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Factors That Influence the Level of Farmers' Knowledge of Patchouli Cultivation Techniques in West Malangke District

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ABSTRACT

Patchouli (Pogostemon cablin Benth.) is a strategic essential oil commodity in South Sulawesi, particularly in West Malangke District, North Luwu Regency. Despite its economic potential, many farmers still rely on traditional cultivation methods without adequate technical guidance. This study aimed to analyze the level of farmers' knowledge of patchouli cultivation techniques and to identify the factors influencing it. A quantitative survey approach was employed with 175 respondents selected through simple random sampling from a population of 1,268 patchouli farmers. Data were collected using a structured questionnaire and analyzed using Variance-Based Structural Equation Modeling (VB-SEM). Results showed that the overall level of farmers' knowledge was high (mean score = 79.48), covering technical cultivation (75.00), farm management (93.36), and post-harvest handling (70.09). Internal factors — comprising age, education level, farming experience, and training — had a significant positive effect on farmers' knowledge (T-statistic = 4.238, p = 0.000). Agricultural extension also significantly influenced farmers' knowledge (T-statistic = 2.890, p = 0.004), although extension visit frequency and duration remained low. External factors (information access, production input access, and social conditions) showed no significant direct effect (p = 0.347). The three variables collectively explained 13.7% of knowledge variability. These findings highlight the need for structured technical training programs, commodity-specific extension intensification focusing on patchouli, and prioritized improvement of post-harvest knowledge to enhance product quality and farmers' economic value.

Keywords: *patchouli farming, farmers' knowledge, agricultural extension, internal factors, SEM analysis*

INTRODUCTION

Patchouli (Pogostemon cablin Benth.) is included in the main essential oil producing commodity that is widely processed in Indonesia, especially at the people's agriculture level. At the provincial level, South Sulawesi is one of the important patchouli oil producing areas in Indonesia, this potential can be seen in the increase in planting area and household-scale refining activities to agroindustry (Hariani Soekamto et al., 2019). At the district level, North Luwu stands out as the center of patchouli development in South Sulawesi. One of the patchouli-producing areas in North Luwu Regency is West Malangke District which has an area of 93.75 km² and is located at the southern tip of North Luwu Regency, with 13 villages that are all definitive villages. Most of the population is engaged in agriculture, and patchouli has developed into an important commodity that local farmers seek as an additional source of income in between cocoa cultivation due to better income prospects and the growing local supply chain (buyers and distillers). Distillation activities that have emerged at the village/sub-district level have also encouraged farmers to plant patchouli due to the consistent demand for raw materials (Nursida, 2017). Although patchouli plants have high economic potential, many farmers still rely on hereditary experience in managing their farming business, without being supported by technical information or assistance from agricultural extension workers. This condition has an impact on the non-optimal productivity and quality of patchouli oil produced. Research (Saqiyah, 2024) by shows that farmers with a better level of knowledge of cultivation techniques tend to produce more optimal harvests.

In the scope of sustainable agriculture, farmers' knowledge includes understanding of land management methods, selection of superior seeds, planting techniques, integrated pest control, and post-harvest handling. A low level of knowledge can lead to errors in cultivation practices such as the use of unhealthy seedlings, unbalanced fertilization, and ineffective disease control, which ultimately lowers yield and production quality (Setiawan et al., 2021). Therefore, it is important to measure the level of knowledge of patchouli farmers related to technical, management to post-harvest and identify factors that affect the yield and quality of patchouli plants using variables of internal factors, agricultural extension and external factors with the aim of mapping the extent of farmers' understanding of patchouli cultivation techniques as well as the basis for the formulation of targeted agricultural extension programs.

Internal Factors are factors that come from within farmers that can affect their level of knowledge, attitude, and skills in carrying out cultivation activities. Internal factors include individual characteristics such as education level, age, experience, and training. These factors play an important role in determining farmers' ability to receive, understand, and implement agricultural innovations (Rachmani & Rahayu, 2021).

Agricultural extension itself has an important role in the process of transferring technological innovations from research institutions to farmers. Through extension activities, farmers can obtain the latest information on cultivation techniques, farm business management, and plant pest and disease control. Thus, agricultural extension functions as a bridge between innovation sources (researchers, government, and universities) and innovation users (farmers) so that there is an increase in knowledge, a change in attitudes, and an increase in the productivity of farming businesses (Vintarno et al., 2019).

External factors are elements or conditions outside of farmers that can also affect their level of knowledge, attitude, and skills towards an activity, including in terms of patchouli cultivation. External factors include the social, economic, institutional, and support from external parties such as agricultural extension workers, the government, and private institutions. These factors can accelerate or hinder the adoption process of agricultural innovation by farmers (Dewi et al., 2025).

Several previous studies have examined various aspects of patchouli cultivation from a social, technical, and technological perspective. (Sahla et al., 2024) found that patchouli farmers in Lhoong District, Aceh Besar Regency are still operating on a small scale with limited human resource capacity, so agricultural extension and technical training are still needed. In line with that, (Said et al., 2025) prove that there is a significant positive correlation between the level of knowledge and skills of patchouli farmers in East Kolaka Regency, which indicates that technical knowledge is the main prerequisite for successful cultivation. From the agronomic side, (Zaini, et al., 2023) it shows that planting spacing adjusted to varieties significantly affects the growth and yield of patchouli oil, so specific technical recommendations need to be transferred to farmers through structured agricultural extension. (Suharjo et al., 2023) added that mastery of cultivation techniques is closely related to the ability of farmers to optimize production factors such as land, seeds, fertilizers, and labor to increase crop yields. Furthermore, (Prananda et al., 2024) emphasized that farmers' knowledge does not only include cultivation techniques, but also includes tool operational skills and post-harvest handling, where the successful adoption of simple mechanization technology is highly dependent on the level of knowledge and training that farmers receive. Based on the study, it can be seen that research that specifically measures the level of knowledge of farmers about patchouli cultivation techniques and the factors that affect them in West Malangke District has not been carried out, so this research is here to fill the gap. This study aims to analyze the level of farmers' knowledge of patchouli cultivation techniques and identify the factors that affect them. The contribution of this research is to provide data on the level of technical, management and post-harvest knowledge of patchouli farmers in West Malangke sub-district through direct measurements in the field and complement previous research related to patchouli cultivation.

Based on previous research studies, it can be understood that the level of knowledge of patchouli farmers is influenced by various factors, both from within the farmer and from the surrounding environment. Internal factors such as age, education level, farming experience and training are suspected to contribute to the capacity of farmers' understanding of the recommended cultivation techniques. On the other hand, agricultural extension activities and external factors such as access to information, access to production facilities, and social conditions of the community are also believed to have an important role in increasing farmers' knowledge. Therefore, this study proposes the following hypotheses: (1) it is suspected that internal factors have a positive and significant effect on the level of knowledge of farmers in the cultivation of patchouli plants in West Malangke District; (2) it is suspected that agricultural extension has a positive and significant effect on the level of knowledge of farmers in the cultivation of patchouli plants in West Malangke District; and (3) it is suspected that external factors have a positive and significant effect on the level of knowledge of farmers in the cultivation of patchouli plants in West Malangke District.

RESEARCH METHODS

This research was carried out in West Malangke District, North Luwu Regency, which is one of the patchouli plant development centers in South Sulawesi, from December 2025 to May 2026. The research uses a quantitative approach with a survey method. The quantitative approach was chosen because it was able to objectively measure research variables and analyze the relationships between variables through systematic statistical procedures.

Data collection was carried out using a structured questionnaire arranged based on research variables. Internal factor variables consist of education, age, farming experience, and training. Agricultural extension variables include the frequency of extension, the relevance of extension materials, and extension methods. External factors consist of access to information, access to means of production, and social conditions of the community. Meanwhile, the level of knowledge of farmers is measured through three main aspects, namely technical knowledge, management, and post-harvest handling of patchouli plants. The equipment used includes stationery, mobile phones, and observation sheets to collect data in the field. The population of the study is all patchouli farmers in West Malangke District which ranges from 1,268 people. The number of samples was determined using the Slovin formula with an error rate of 7%, so that 175 respondents were obtained. Sample extraction was carried out using a simple random sampling technique, which is a sampling technique that provides an equal opportunity for each member of the population to be selected as a research respondent (Noor & Fitrian, 2021). This technique was chosen to minimize bias and produce a sample that is respresentative of the population (Lemeshow & Ferketich, 2020).

This study uses a quantitative descriptive method with a survey approach. Quantitative research aims to test theory by measuring research variables and analyzing the relationships between variables statistically. Data is obtained through a questionnaire designed in a structured manner, which then becomes the main source to be analyzed with statistical procedures (Sihotang, 2023).

Before being used in research, the instrument/questionnaire is tested for validity and reliability. The validity test was carried out using Pearson's Product Moment correlation to determine the ability of each statement item to measure the construct being studied. The instrument is declared valid if the value of r-calculation is greater than the r-table at a significance level of 5%. Next, reliability tests are performed using Cronbach's Alpha coefficient to measure the level of internal consistency of the instrument. The instrument is declared reliable if it has a Cronbach's Alpha value of ≥ 0.7 (Utami, 2023). The results of the validity and reliability test are declared valid with significance values of <0.05 and the results of the reliability test show a Cronbach alpha value of >0.7 so that it is stated that the research instrument is valid and reliable.

RESULT AND DISCUSSION

Farmers' Knowledge Level in Patchouli Cultivation

The level of knowledge of farmers in this study was measured through 29 multiple-choice questions covering three sub-dimensions, namely technical knowledge of cultivation (12 questions), knowledge of farming management (8 questions), and post-harvest knowledge (9 questions). Each correct answer is scored 1 and the wrong answer is scored 0, so the overall theoretical maximum score is 29. The raw score of each respondent is then converted into a scale of 0 to 100 using the formula: Score = (number of correct answers × 100/total questions), so that the minimum score that can be obtained is 0 and the maximum score is 100. The results of the categorization of the level of knowledge of patchouli farmers in each sub-dimension are presented in Table 1 below..

Table 1. Knowledge level score of patchouli farmers in West Malangke District

Yes	Knowledge	Score	Categories
1	Technical	75,00	Height
2	Management	93,36	Height
3	Post-Harvest	70,09	Height
	Average score	**79,48**	**Height**

Remarks: score <33.33 = low; 33.33-66.66 = moderate; >66.66 = high

Source: *Processed Primary data 2026*

Based on Table 1, the level of knowledge of farmers in patchouli cultivation as a whole is in the high category with an average score of 79.48. These results show that patchouli farmers have an adequate understanding covering all aspects of cultivation, from production techniques to post-harvest.

In the sub-dimension of technical knowledge of cultivation, farmers obtained a score of 75.00 which is included in the high category. This indicates that most farmers have understood the technical aspects of the patchouli cultivation process, such as seed selection, land cultivation, fertilization, and pest and disease control. Meanwhile, the sub-dimension of farming management knowledge recorded the highest score among the three sub-dimensions, namely 93.36 in the high category. This score reflects that farmers have excellent mastery in terms of planning, managing inputs, and organizing their patchouli farming business. As for the sub-dimension of post-harvest knowledge, farmers obtained a score of 70.09 which was also in the high category, although it was the lowest score among the three sub-dimensions. This condition shows that farmers' knowledge related to crop handling, processing, and marketing of patchouli still needs to be improved compared to other aspects.

Overall, the high level of knowledge of farmers in the three sub-dimensions indicates that patchouli farmers in West Malangke District have gained access to sufficient information and experience in managing patchouli cultivation businesses. However, the post-harvest sub-dimension that has the lowest score needs to receive more attention through focused agricultural extension and training, in order to increase the added value and competitiveness of the patchouli products produced.

Respondent Characteristics

The characteristics of the respondents in this study are part of internal factors that are suspected to affect the level of farmers' knowledge of patchouli cultivation in West Malangke District. The internal factors studied include four indicators, namely age, education level, farming experience, and training that farmers have undergone. The four indicators reflect the individual conditions of farmers who can directly form the capacity to understand and apply good and correct patchouli cultivation techniques. A complete description of the characteristics of the respondents is presented in Table 2 below.

Table 2. characteristics of respondents in West Malangke District

Characteristic categories		Frequency	Percentage (%)
Age			
Late teens (17-25 years old)		34	19,4
Early adults (26-35 years)		44	25,1
Late adults (36-45 years)		53	30,3
Early Elderly (46-55 years)		35	20,0
Late elderly (56-65 years old)		9	5,1
	Total	**175**	**100,0**
Education Level			
Not finished elementary school		14	8,0
SD		35	20,0
Junior High School		24	13,7
High School		82	46,9
S1		20	11,4
	Total	**175**	**100,0**
Farming Experience			
new		25	14,3
Quite experienced		6	3,4
Experienced		52	29,7
Highly experienced		92	52,6
	Total	**175**	**100,0**
Training			
Low (0-7 times)		169	96,6
Medium (8-14 times)		5	2,9
Height (15-20)		1	0,5
	Total	**175**	**100,0**

Source: Processed Primary data 2026

Characteristics of Respondents by Age

The characteristics of respondents based on age in this study were grouped referring to the classification of age categories according to the Ministry of Health of the Republic of Indonesia (2016) which divided the age

grouping into late adolescence (17–25 years), early adulthood (26–35 years), late adulthood (36–45 years), early elderly (46–55 years), and late elderly (56–65 years). Based on Table 2, it is known that the most dominant age category is late adults (36–45 years) with a total of 53 people or 30.3%, followed by early adults (26–35 years) as many as 44 people (25.1%), early elderly (46–55 years) as many as 35 people (20.0%), late adolescents (17–25 years) as many as 34 people (19.4%), and the least are the late elderly (56–65 years) as many as 9 people (5.1%). When summed up, farmers who are classified as productive age groups, namely the category of early adults to early elderly (26-55 years) reach 75.4% of the total respondents. This condition indicates that most patchouli farmers in West Malangke District are still at the age that is physically and cognitively optimal to carry out farming activities. Productive age affects farmers' behavior and decision-making, ability to find new methods, managerial skills, and optimal physical ability in running farming (Riani et al., 2021). Furthermore, partially, age has a positive and significant influence on the level of farmers' knowledge about the benefits and how to use technology in agriculture (Gusti et al., 2022). On the other hand, the low proportion of farmers in the final elderly category (5.1%) indicates that the regeneration of farmers at the research site is still going relatively well, considering that farmers who enter old age generally face limitations in adapting to new innovations because they are still strong in their behavior towards adoption of innovations that are already available.

Characteristics of Respondents Based on Education Level

Education level is one of the internal factors that plays an important role in shaping the cognitive capacity of farmers, especially the ability to understand, process, and apply information related to cultivation techniques. Based on Table 2, it is known that the formal education level of patchouli farmers is spread into five categories. Farmers who did not graduate from elementary school amounted to 14 people (8.0%), 35 people graduated from elementary school (20.0%), 24 people graduated from junior high school (13.7%), 82 people graduated from high school (46.9%), and 20 people had a S1 education (11.4%). The most dominant education category is high school with a proportion of 46.9%, and when totaled, farmers who have studied at the high school level and above reach 58.3% of the total respondents. This condition indicates that more than half of patchouli farmers in West Malangke District have adequate formal education as a basis for absorbing knowledge and innovation in cultivation technology. Education can affect a person's way of thinking and reasoning skills so that it affects decision-making, problem solving, and actions taken, and the higher a person's level of education, the more open they will be to accepting new innovations. The level of formal education has been proven to have a significant effect on the level of knowledge of farmers in utilizing innovation and technology in the agricultural sector (Yantika et al., 2025). However, there are still 28.0% of farmers who have an elementary education and below, even 8.0% of them do not complete basic education. This condition needs special attention in the design of agricultural extension strategies, because there is a very significant positive relationship between the level of education of farmers and the ease of acceptance of information technology in agricultural extension, so there needs to be a special strategy to increase the ease of access to information for farmers with low education. Therefore, extension programs for patchouli farmers need to be designed in an inclusive manner through visual approaches, hands-on demonstrations in the field, and simple and contextual two-way communication so that the transfer of cultivation knowledge can take place evenly across all education categories.

Characteristics of Respondents Based on Farming Experience

Farming experience is one of the important indicators of the internal factors of farmers that reflect how long a farmer has been carrying out his farming activities directly in the field. In this study, farming experience is categorized into 4 categories with a class interval of 10 years. Based on Table 2, it is known that the distribution of respondents' farming experience is dominated by the highly experienced category (31–40 years) with a total of 92 people or 52.6%, followed by the experienced category (21–30 years) as many as 52 people (29.7%), the new category (1–10 years) as many as 25 people (14.3%), and the least is the moderately experienced category (11–20 years) as many as 6 people (3.4%). When summed up, farmers who are classified as experienced and highly experienced over 21 years old reach 82.3% of the total respondents. This condition illustrates that the majority of patchouli farmers in West Malangke District have accumulated knowledge and practical skills that are quite long in managing farming. The more experience farmers gain, it is hoped that the productivity of farmers will be higher, so that in doing farming it will be better. Farming experience has a significant impact on the acceptance of innovation, and farmers with longer farming experience tend to have better skills in managing their farming (Munawaroh et al., 2020).

However, the proportion of farmers in the category of moderately experienced (11-20 years) which is very small, at only 3.4%, indicates a gap in experience distribution among respondents. Such conditions need to be considered in the design of extension programs, because farmers with very long experience do not necessarily have high knowledge if the farming practices carried out are still conventional and have not been touched by more up-to-date cultivation technology innovations.

Characteristics of Respondents Based on Agricultural Training

Agricultural training is one of the indicators of internal factors that reflect the intensity of farmers in participating in non-formal educational activities in the agricultural sector. In this study, the frequency of agricultural training was categorized into 3 categories with a class interval of 7 times per category. Based on Table 2, it is known that most patchouli farmers in West Malangke District are in the low training category (0-7 times) with a total of 169 people or 96.6% of the total respondents. Farmers who are in the medium category (8-14 times) are only 5 people (2.9%), and those who are in the high category (15-20 times) are only 1 person (0.6%). The dominance of farmers in the low training category with a very large proportion, namely 96.6%, is the most prominent finding among all the characteristic variables of the respondents in this study. This condition indicates that patchouli farmers' access to agricultural training activities at research sites is still very limited, both in terms of frequency and availability of training programs that specifically target patchouli commodities. The lack of support in the form of agricultural extension and technical assistance exacerbates this situation, so agricultural productivity among smallholders remains low. Non-formal education shows a positive relationship with farmers' knowledge, attitudes, and skills, so the importance of non-formal education in improving farmers' knowledge and skills needs to receive more serious attention from various stakeholders.

Agricultural Extension

Agricultural extension is one of the variables that is suspected to affect the level of knowledge of patchouli farmers in West Malangke District. In this study, agricultural extension was studied through three main indicators, namely the frequency of extension workers' visits, the relevance of the extension materials, and the extension methods used. The frequency is assessed based on the number of extension visits, the duration of the meeting, and the number of farmer group meetings held. Meanwhile, the relevance and extension methods were assessed by farmers using an assessment scale ranging from very inappropriate to very appropriate. Farmers' assessment of agricultural extension activities based on these three indicators is presented in Table 3 below.

Table 3. Farmers' Assessment of Agricultural Extension Activities in West Malangke District

No.	Agricultural Extension	Categories				
1	Frequency	**Number of extension visits**	**Duration of the meeting**	**Number of group meetings**		
		1 time/month	0.72 hours	1,37		
		STS	**TS**	**CS**	**S**	**SS**
2	Relevance (%)	2,3	6,9	29,7	49,1	12,0
3	Method (%)	3,4	8,6	28,6	46,9	12,6

Remarks: STS = very unsuitable; TS = inappropriate; CS = fairly appropriate; S= appropriate; SS= is perfectly suited

Source: Processed Primary data 2026

Table 3 presents farmers' assessment of patchouli agricultural extension activities which includes three aspects, namely frequency, relevance, and extension methods. In the aspect of extension frequency, measurements are carried out through three indicators, namely the number of extension visits, the duration of meetings, and the number of group meetings. The number of extension visits was recorded 1 time per month, with an average duration of each meeting of 0.72 hours, and an average number of group meetings of 1.37 times. This condition illustrates that the intensity of extension assistance to patchouli farmers is still relatively low, both in terms of frequency and duration of face-to-face meetings.

In terms of the relevance of extension materials, the distribution of farmers' assessments showed that 2.3% stated that they were very inappropriate (STS), 6.9% were not suitable (TS), 29.7% were fairly appropriate (CS), 49.1% were suitable (S), and 12.0% were very suitable (SS). Thus, most farmers, 61.1%, considered that the material presented in the extension activity was relevant to the needs and real conditions of the farming business they were engaged in.

In terms of extension methods, farmers' assessments showed that 3.4% stated that they were very inappropriate (STS), 8.6% were not suitable (TS), 28.6% were fairly appropriate (CS), 46.9% were

suitable (S), and 12.6% were very suitable (SS). This shows that the majority of farmers (59.5%) consider the method used by extension workers to convey information to be appropriate and well accepted by farmers.

Overall, all three aspects of agricultural extension received a fairly positive assessment from farmers, with the appropriate category (S) as the dominant assessment in terms of relevance and method. However, the aspect of frequency that shows the intensity of visits and the duration of meetings that are still low need more attention. Therefore, increasing the frequency of extension visits and extending the duration of meetings is very necessary, especially through the implementation of extension activities specifically designed for patchouli commodities, not just general agricultural extensions, so that the transfer of knowledge and skills conveyed is more directed, specific, and in accordance with the real challenges faced by patchouli farmers in the field.

External Factors

In addition to internal factors and agricultural extension, external factors are also suspected to have an influence on the level of knowledge of patchouli farmers in West Malangke District. External factors in this study are studied through three indicators, namely access to information, access to production facilities, and social conditions of the community. These three indicators reflect the extent to which the environment outside of farmers is able to support or hinder the improvement of their knowledge in running patchouli farming businesses. Farmers' assessment of each of these external factor indicators is presented in Table 4 below.

Table 4. Farmers' Assessment of External Factors in West Malangke District

Yes	External factors	Category %				
		STS	TS	CS	S	SS
1	Access information	1,7	5,1	25,1	50,9	17,1
2	Access to means of production	6	3,4	34,9	44,6	16,6
3	Social conditions of the community	6	2,3	28,6	49,1	19,4

Remarks: STS = very unsuitable; TS = inappropriate; CS = fairly appropriate; S= appropriate; SS= is perfectly suited

Source: Processed Primary data 2026

Table 4 presents farmers' assessment of external factors which includes three aspects, namely access to information, access to production facilities, and social conditions of the community. In terms of access to information, the distribution of farmers' assessments showed that 1.7% stated that they were very inappropriate (STS), 5.1% were not suitable (TS), 25.1% were fairly appropriate (CS), 50.9% were suitable (S), and 17.1% were very suitable (SS). Thus, most farmers, 68.0%, consider that access to information related to patchouli farming is appropriate and very suitable for their needs. This indicates that farmers relatively do not experience significant obstacles in obtaining relevant information related to patchouli cultivation.

In terms of access to production facilities, farmers' assessments showed that 6.0% stated that they were very inappropriate (STS), 3.4% were not suitable (TS), 34.9% were fairly appropriate (CS), 44.6% were suitable (S), and 16.6% were very suitable (SS). As many as 61.2% of farmers consider the availability and ease of access to patchouli agricultural production facilities to be appropriate. However, the proportion of farmers who provide STS assessments on this aspect is higher than the access to information aspect, which indicates that there are still obstacles in terms of availability and affordability of production facilities for some farmers.

In terms of community social conditions, the distribution of farmers' assessments showed that 6.0% stated that they were very inappropriate (STS), 2.3% were not suitable (TS), 28.6% were fairly appropriate (CS), 49.1% were suitable (S), and 19.4% were very suitable (SS). Most farmers, 68.5%, consider that the social conditions of the community in their environment are appropriate and support the sustainability of patchouli farming businesses. The high proportion of assessments that are appropriate and very appropriate in this aspect reflect the existence of strong social support from the surrounding environment for the development of patchouli farming businesses.

Overall, the three external factors measured received a positive assessment from farmers with the appropriate category (S) as the dominant assessment. Among these three aspects, the social condition of the community obtained the highest proportion of appropriate and very appropriate assessments of 68.5%, followed by access to information at 68.0%, and access to production facilities at 61.2%. However, the aspect of access to production facilities needs more attention considering that there are still farmers who face limitations in obtaining the production facilities needed to optimize patchouli cultivation results.

Sem Model Evaluation

Before using SEM models for hypothesis testing, it is important to perform validity and reliability testing on the model. For model validity, what is tested is convergent validity by examining the outer loading and Average Variance Extracted (AVE) values. The SEM model is considered valid if the outer loading is more than 0.7 and the AVE is more than 0.5. For the reliability of the SEM model, it is measured through Composite Reliability (CR) and *I*. This reliability aims to assess how consistent a variable indicator is internally. A variable is said to have reliability if Cronbach's Alpha value is more than 0.6, whereas for Composite Reliability, its value must be above 0,7 (Sadik & Syafruddin, 2024). The results of the validity and reliability test of the SEM model are presented in Table 5.

Table 5. Results of the SEM Model validity and reliability test

Variable	Indicator	Loading factor	Cutt of value	AVE	Validity	Cronbach's Alpha	CR	Reliability
Internal factor (X1)	X1.1	0.831	0,7	0.860	Valid	0.945	0.961	Reliable
	X1.2	0.967	0,7		Valid			
	X1.3	0.962	0,7		Valid			
	X1.4	0.941	0,7		Valid			
Agricultural extension (X2)	X2.1	0.894	0,7	0.838	Valid	0.908	0.940	Reliable
	X2.2	0.919	0,7		Valid			
	X2.3	0.933	0,7		Valid			
External factors (X3)	X3.1	0.864	0,7	0.782	Valid	0.867	0.915	Reliable
	X3.2	0.930	0,7		Valid			
	X3.3	0.856	0,7		Valid			
Farmers' Knowledge Level of Patchouli Cultivation (Y)	Y.1	0.747	0,7	0.655	Valid	0.743	0.850	Reliable
	Y.2	0.807	0,7		Valid			
	Y.3	0.869	0,7		Valid			

Source: Processed Primary data 2026

Based on Table 5, the SEM model has met the criteria for validity and reliability. This is shown by the outer loading value of all indicators >0.7 and the AVE value of >0.5. Meanwhile, the reliability criteria are determined based on the Cronbach Alpha value of all variables >0.6 and the CR value of >0.7.

Factors That Affect Farmers' Knowledge Of Patchouli Cultivation Techniques

The type of analysis used to determine the influence of internal factors, agricultural extension and external factors on the level of knowledge of farmers related to patchouli cultivation techniques is variance based Structural Equation Modeling (SEM) or VB-SEM. The SEM model of the analysis is presented in Figure 1.

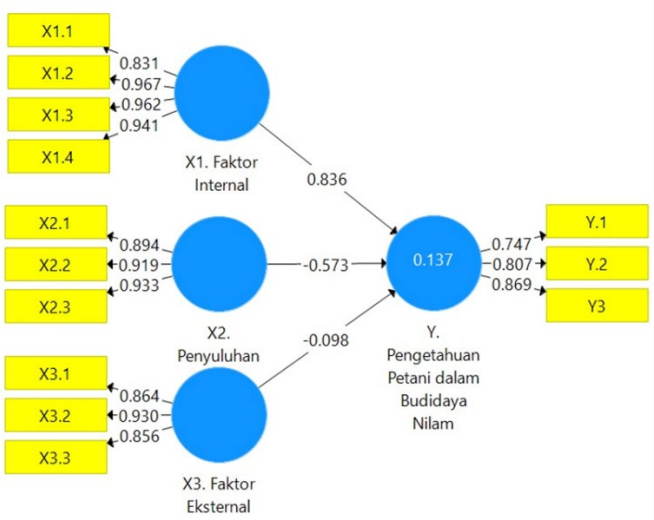

Figure 1. SEM Model analysis results

Figure 1 shows the influence of internal factors, agricultural extension and external factors on the level of farmers' knowledge related to patchouli cultivation techniques in West Malangke District, North Luwu Regency. The magnitude of the influence between variables is presented in Table 6.

Table 6. The influence of internal factors, agricultural extension and external factors on the role of extension workers

Influence on variable Y	T Statistics	T-Table	P Values	Cut off Value
X1. Internal Factors -> Y. Farmers' Knowledge in Patchouli Cultivation	4.238	1,654	0.000	0,05
X2. Agricultural extension -> Y. Farmers' Knowledge in Patchouli Cultivation	2.890	1,654	0.004	0,05
X3. External Factors -> Y. Farmers' Knowledge in Patchouli Cultivation	0.941	1,654	0.347	0,05

Internal Factors

The results of the analysis in Table 6 show that the Internal Factor (X1) has a positive and significant effect on Farmers' Knowledge in Patchouli Cultivation (Y), with a T-Statistics value of 4.238 > T-Table of 1.654 and P-Values of 0.000 < Cut-off Value of 0.05. Thus, the hypothesis that internal factors affect farmers' knowledge in patchouli cultivation is accepted. This shows that the better the condition of the internal factors of the farmer which includes age, level of education, farming experience, and training, the higher the farmer's knowledge in applying good and correct patchouli cultivation techniques. The results of the analysis test on factors that are suspected to affect the level of knowledge of farmers show that overall, internal factors contribute more than other factors. The internal factors in question include individual characteristics of farmers such as age, education level, farming experience, and agricultural training.

The dominant role of these internal factors suggests that the condition and innate capacity of farmers themselves are the main determinants of how far they are able to absorb and understand information related to patchouli cultivation techniques. The results of this study are in line with (Tasnim et al., 2022) those who state that training is able to significantly increase farmers' knowledge. In addition, it is also in line with (Oliyah, 2024) those that show that farming experience is positively correlated with farming decision making skills, as well (Pratiwi & Suzuki, 2017) as those that affirm the contribution of training to the adoption of agricultural technology. Thus, optimizing the internal capacity of farmers will strengthen their ability to absorb information and cultivation technology. Improving the quality of human resources (HR) is a fundamental aspect in the sustainability of patchouli farming development, because the better the internal capacity that farmers have, the greater their ability to understand information and technology in plant cultivation.

Agricultural extension

The Extension Variable (X2) was proven to have a positive and significant effect on Farmers' Knowledge in Patchouli Cultivation (Y), with a T-Statistics value of 2.890 > T-Table of 1.654 and P-Values of 0.004 < 0.05. Thus, the hypothesis that agricultural extension has an effect on the knowledge of patchouli farmers is accepted. This result proves that the more intensive and quality of extension activities received by farmers, the more their understanding and knowledge of the right patchouli cultivation techniques will increase. These findings are in line with the results of research (Maduwu et al., 2024) that proves that agricultural extension methods applied effectively have been proven to be able to significantly improve farmers' knowledge and skills. In addition, agricultural extension is a strategic instrument that allows the transfer of knowledge and technology to farmers, including the implementation of more efficient and productive cultivation technique innovations. Therefore, the existence of agricultural extension workers who are active, competent, and routinely providing assistance to patchouli farmers is a crucial factor that needs to be strengthened to ensure that knowledge of patchouli cultivation techniques can be conveyed effectively and sustainably at the field level.

External Factors

In contrast to the previous two variables, External Factors (X3) had a insignificant effect on Farmers' Knowledge in Patchouli Cultivation (Y), with a T-Statistics value of 0.941 < T-Table of 1.654 and P-Values of 0.347 > 0.05. Thus, the hypothesis that external factors affect the knowledge of patchouli farmers is rejected. This condition indicates that environmental factors outside of farmers such as the availability of access to information, access to production facilities, and social conditions of the community have not made a real direct contribution to increasing farmers' knowledge of patchouli cultivation techniques in West Malangke District. This result can

be understood in the framework that knowledge is a cognitive domain that is more formed by active learning processes from within the individual and through direct interaction with extension workers, rather than solely from external environmental conditions. This is in line with (Baul et al., 2024) findings that limited infrastructure and lack of access to technical information and training exacerbate the inability of smallholders to adopt and maintain agricultural knowledge effectively, but the impact is indirect and dependent on region-specific conditions. Furthermore, external factors such as internet networks, ICT infrastructure, device costs, and institutional support actually have more impact on the selection of extension media, rather than directly on increasing the knowledge of farmers themselves. Thus, an approach that focuses more on strengthening the individual capacity of farmers and intensifying extension activities is needed as the main path to increase knowledge of patchouli cultivation, while improving external factors is still needed as long-term support.

Overall Influence of Variables

Based on the results of the PLS-SEM analysis, the R-Square (R^2) value obtained in the variable of Farmer Knowledge in Patchouli Cultivation (Y) was 0.137 or 13.7%. This value means that overall, the three independent variables consisting of Internal Factors (X1), Extension (X2), and External Factors (X3) together contribute 13.7% in explaining the variation in farmers' knowledge levels of patchouli cultivation techniques. The remaining 86.3% was influenced by other variables that were not observed in this study.

These results illustrate that farmers' knowledge in patchouli cultivation is a construct formed from various factors that are very diverse and multidimensional. This is in line with the understanding that human knowledge is not formed from just one or two sources, but is an accumulation of various experiences, social interactions, and learning processes that take place continuously throughout the life of farmers. Therefore, efforts to increase the knowledge of patchouli farmers are not enough to focus only on strengthening internal factors and intensifying extension, but also need to be supported by a more holistic approach including improving the social environment, strengthening farmer institutions, and expanding access to agricultural information sources that are relevant and easily accessible to farmers at the field level.

CONCLUSION

This study reveals that patchouli farmers in West Malangke District actually have a strong foundation of knowledge in all aspects of cultivation, with prominent mastery of farming management and post-harvest knowledge as the only gap that still needs to be strengthened. The most important finding of this study is that the internal capacity of farmers i.e. accumulated education, experience, productive age, and involvement in training proved to be the main determinants of how far a farmer is able to absorb and internalize technical knowledge of cultivation, while agricultural extension acts as a catalyst that accelerates the process. Conversely, external environmental factors such as access to information and social conditions, although positively assessed by farmers, do not directly shape knowledge of a finding that challenges the common assumption that expanding access to information by itself will increase farmers' cognitive capacity. The practical implication is that extension programs for specific commodities such as patchouli can no longer be designed generically; It must be based on the profile of farmers' internal capacity as a starting point, then built gradually with priority on post-harvest aspects that have high added value but are still weak. The limited low R-Squared value is an important signal that farmer knowledge is a much more complex construct than what has been modeled, so further research needs to include hidden variables such as economic motivation, farmer group dynamics, and relational proximity between extension workers and farmers as more comprehensive explanatory factors.

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