

The study sample (n=211) primarily comprised male participants (63%), with an average age of 44.4 years. The majority fell within the "Gen X" (43-57 years) and "Gen Y/Millennial" (26-42 years) age groups. Educationally, most held a bachelor's degree (36%) or were high school graduates (34%). Occupationally, farmers constituted the largest group (56%), followed by agricultural extension workers (26%) and female farmers (18%). These demographics reflect the typical profile of individuals engaged in nutmeg cultivation in the region.

Overall, participant reactions to the technical training were positive, with scores ranging from 4.26 to 4.57 (out of 5) across the five evaluated subcategories. Trainer competency and training materials received the highest ratings, with over 60% of participants rating them as "Excellent". This aligns with previous research highlighting the importance of competent trainers and relevant materials in agricultural training programs (Masta & Janjhua, 2020). Notably, 'duration' was the lowest-rated aspect, with only 45% of participants rating it as "Excellent" (Figure 1). This suggests a potential need for adjusting training duration or content to optimize engagement and learning outcomes. This finding is consistent with studies emphasizing the importance of appropriate training duration to avoid

information overload and fatigue (Chernbumroong et al., 2022). The identification of 'duration' as an area for improvement offers specific actionable insights for future training program design.

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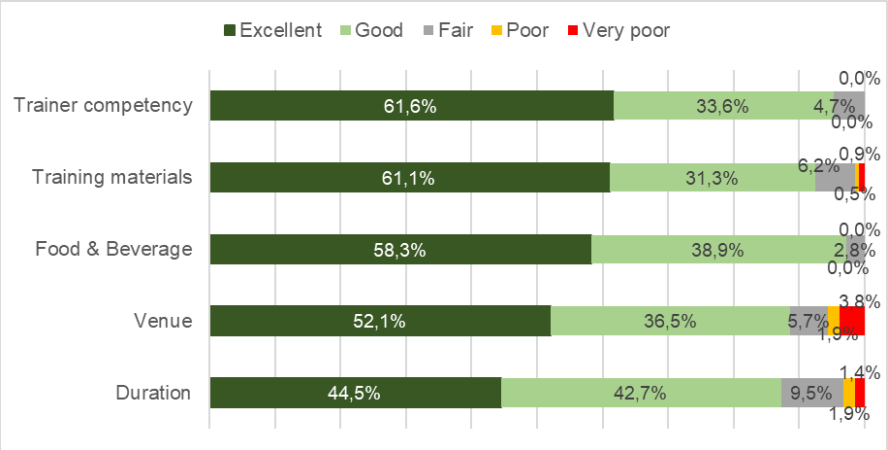


Figure 1.
Overall rating of technical training

Table 1 reveals that the technical training on nutmeg farming elicited largely positive reactions from participants. An overwhelming majority (82.9%) strongly agreed with the importance of seed selection in nutmeg cultivation, highlighting a recognition of this critical aspect among farmers. This aligns with previous studies emphasizing the role of quality planting material in enhancing nutmeg yield and quality (Assagaf et al., 2021) (Mini Raj et al., 2023). High agreement levels were also observed for other components like fertilization strategies and integrated pest management, indicating the relevance of these topics to the farmers' needs.

However, the component related to value-added nutmeg processing and products garnered less than half of the participants' strong agreement. This suggests a potential knowledge gap or perhaps a lower perceived priority for value addition among the farmers. This finding diverges from the growing emphasis in agricultural extension on promoting value addition as a means to increase farmer incomes and enhance market competitiveness (Danso-Abbeam et al., 2018)

The Level-2 evaluation, focused on knowledge retention, employed a pre- and post-test design to gauge the impact of the technical training on participants' theoretical understanding of nutmeg cultivation and processing. The results, summarized in Figure 2, reveal a mixed picture with both encouraging improvements and areas requiring attention.

While the data indicate an overall increase in knowledge, this improvement was not uniform across all topics. Only two topics – "The ideal composition of male & female nutmeg plants" and "The process of creating nutmeg juice" – saw more than 80% of participants answering correctly post-training. This suggests that certain aspects of the training were more effectively absorbed than others, warranting further investigation into the factors influencing knowledge acquisition.

Table 1.
Participant reactions to implementation good farming practices of nutmeg

Components	Strongly agree		Agree		Neutral		Disagree		Strongly Disagree		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%
Importance of Seed Selection in Nutmeg Cultivation	175	82,9 %	29	13,7 %	4	1,9 %	0	0,0 %	0	0%	3	1,4 %
Fertilization Strategies for Optimal Nutmeg Yields	130	61,6 %	70	33,2 %	4	1,9 %	0	0,0 %	2	1%	5	2,4 %
Seed Source Selection in Nutmeg Cultivation Using Mother Tree Selection	111	52,6 %	69	32,7 %	7	3,3 %	9	4,3 %	14	7%	1	0,5 %
Integrated Pest Management in Nutmeg Farming	130	61,6 %	68	32,2 %	8	3,8 %	3	1,4 %	0	0%	2	0,9 %
Value-Added Nutmeg Processing and Products	103	48,8 %	77	36,5 %	8	3,8 %	18	8,5 %	3	1%	2	0,9 %
Utilization of Nutmeg Waste for Secondary Products	122	57,8 %	71	33,6 %	9	4,3 %	2	0,9 %	3	1%	4	1,9 %
Increasing the Value of Nutmeg Fruit Flesh through Processing and Utilization.	118	55,9 %	71	33,6 %	14	6,6 %	7	3,3 %	0	0%	1	0,5 %

Source: Primary data analysis, 2022

A particularly concerning finding is the decrease in correct responses for the topic of "Postharvest handling of nutmeg." This unexpected decline suggests potential confusion or distraction during the training session, highlighting the need for instructional refinement in this area.

These findings resonate with previous research emphasizing the importance of clear and engaging training methods in agricultural extension (Nettle et al., 2022). The varying levels of knowledge gain across different topics also underscore the complexity of knowledge transfer and the need for tailored instructional approaches that

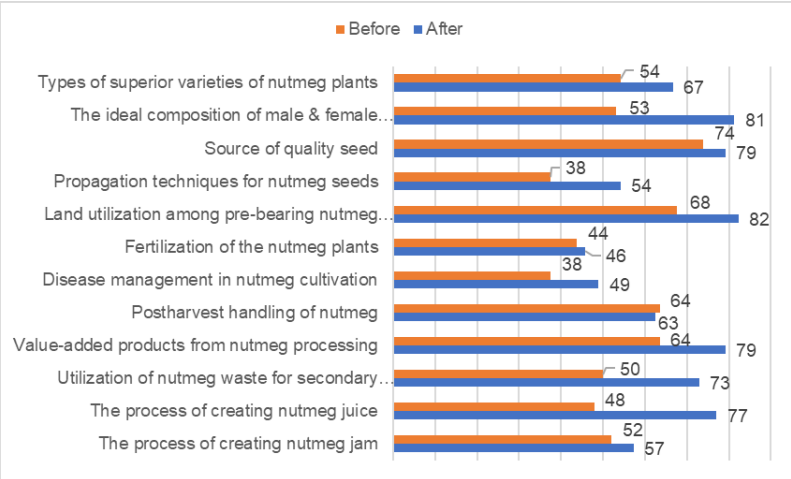
address diverse learning styles and prior knowledge levels

The mean of the scores and standard deviations are displayed in Table 2. There was statistical significantly difference between the pre and post-test. The average value of the pre-test is 53.9 + 11.5. Meanwhile, the post-test score was 67.2 +13.1. The results of the t-test showed that the pre-test and post-test were significantly different. The correlation level of the two tests was 0.69 which was classified as highly intermediate.

The results of the post-test assessment revealed that the participants' mean score of 67.2, while an improvement from the pre-test score of 53.9, is still considered unsatisfactory. This is likely since the initial baseline of the participants' knowledge of good nutmeg farming practices was relatively low. Despite a 13.3-point increase, the mean score remains well below the desired threshold of 80. These findings indicate that further interventions and improvements are needed in order to enhance the knowledge and skills of nutmeg farmers.

The paired samples t-test revealed a statistically significant difference between pre- and post-test scores (Table 2). The mean score increased from 53.9 (SD = 11.5) in the pre-test to 67.2 (SD = 13.1) in the post-test. This 13.3-point improvement suggests that the technical training positively impacted participants' knowledge of good nutmeg farming practices. The moderate-to-high correlation (r = .695, p = .012) between the pre- and post-test scores further supports the notion that the training influenced the observed changes.

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Source: Primary data analysis, 2022

Figure 2.
Percentage of correct answers for questions of the pre and post-test in technical training of nutmeg farming

While the statistically significant increase in scores is encouraging, the post-test mean of 67.2 falls short of the desired threshold of 80, indicating that further knowledge and skill enhancement is necessary. This aligns with the observation that some topics in the post-test showed limited improvement or even a decline in correct responses, as seen in Table 2. The relatively low baseline knowledge (pre-test mean of 53.9) underscores the existing knowledge gap

among nutmeg farmers, which the training program partially addressed but did not fully bridge.

These findings resonate with previous research highlighting the challenges in achieving substantial and sustainable improvements in farmer knowledge and practices through short-term training programs (Lei & Yang, 2024). They emphasize the need for a multi-faceted approach to agricultural extension, combining training with ongoing support and reinforcement to ensure lasting impact.

Table 2.
Mean and standard deviations result from participants in different test

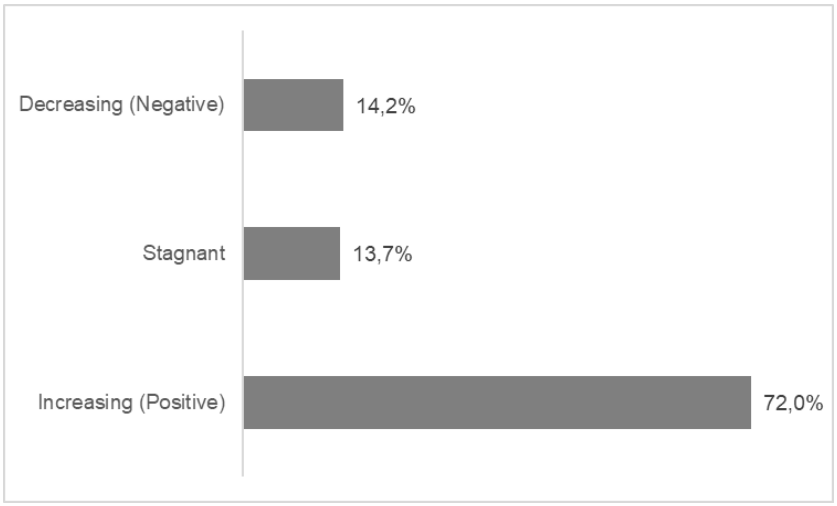
Pair Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre	53.9167	12	11.54011	3.33134
	Post	67.2500	12	13.12267	3.78819

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre & Post	12	.695	.012

Source: Primary data analysis, 2022



Source: Primary data analysis, 2022

Figure 3.
Percentage of participants individual knowledge evaluation about good farming practices on nutmeg after technical training program

A closer examination of individual participant performance revealed a nuanced picture of knowledge change following the technical training. While the overall mean scores showed a statistically significant increase, the individual-level data reveals that not all participants benefited equally. Notably, 14.2% of participants experienced a decrease in their knowledge scores, and an additional 13.7% demonstrated stagnant scores, indicating no significant improvement. This translates to a concerning 27.9% of participants for whom the training did not result in a measurable knowledge gain (Figure 3).

This observation challenges the assumption that training universally leads

to positive learning outcomes. It aligns with previous research highlighting the heterogeneity in learning experiences and the potential for individual differences to influence training effectiveness (Traut et al., 2021). Factors such as prior knowledge (Andres & Petersen, 2002; Eshuis & Stuiver, 2005; Ritonga et al., 2019), motivation, learning style (Chow et al., 2011), and engagement (Chow et al., 2011; Kiptot & Franzel, 2015) during the training could have contributed to the observed variation in knowledge change.

Furthermore, the finding that a subset of participants experienced a decrease in scores raises questions about potential negative impacts of the training. This could be attributed to confusion arising from new information, or a mismatch between training content and participants' existing knowledge and expectations. This phenomenon, though less frequently reported, has been observed in other training contexts (D'Mello et al., 2014).

CONCLUSION

This study, utilizing the Kirkpatrick model up to Level-2 (Learning), assessed the effectiveness of technical training in nutmeg farming in Indonesia. While participants expressed general satisfaction with the program, pre- and post-test assessments revealed a concerning knowledge decline in some individuals. This underscores the need for further research to pinpoint the causes of this discrepancy and develop strategies for more inclusive and effective training programs. Tailoring training materials to the specific cultural context, providing ongoing farmer support, and continuous program evaluation and adaptation are crucial steps towards achieving nutmeg excellence. The study ultimately reaffirms the importance of technical training as a continuous investment in enhancing nutmeg production and improving farmer livelihoods.

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