Proceedings of the 12th International Conference on Agriculture, Vol. 10, Issue 1, 2025, pp. 85-98
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ISSN 2682-7018 online
DOI: https://doi.org/10.17501/26827018.2025.10106

KNOWLEDGE AND ADOPTION LEVEL TO THE TECHNICAL PACKAGE OF VANILLA CULTIVATION (*Vanilla planifolia*): A CASE STUDY IN KANDY DISTRICT

Ranawaka RAMD[1*], and Sandika AL[2]

[1]*Faculty of Agriculture University of Ruhuna Sri Lanka*

[2] *Hector Kobbekaduwa Agrarian Research and Training Institute, Sri Lanka*

Abstract: Vanilla (*Vanilla planifolia*) is a minor export crop in Sri Lanka; however, it ranks as the second most expensive crop globally, making it a significant source of income. This study aimed to evaluate knowledge and adoption of recommended practices of Vanilla cultivation, to analyze the economic performance of Vanilla in Sri Lanka, and make appropriate suggestions to improve Vanilla cultivation in the country focusing on the Ganga Ihala Korale divisional secretarial division, which has the highest number of Vanilla growers in the Kandy district. Primary data was collected through a semi-structured questionnaire and face-to-face interviews with farmers. The study population consisted of Vanilla growers in Sri Lanka, with 80 farmers (53%) selected from the 150 registered under the extension office in Ganga Ihala Korale divisional secretarial division. Data analysis employed inferential analysis techniques. Knowledge and adoption of the recommended practices were measured by employing a knowledge and adoption index with three-point scale. Based on the findings, a significant majority of farmers showed a high level of knowledge (97.5%) and adoption (95%) concerning the recommended practices for Vanilla cultivation. According to the Pearson correlation analysis, knowledge and adoption of the recommended practices of Vanilla cultivation were highly correlated ($r = 0.631$, $p = 0.00$). It was further observed that cultivated land extent ($r = 0.225$, $p = 0.04$) and the number of plants in the field ($r = 0.245$, $p = 0.04$) were also significantly correlated with the adoption level. The findings suggest a strong correlation between the high adoption rate and extensive knowledge regarding the recommended practices for Vanilla cultivation. That mean Vanilla cultivation totally depend on adoption and knowledge of recommended practices. Considering these findings, it is recommended to promote Vanilla cultivation, especially among women and younger individuals. Suggestions for improving Vanilla cultivation include enhancing protection methods against wild animals, providing knowledge on different cultivation techniques, and encouraging the youth through increased knowledge dissemination programs.

Keywords: adoption, income, knowledge, Vanilla, export crop

1. Introduction

Vanilla is a globally important flavoring agent and spice, belonging to the family Orchidaceae. It is recognized as the second-most expensive spice in the world, surpassed only by saffron, primarily due to its labor-intensive cultivation and harvesting procedures (La Mesa et al., 2021). While native to the tropical forests of Mexico and Central America, Vanilla planifolia is now widely distributed throughout the tropics. In Sri Lanka, this species is the predominant variety cultivated, particularly in the wet and

*Corresponding Author's Email: ranawaka4842@ags.ruh.ac.lk

intermediate zones of the up-country and mid-country, including districts such as Kandy, Matale, and Nuwara Eliya (Kariyawasam et al., 2019a)

The economic significance of vanilla stems from the vanillin compound found in its pods, which provides the characteristic flavor and aroma demanded by the food, beverage, pharmaceutical, and perfumery industries (Wahyudi et al., 2023) In recent years, global demand for natural vanilla has surged as consumers shift away from synthetic alternatives, leading to significant price increases (Wahyudi et al., 2021). Since vanilla is a highly demand commercial crop, flowering generally commences approximately three years after planting. Hand pollination is essential, as natural pollination is insufficient to ensure effective and timely fruit set (Andriamahery et al., 2018). (Pemberton et al., n.d.)

1.1 Problem Statement

In past Vanilla cultivation is monor export crop and it happened in home garden leewel and not tend to do export from sri lanka. Mainly it cultivated in wet and intermediate zone in Sri Lanka in small scale level (Kariyawasam et al., 2019a). In contrast, countries such as Madagascar, which produce and harvest large quantities of vanilla annually, consider vanilla cultivation a major economic contributor (Andriamahery et al., 2018). Farmers and the national economy benefit significantly from vanilla production in Madagascar. The country reportedly earns over USD 800 million annually from vanilla cultivation, making it an important source of foreign exchange and contributing substantially to national economic growth (Neimark et al., 2021).

In Sri Lanka, favorable climatic conditions for vanilla cultivation exist, including annual rainfall ranging from 2000 mm to 2500 mm and altitudes above 1000 m. However, the extent of land cultivated with vanilla remains less than 100 hectares, with approximately 2,000 active vanilla farmers currently engaged in production (Neimark et al., 2021). Despite these favorable environmental conditions, farmer-level involvement in vanilla cultivation remains relatively low. Several challenges faced the expansion of vanilla cultivation in Sri Lanka, including the high labor intensity required for management practices, particularly hand pollination, and the lengthy curing process, which may take more than four months to complete. In addition, limited technical knowledge and low adoption of improved cultivation practices have contributed to lower vanilla productivity and yields (Kariyawasam et al., 2019a).

1.2 Objectives

This study aim to evaluate the knowledge and adoption levels regarding recommended practices and provide suggestion to improve vanilla cultivation in Sri Lanka. Specific objectives include:

- To evaluate the knowledge and adoption levels toward the recommended practices of vanilla cultivation.
- To provide appropriate suggestions and recommendations to improve the vanilla Cultivation in Sri Lanka.

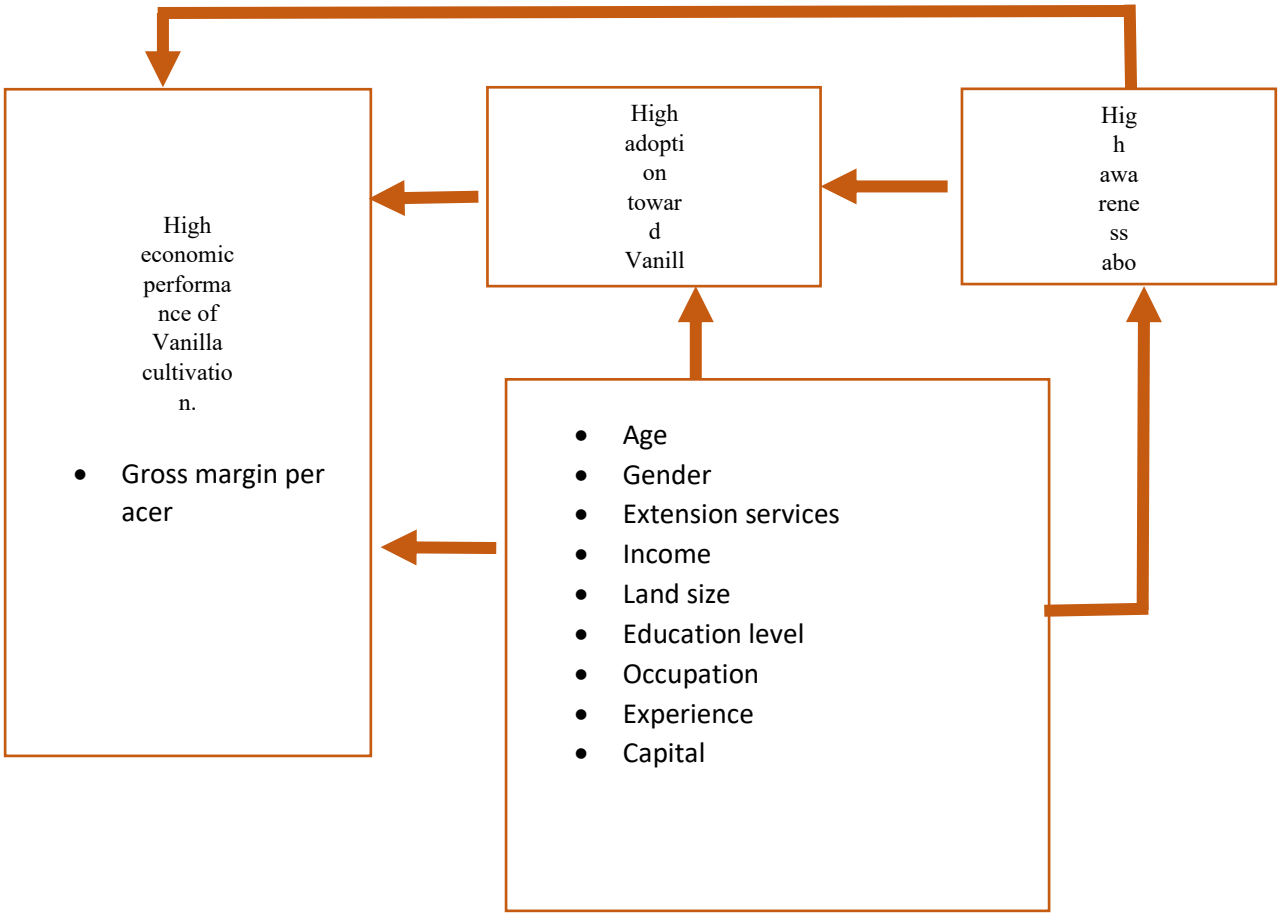
1.2 Significance of the Study

Under the current economic conditions in Sri Lanka, vanilla cultivation has the potential to enhance foreign exchange earnings and increase export revenue, thereby contributing to the improvement of living standards among smallholder farmers. Vanilla is a high-value crop that can be cultivated in small

land areas or even in pots, making it a suitable option for crop diversification among small-scale farmers (Asmarahman et al., 2023). This research aims to identify the knowledge and adoption gaps among farmers in relation to vanilla cultivation practices, in order to support the development and expansion of the vanilla sector in Sri Lanka.

1.3 Conceptual Framework

This research aims to illustrate the interrelation among various factors. The primary factors include the economic performance of Vanilla cultivation, the adoption of recommended Vanilla cultivation practices, knowledge of recommended practices in Vanilla cultivation, and general information about farmers. This encompasses factors such as farmer age, gender, extension services, income, land size, education level, occupation, experience, and capital. The study seeks to understand how changes in these general information factors affect the adoption of recommended management practices in Vanilla cultivation, the knowledge level about Vanilla cultivation practices, and various economic parameters. Additionally, the research explores the relationships between adoption and knowledge level, knowledge level and economic performance of Vanilla cultivation, as well as adoption and economic performance. Following chart showed that relation among different factors.



2. Methodology

In Sri Lanka Vanilla highly growing in wet and intermediate zone of upcountry and mid country. Kandy, Matale, Nuwara Eliya, Kegalle, Ratnapura, Badulla, and Galle are the main growing areas. Among those area high Vanilla cultivation available in Kandy district. Within Kandy districts many farmers are in hill area. As research area Ganga Ihala Korale Divisional Secretarial Division (DSD), which was the top small scale Vanilla producing DSD in Kandy District of Sri Lanka was selected (Kariyawasam et al., 2019b)

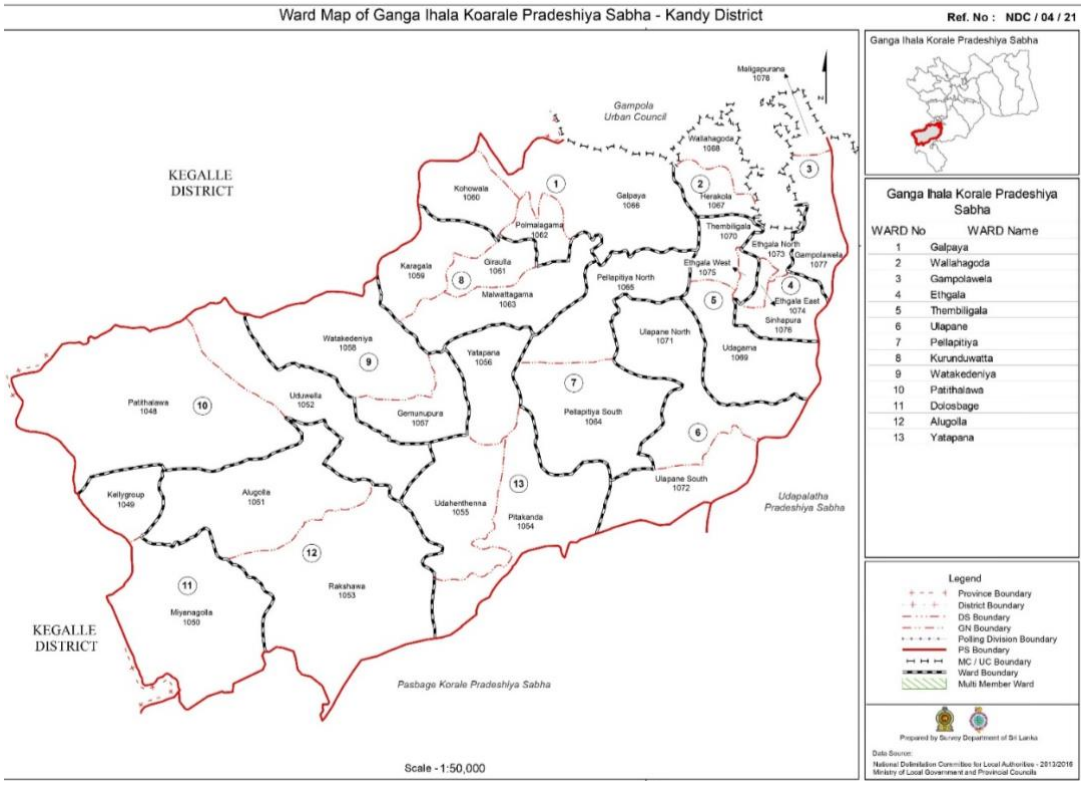


Figure 1: Ganga Ihala Korale DS division

Vanilla growers in Sri Lanka was considered as the population. Vanilla growers in Kandy district was the target population. There were 150 of farmers in the register list which was taken from extension officer in Ganga Ihala Korale who cultivate Vanilla in selected area was sample frame. Among 150 farmers 80 farmers were selected by purposive simple random sampling method who cultivate more than 10 Vanilla vines.

Primary and secondary information was collected for the study. The two major strategies for gathering primary data were semi-structured questionnaires and interviews. Additionally, initial information is often gathered through observation of farmers' fields and cultivation lands. Secondary data was collected by article papers which published in websites, and other online platforms, books which were store in library, websites, which gathering more information related to study.

3. Data Analysis

The data initially analyzed by using descriptive analysis methods such as mean, mode median and percentages.

Knowledge and adoption measured using knowledge index and adoption index.

3.1 Measure the adoption level of farmers

Adoption was first introduced by Evert Roger in early 1960 in the diffusion of innovation theory. That was a qualitative description. After that, many researchers deviated from that theory and switched to quantitative methods.

In this section, we measure the adoption level of farmers for recommended practices of Vanilla cultivation by using an adoption index. For that, we developed a scoring system to measure the adoption level of farmers. Then the adoption score converts into the adoption index. Then final scores were categorized into three groups: fully adopted, partially adopted, and not adopted, considering mean value and standard deviation (Wadekar et al., 2018)

$$\text{Adoption index} = \frac{\text{obtained adoption score for applicable recommended practices}}{\text{maximum obtainble adoption score for applicable management practices}} \times 100$$

3.2 Measure the knowledge level of farmers

To test farmers knowledge, teachers made test was used. It evaluated farmers knowledge levels for recommended practices for Vanilla cultivation.

Here is a questionnaire to assess farmers knowledge. Then provide a score for the question from 0 to 2. According to farmers answer, provide marks 0,1,2 get low, medium, high knowledge respectively. Based on the knowledge score, calculated the knowledge index using an equation. This procedure has been adopted by many researchers. After calculating the knowledge index, compare those indexes. (Jaganathan et al., 2012, 2015a) (Meena et al., 2012). Following equation was used to measure knowledge index of farmers.

$$\text{Knowledge index} = \frac{\boldsymbol{obtained\ adoption\ score\ for\ applicable\ recommended\ practices}}{\boldsymbol{maximum\ obtainble\ adoption\ score\ for\ applicable\ management\ practices}} \times \mathbf{100}$$

4. Result and Discussion

This chapter presents the findings derived from the empirical data collected from 80 vanilla farmers in the Ganga Ihala Korale Divisional Secretarial Division. The analysis focuses on the socio economic factors of the respondents, their knowledge level and adoption level regarding recommended cultivation practices.

4.1 Socio-Economic Profile of Vanilla Farmers

Among the socio-economic factors of vanilla farmers, demographic characteristics are important in understanding farmers' involvement in vanilla cultivation. According to Table 01, the majority of farmers (68.70%) are male, while female farmers account for 31.30%. This indicates that vanilla cultivation is currently a male-dominated small-scale enterprise, often functioning as a primary source of household income.

However, the presence of 31.30% female participation highlights a significant potential for women's empowerment through engagement in high-value vanilla cultivation as an income-generating enterprise.

Promoting female participation in vanilla farming could contribute to improved household income diversification and socio-economic development among rural communities (Kariyawasam et al., 2019a).

4.2 Age and Family Structure

When considering the age distribution of farmers, the majority of farmers are older rather than younger. About 56.30% of farmers are aged above 45 years, with a mean age of 47.8 years, indicating that most farmers belong to the older age category. In contrast, only a small proportion (3.70%) of farmers are young (17–30 years). Although the productivity of older farmers may be comparatively lower than that of younger and middle-aged farmers, vanilla cultivation is relatively easy to manage and handle, making it suitable for older farmers. Therefore, even with small-scale production, older farmers can earn relatively high income from vanilla cultivation due to its high market value. (Kariyawasam et al., 2019a; Wahyudi et al., 2021). Regarding family size, the majority (52.50%) of farmers have 4-6 members, with a mean of 4. This mean that the importance of vanilla as a livelihood strategy to meet the consumption needs of medium-to-large households.

4.3 Education and Experience

The educational level of the farmers is relatively high, with 35% having completed Advanced Levels (A/L) and 43.70% having completed Ordinary Levels (O/L). This relatively high literacy rate is a positive indicator for the potential adoption of scientific and improved management practices in vanilla cultivation. Despite their education, the majority of farmers (65%) have less than five years of experience in commercial vanilla cultivation, with a mean farming experience of 5.4 years. These findings suggest that vanilla is increasingly recognized as a cash crop in the region, aligning with recent trends in the diversification of Sri Lanka's export-oriented agricultural sector (Kariyawasam et al., 2019a).

4.4 Livelihood Factors and Intercropping Patterns

Vanilla cultivation in the study area is closely associated with tea cultivation, and it is commonly practiced as an intercrop within tea plantations. In the study area, vanilla cultivation is well integrated with existing tea farming systems. According to Table 02, 63.70% of vanilla growers are also tea farmers, indicating a strong linkage between tea and vanilla cultivation. Vanilla is predominantly grown as an intercrop, utilizing existing plantation resources. Gliricidia sepium is commonly used as a shade tree in tea lands and also serves as a live trellis to support vanilla vines, thereby facilitating efficient land use and improving crop management.

This intercropping system reduces the labor requirements and initial investment costs, as the routine management practices applied to tea plants and shade trees also support the growth of vanilla vines (Asmarahman et al., 2023) (Kariyawasam et al., 2019a). Among the respondents, only 5% of farmers were engaged solely in vanilla cultivation, while the majority of farmers practiced vanilla cultivation as a supplementary income source rather than their primary source of income. Other minor occupations include government service (10%) and small-scale business (7.5%).

Table 1 Socio-Economic factors of respondents

N=80		Frequency	Percentage	Mean	Mode	Medium	Max	Min
Gender	male	55	68.70					
	female	25	31.30					

Age	17-30	3	3.70	47.80	36	45.50	81	17
	31- 45	32	40					
	Above 45	45	56.30					
Family size	<2	3	3.70	4	4	4	8	1
	2_4	26	32.50					
	4_6	42	52.50					
	Above 6	9	11.30					
Education level	Grade 1- 5	1	1.30					
	Grade 6-10	15	18.70					
	O/L	35	43.70					
	A/L	28	35					
	Degree	1	1.30					

Table 2 Livelihood factors of Vanilla farmers

N=80		**Frequency**	**Percentage**	**Mean**	**Mode**	**Medium**	**Max**	**Min**
Occupation								
	Tea farmer	51	63.70					
	Vanilla farmers	4	5					
	Vegetable farmers	1	1.30					
	Businessman	6	7.50					
	Government	8	10					
	Labour	4	5					
	Non-government	5	6.30					
Experience	0-5	52	65	5.40	5	5	20	1
	6_10	24	30					
	11_15	2	2.50					
	Above 15	2	2.50					

4.5 Knowledge and Adoption of Recommended Management Practices

The first objective of the study was to evaluate the knowledge and adoption levels of farmers toward recommended management practices in vanilla cultivation. Understanding the knowledge and adoption level of farmers is essential to measure effectiveness of the extension services and improving agricultural productivity. Knowledge serves as the foundation for informed decision making, while adoption important to the practical application of that knowledge in real situation in the field (Singh et al., 2013).

According to the Diffusion of Innovation Theory found by Rogers (2003) (Ismail, 2006), farmers can be categorized into five groups based on their adoption behavior. Those are innovators, early adopters, early majority, late majority, and laggards. This is base on the decision to adopt, reject, or postpone an

innovation is influenced by the knowledge and perception acquired by individuals over time (Jabbar et al., 2003). Therefore, evaluating both knowledge and adoption levels of the farmers provides valuable insight into farmers' readiness to implement recommended agricultural practices.

4.6 Knowledge-Adoption Gap

Farmers maintain higher knowledge levels than adoption levels for the most of technical tasks, including planting material selection, land preparation, spacing, and irrigation (Department of Export Agriculture, 2022). This knowledge and adoption gap suggests that practical or economic constraints prevent farmers from fully implementing these techniques, while extension services may be effective in disseminating knowledge (Kariyawasam et al., 2019a; Wahyudi et al., 2021). According to the results, adoption levels for "pretreatment of cuttings" and "pest and disease management" were notably low, scoring below 1.5 on a 2-point scale, with pest management receiving a particularly low score of 0.72.

Other practices such as "training and pruning," "fertilizing," and "flower induction" showed higher adoption than knowledge. This unusual result may be because farmers are using traditional methods or copying their neighbors without really understanding the science behind them. Medium level of knowledge has been seen in the other farmers who is cultivating other high value crop, long lasting crops in the area (Kariyawasam et al., 2019a).

4.7 Factors Affecting Yield and Performance

Pearson Correlation analysis was employed to identify significant relationships between knowledge, adoption, and productivity.

4.8 Factors affecting to knowledge and adoption level of farmers toward recommended management practices of Vanilla cultivation

In Table 3Pearson correlation analysis was calculated to identify relationships between socio economic variables, and adoption level (AI), knowledge level (KI) of recommended management practices.

The results showed that statistically significant positive correlation between knowledge level and adoption level ($r = 0.621$, $p = 0.000$). Since there is a positive relationship between these two factors, an increase in farmers' knowledge leads to a corresponding increase in their adoption of management practices. Farmers who has greater technical knowledge about practices are more likely to implement improved cultivation methods, resulting in increase farm performance.

And also, adoption level created a significant positive relationship with total yield ($r = 0.256$, $p = 0.030$). This result revealed that farmers who adopt recommended management practices tend to receive higher yields compared to others who are using traditional methods. Improved management practices such as proper spacing, pest control, timely irrigation and post-harvest management directly effect to improved crop productivity and quality.

Although there was a positive association ($r = 0.210$) between knowledge level and annual yield, it was not statistically significant. Additionally, there was a weak but positive correlation between knowledge level and overall yield. These findings imply that information by itself cannot ensure higher productivity until it is implemented in real world settings.

Education level, farming experience, access to extension services, and financial capacity have a moderate relationship with farmers' knowledge and adoption levels. However, farmers who possess higher knowledge and adoption of practices are more likely to accept new technologies and make correct and strategic decisions regarding cultivation problems. Similarly, farmers with greater experience in vanilla farming tend to have higher confidence in adopting new practices and acquiring practical knowledge.

Additionally, training programs, access to credit facilities, farmer field schools play a significant role in increasing adoption rates. Price stability and availability of market information also influence farmers' willingness to invest in recommended practices.

- Knowledge vs. Adoption: A strong, positive, and significant correlation was found between the Knowledge Index and the Adoption Index. This relationship indicates that as a farmer's scientific understanding of vanilla cultivation increases, their adoption of recommended practices improves significantly.

- Adoption vs. Yield: The Adoption Index was significantly correlated with total Vanilla yield. This empirical evidence confirms that farmers who strictly adhere to recommended management practices obtain higher yields compared to non-adopters.

These results emphasize that improving technical efficiency through targeted extension services is a viable pathway to increasing vanilla productivity in Sri Lanka (Kariyawasam et al., 2019a). However, the lack of significant correlation between knowledge Index and Year Yield suggests that knowledge alone, without the resource capacity to adopt practices, is insufficient for immediate productivity gains. Therefore, strategies that use to fill the knowledge gap with practical application are crucial to the industry's expansion (Asmarahman et al., 2023) (Wahyudi et al., 2023).

Overall result showed that, the findings emphasize the importance of strengthening agricultural extension services and capacity building programs to increase both knowledge and adoption levels among vanilla farmers. Improved awareness, combined financial and technical support, can significantly improve productivity, income generation, and long-term sustainability of vanilla cultivation systems.

Table 3: Pearson correlation coefficient

		KI	AI
Year yield	Pearson Correlation	0.210	0.229
	Sig. (2-tailed)	0.110	0.082
Total yield	Pearson Correlation	0.196	0.256
	Sig. (2-tailed)	0.099	0.030
KI	Pearson Correlation		0.621
	Sig. (2-tailed)		0.000

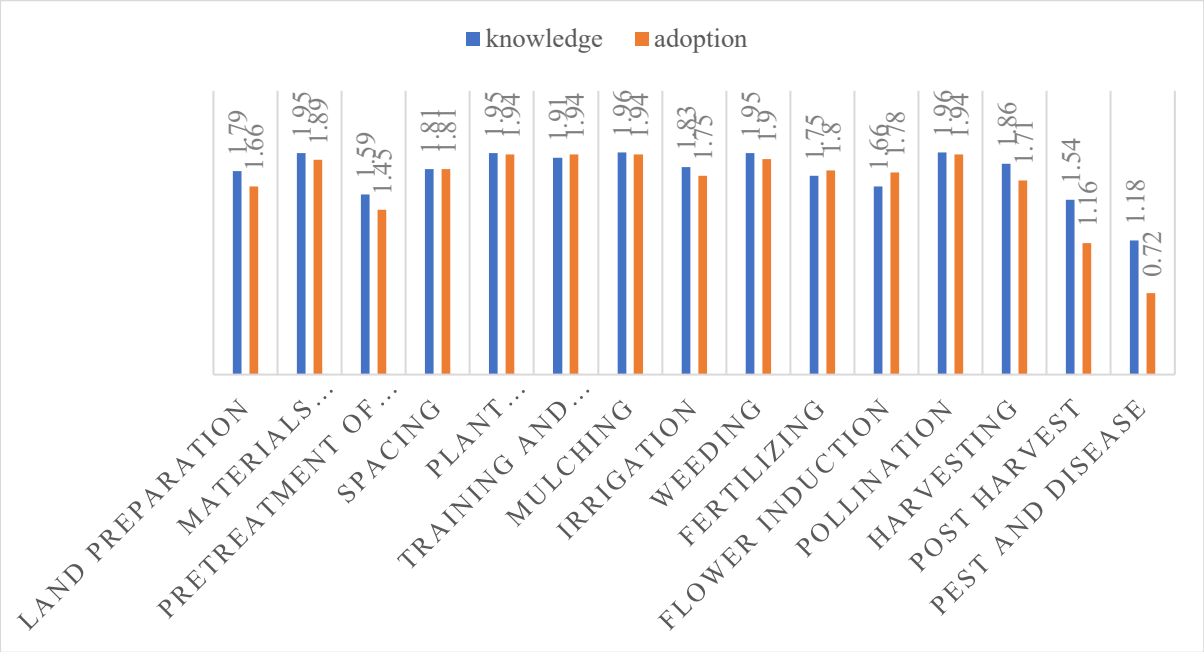


Figure 2: Overall average knowledge and adoption level of farmers (Low=0, Medium=1, High=2)

When considering the overall analysis (Figure 2) of knowledge level and adoption levels indicated that farmers showed relatively higher knowledge compared to their adoption level across several recommended practices. Specifically, farmers showed higher knowledge levels in land preparation, Plant material selection, pre-treatment of cuttings, spacing, plant establishment, mulching, irrigation, pollination, weeding harvesting, post-harvest management, and pest and disease control. However, the actual adoption level for these practices comparatively lower, suggesting the presence of constraints that limit practical implementation.

But certain practices such as training and pruning, fertilization, and flower induction showed higher adoption levels than knowledge levels. rather than formal training programs, This pattern may be can change to farmers learning through observation, peer interaction, and experiential learning rather than formal training programs. Most of rural communities, transfer their knowledge through farmer-to-farmer communication networks, which play an important role in spreading agricultural innovations. The findings of this study are consistent with earlier research conducted in cocoa farming systems in India, where the majority of cocoa growers (68.30%) demonstrated medium levels of knowledge regarding organic farming practices (Jaganathan et al., 2015a). The use of knowledge indices has proven to be an effective method for assessing farmers' understanding of recommended technologies. In the present study, the overall knowledge level of vanilla farmers was observed to be relatively high, indicating positive awareness of recommended practices.

Despite adequate knowledge, the adoption level of certain practices such as pre-treatment of cuttings, post-harvest management, and pest and disease management remained below the medium threshold (less than 1.5). In particular, pest and disease management recorded a medium adoption level (0.72), suggesting the need for targeted extension support in this area. Similar trends were reported by

(Jaganathan et al., 2015b), who observed that mulching and fertilizer use were adopted by 70.8% and 36.7% of cocoa growers, respectively.

According to (Ismail, 2006) knowledge alone cannot guarantee the adoption level for recommended management practices. Not only that, individual attitudes, perceptions, and socio-economic conditions also significantly affect adoption behavior. Farmers may have adequate knowledge but there is some failure to adopt certain practices due to financial limitations, labor shortages, lack of inputs, or uncertainty regarding economic returns.

5. Conclusion

According to study it provides comprehensive insights about socio-economic characteristics, knowledge levels, and adoption behavior of vanilla farmers, as well as the factors influencing productivity of vanilla cultivation. The result showed that this vanilla cultivation is male dominant and majority of them are male Farmens while female participation is medium. Female participial for vanilla cultivation shows potential of women empowerment in rural are by giving them good source of income.

Most of the farmer family had 4-6 family members. That mean they need standers income for their family as income source. it is important to have vanilla cultivation as alternative income for the families. The educational level of farmers was largely concentrated at the secondary level, up to Ordinary Level and Advanced Level education. This moderate educational level important to provides a foundation for understanding recommended agricultural practices, although limited higher education may restrict access to advanced technological knowledge and modern production strategies.

Livelihood analysis indicated that vanilla cultivation is mainly practiced as an intercrop within tea plantations, using a diversified farming strategy that increases resource utilization and reduces economic risk. The majority of farmers had less than five years of experience in vanilla cultivation, assuring that vanilla is a relatively new cash crop in the study area. This limited experience tends to indicate the need for continuous technical support and training programs to enhance farmers' capacity in managing vanilla cultivation effectively.

According to correlation analysis, there is a strong and statistically significant positive relationship between knowledge level and adoption level, showing that a higher level of farmers' knowledge affects the adoption level of farmers toward new technologies. Furthermore, adoption level was significantly positively related to total yield, showing that new methods of management practices directly affect the increase of the yield of vanilla cultivation.

To summarize, the effective growth of vanilla farming as a lucrative cash crop relies on increasing farmers' understanding, enabling the adoption of scientifically endorsed methods, and tackling socio-economic barriers that hinder productive execution. By bolstering technical skills, reinforcing support networks, and encouraging eco-friendly farming methods, vanilla farming offers considerable opportunities to boost family income, ensure livelihood stability, and advance rural economic progress within the region examined.

6. Limitations and Suggestions

There is an opportunity to conduct new research to evaluate farmers' knowledge and adoption of practices over time and analyze the results to identify improvements and optimize cultivation processes.

Evaluate the economic profitability and feasibility of vanilla cultivation under different cropping patterns such as monocropping and intercropping with tea.

Investigate the impact of financial support on adoption, access to credit, subsidies of recommended management practices.

Evaluate the effectiveness of agricultural training programs and extension services in improving farmers' knowledge and adoption of recommended practices.

Examine the roles and contributions of women in vanilla cultivation, specially for in pollination, processing, and post harvest management.

Examine and evaluate the vanilla market supply chain in the country, including domestic cultivation and export channels.

Conduct research to enhance productivity and minimize crop losses through improved pest and disease management strategies.

Examine post-harvest handling, value addition techniques, and curing methods to enhance vanilla quality and market value.

Acknowledgment

I extend my heartfelt gratitude to Prof. A.L.Sandika of the Department of Agriculture Economics and Agribusiness, Faculty of Agriculture, University of Ruhuna, for his unwavering guidance throughout my research work.

Additionally, I express my appreciation to other esteemed faculty members, including Senior Lecturer and Head of the Department, Prof. W. Nilantha De Silva, for providing valuable guidance in selecting my research topic, and Senior Lecturer Dr. KN Nadeeshani Silva for her insightful advice and also other staff members.

Special thanks are extended to Mrs. Mahesh, the extension officer in Ganga Ihala Korale DS Division, whose assistance was instrumental in locating Vanilla growers in the Kandy district. I am also grateful to Mrs. AAK Madagedara, the owner of Mak Retoucher, for his guidance, support, and provision of transportation, which significantly contributed to my research endeavors.

Furthermore, I acknowledge the contributions of Mrs. KG Duglus, Mrs. Sudesh Nawarathne, Mrs. PGC Jayasantha Balarathne, and Mrs. Indika, who generously shared their additional insights on Vanilla cultivation and other farmers who provide me their support during interviewing them.

I provide my heartiest thank for Vanila growers who have voluntary participated to the data collection by giving valuable information.

I would like to express my sincere thanks to my parents, sister, friends, and neighbors for their unwavering support, which played a crucial role in the successful completion of my research.

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