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Strengthening The Capacity of Tunggularum Hamlet Community, In Optimizing the Lemongrass Plants into Essential Oil Products

Aprilia Fitriani[1], Nurul Hidayah[2], Liya Yusrina Sabila[3], Haris Imam Karim Fathurrahman[4*]

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ABSTRAK

Tunggularum Hamlet, Wonokerto Village, Sleman Regency, has considerable potential in lemongrass cultivation, but its utilization remains limited to traditional uses such as seasoning and herbal drinks. This community service program aimed to strengthen community capacity in optimizing lemongrass into value-added essential oil products through socialization, training, and the provision of distillation equipment. The activities included discussions with partners, socialization on lemongrass essential oil processing and packaging, practical distillation training, and evaluation through questionnaires. The program involved lecturers, students, and approximately 20–25 community participants, predominantly women farmers and housewives. The results showed that the program positively improved participants' knowledge, management skills, economic independence, and mindset regarding the business potential of lemongrass essential oil. Most participants reported sufficient knowledge improvement, slight increases in management capability and economic independence, as well as positive changes in their entrepreneurial mindset. In addition, participants highly appreciated the support provided by the community service team during the program. Overall, the program successfully enhanced community awareness and initial capacity in developing lemongrass essential oil businesses, although further mentoring and practical assistance are still needed to achieve sustainable economic impacts and stronger entrepreneurial readiness.

Keywords: Community service; Essential oil; Lemongrass; Tunggularum

INTRODUCTION

In 2023, the agricultural sector contributed 12.53% to the total Gross Domestic Product (GDP), ranking third after the manufacturing sector (18.67%) and trade (12.94%). This figure represents a relatively small increase compared to the previous year's 12.40%. Of this total contribution, approximately 1.44% came from the horticulture subsector, including lemongrass cultivation (Badan Pusat Statistik, 2023).

As a key sector, agricultural activities in Indonesia are widespread across various regions and segments of society. One area with agricultural potential is the Special Region of Yogyakarta Province, particularly in Wonokerto Village, Turi Subdistrict, Sleman Regency. Most residents in Tunggularum Hamlet are farmers, growing food crops such as rice and corn. Furthermore, many farmers also cultivate horticultural crops, including lemongrass (*Cymbopogon citratus*), both in their yards and on vacant land, although management has not been optimal (Soliman et al., 2017).

Lemongrass (*Cymbopogon citratus*) is highly adaptable, allowing it to grow in a variety of environmental conditions in Indonesia, from lowlands to highlands, in a variety of soil types and climates, even with relatively minimal maintenance (Corpas, 2026). Furthermore, before World War II, Indonesia was a major exporter of lemongrass essential oil. However, this position has now been overtaken by China as the leading

[1-2] Food Technology, Faculty of Industrial Technology, Universitas Ahmad Dahlan

[3-4*] Electrical Engineering, Faculty of Industrial Technology, Universitas Ahmad Dahlan

*) *corresponding author*

Haris Imam Karim Fathurrahman
Electrical Engineering, Faculty of Industrial Technology, Universitas Ahmad Dahlan
Email: haris.fathurrahman@te.uad.ac.id

producer. Although global demand for lemongrass essential oil continues to increase annually, Indonesia is only able to meet approximately 10% of this demand. Therefore, developing an essential oil refining industry is a strategic step that needs to be pursued (Singh et al., 2022).

Figure 1. Documentation of discussions with representatives of the Wonokerto Village Government

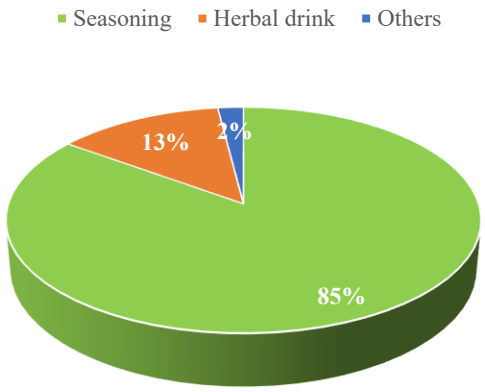

Figure 2. Results of the Survey of Knowledge of Lemongrass Derivative Products

Based on discussions with a representative of the Wonokerto Village government (Figure 1), lemongrass was deemed the most potential commodity for development in the region. Increasing economic value can be achieved through processing lemongrass into essential oil. As a follow-up, a random survey was conducted among residents of Wonokerto Village, coordinated by the Tunggularum Hamlet. The survey results (Figures 2 and 3) show that the use of lemongrass by the community is still limited as a seasoning and herbal drink, while knowledge regarding the essential oil distillation process is still very limited.

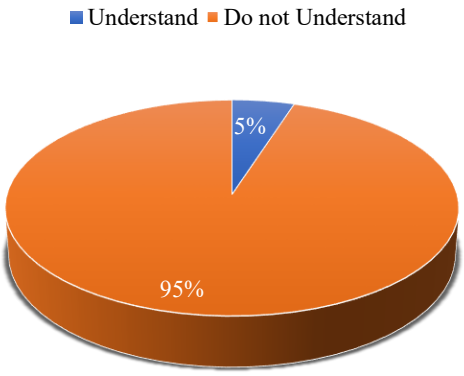

Figure 3. Results of the Survey on Understanding of Essential Oil Distillation

LITERATURE OR CONCEPTUAL REVIEW

A literature review on the use of lemongrass as an essential oil in Tunggularum Hamlet, Wonokerto Village, shows that lemongrass essential oil has significant potential as a functional ingredient in food, health, and household products, as reported in various academic books and recent scientific articles (Mukarram et al., 2022; Rabbani et al., 2026). This review not only summarizes findings related to the chemical composition, bioactive activity, and extraction techniques of lemongrass oil but also explains its relevance to local conditions. In the conceptual analysis, only literature that directly supports the discussion is used, while still objectively considering various research results that may show limitations or differing results, thus producing a comprehensive and unbiased scientific review.

Furthermore, several studies have shown that lemongrass (*Cymbopogon citratus*) essential oil is rich in bioactive compounds such as citral, geraniol, and limonene, which contribute to its antimicrobial and antioxidant activities (Okpo and Edeh, 2023; Wan and Xing, 2025). These findings support the use of lemongrass not only as an aromatic ingredient but also as a natural preservative in food products and an active ingredient in health and hygiene products (Singh et al., 2022; Soliman et al., 2017). In the context of Tunggularum Hamlet, this potential can be integrated with local agricultural practices to increase the added value of lemongrass through a simple distillation process suitable for household and small business scale.

Moreover, a literature review revealed that the success of lemongrass essential oil development is significantly influenced by post-harvest factors, extraction methods, and the quality standards of the resulting oil. Various methods, such as steam distillation and hydrodistillation, yield different oil yields and qualities, making selecting the right technique crucial for producing a competitive product. Several studies also highlight challenges related to volatile compound stability and the need for quality standardization, which are crucial for developing local lemongrass-based businesses (Do et al., 2021; Rodrigues et al., 2022; Slamet et al., 2013).

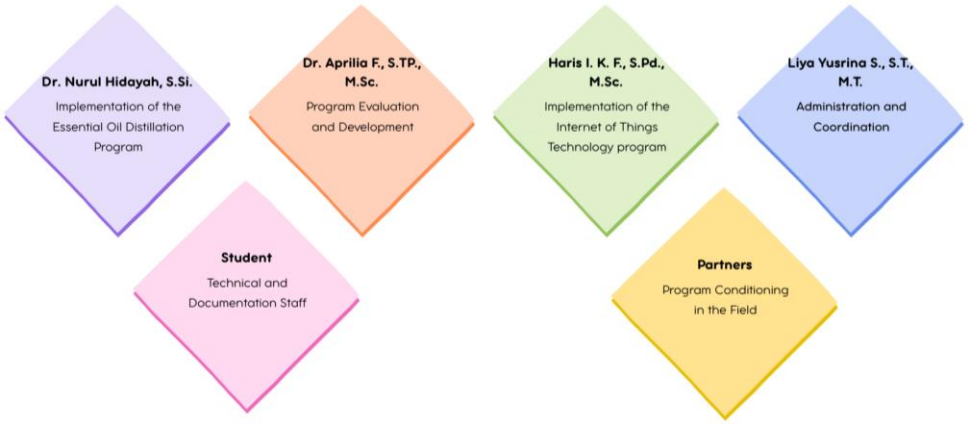

Figure 4. Division of tasks for implementing community service

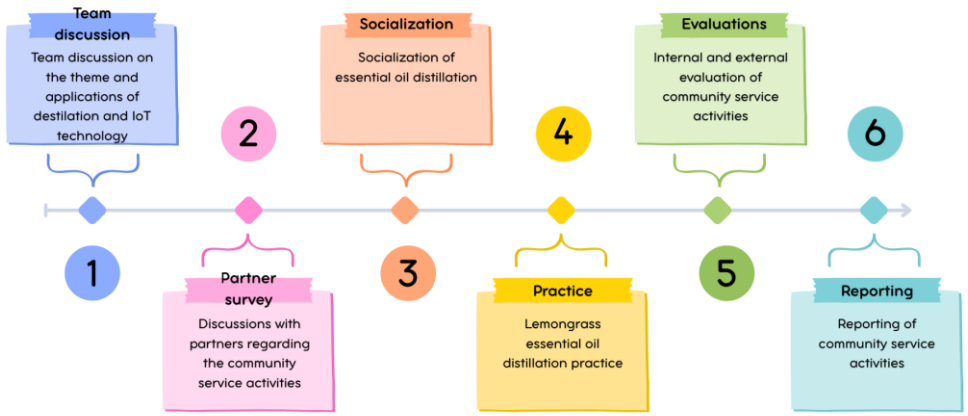

Figure 5. Methods of implementing community service

Taking all these findings into account, the conceptual analysis in this study emphasizes the importance of integrating scientific knowledge with the local wisdom of the Tunggularum Hamlet community. This approach enables the development of lemongrass essential oil products that are not only based on scientific evidence but also economically and socially sustainable. Therefore, this literature review provides a strong foundation for designing optimal lemongrass utilization strategies, while also opening up opportunities for further, more applicable and contextual research in the region.

MATERIALS AND METHODS

Community Service Design

The Community Service (PkM) activity reported in this article is the implementation of PkM activities with the title "Pemberdayaan Masyarakat Kalurahan Wonokerto untuk Optimalisasi Produk Minyak Atsiri Turunan Pertanian Serai Menggunakan Teknologi Internet of Things dan Database Terpusat". This activity was carried out in Tunggularum Hamlet, Wonokerto Village, Sleman. PkM activities included discussions with Tunggularum Hamlet and Tunggularum Hamlet community groups, to the implementation of lemongrass essential oil distillation socialization, lemongrass essential oil packaging socialization, and lemongrass essential oil distillation training. The socialization and training activities were attended by around 20-25 residents of Tunggularum Hamlet. This PkM activity involved 2 lecturers from the Food Technology Study Program (Dr. Nurul Hidayah, S.Si. and Dr. Aprilia Fitriani, S.TP., M.Sc.), as well as 2 lecturers from the Electrical Engineering Study Program (Haris Imam Karim Fathurrahman, S.Pd., M.Sc. and Liya Yusrina Sabila, S.T., M.T.) from Ahmad Dahlan University. This activity also involved several students including 5 students from the Food Technology Study Program (Lin Maesyarotul Himmah, Kayladinda Zahra Kaulika, Dhamar Faturrochman, Ananda Prastika Anggara, and Arya Saksena) and 1 student from the Electrical Engineering Study Program (Ahmad Fauzi). The division of tasks for each implementer can be seen in Figure 4.

Figure 6. Documentation of the community service team's audience with partners

The method used in implementing PkM in the Tunggularum Hamlet environment consists of 6 stages as can be seen in Figure 5. First, a team discussion was held to determine the theme of the PkM activity, determine the PkM implementation partner, and determine the partner in making the distillation equipment. The second stage, a discussion and survey were conducted with the PkM activity partner, namely the Tunggularum Hamlet. This second stage was also accompanied by the processing of PkM activity permits in the partner environment. After the permit was obtained, the PkM activity began with a socialization of essential oil distillation from lemongrass (stage 3) and practice in essential oil distillation.

During the socialization activity, socialization was provided regarding the essential oil distillation process, essential oil packaging, and capital and profit calculations in the lemongrass essential oil production business. The essential oil distillation practice activity used distillation equipment which was then given to the Tunggularum Hamlet. The essential oil distillation practice was accompanied by the application of IoT technology for the digitalization process in essential oil distillation. The evaluation stage is carried out after the activity is completed, both internally by the community service team and externally, between the team, partners, and the PkM implementation funders. The final stage is reporting on PkM activities as a form of accountability for the implementation team to the funders.

RESULTS AND DISCUSSION

Audience with partners

The community service team led by Dr. Nurul Hidayah, S.Si., conducted a hearing activity in Tunggularum Hamlet as the initial stage of program implementation. In the hearing, the community was represented by Mr. Kristanto as the Head of the Hamlet and Mrs. Ningrum as the driver of the Women Farmers Group (KWT), as shown in Figure 6. This hearing activity resulted in several main points, namely: (1) Tunggularum Hamlet as a partner conveyed the need for community empowerment, where the development of essential oil distillation is the main priority; (2) the community service team presented a program plan that includes socialization and practical activities related to processing lemongrass plants into essential oils; and (3) determining the schedule for implementing activities to be carried out in Tunggularum Hamlet.

Figure 7. Assembly of essential oil distillation equipment by supplier

Essential oil distillation instrument

A 10 kg distillation apparatus for small-scale industries was obtained from CV. Aneka Medica. The equipment was shipped directly by the supplier to Ahmad Dahlan University Campus 4 in good condition. A visualization of the distillation apparatus is shown in Figure 7. Before being handed over to the partner, a team of lecturers and students conducted two performance tests on the apparatus in the Food Engineering Laboratory on the second floor of the Laboratory Building, Campus 4, UAD. These tests aimed to ensure optimal distillation functionality. The trial process was conducted using a 7 kg sample of lemongrass, with documentation of the activity shown in Figure 8.

Briefly, the distillation procedure begins by loading 7 kg of lemongrass into section A. Section B (boiler) is then filled with water to half its capacity, while section C (condenser) is filled to the top with water and equipped with a pump. The boiler is then heated using a stove until the temperature reaches 100°C. The distillation process lasts for 5–6 hours. The resulting distillate was collected in an Erlenmeyer flask and exhibited two phases: an upper layer of essential oil and a lower layer of water. The lemongrass essential oil was then separated using a separating funnel and collected in a beaker (Figure 9). For storage, the essential oil was placed in a dark glass container to maintain its quality.

Figure 8. Documentation of the distillation apparatus trial (left); Appearance of the distillation apparatus (right)

Figure 9. Results of the distillation apparatus trial using lemongrass samples

Handover of essential oil distillation equipment to Partners

After the equipment was confirmed to be functioning properly, the distillation instrument was cleaned after the trial and optimally packaged for subsequent distribution and handover to the Community Service (PkM) activity partners in Tunggularum Hamlet. The equipment handover process was carried out directly by the PkM team to the partners, represented by Mr. Kristanto as the Head of the Hamlet and Ms. Ningrum as the motivator of the Women Farmers Group (KWT). Documentation of the handover activity is presented in Figure 10.

Figure 10. Documentation of the handover of distillation equipment from the team to the partner

Community service activities

On Thursday, August 29, 2024, a socialization activity on lemongrass distillation using a distillation apparatus was held at the residence of Mr. Kristanto, Head of Tunggularum Hamlet. The event was attended by a team of lecturers, students, and 25 members of the Tunggularum Hamlet community, all of whom were women (Figure 11). The presentation was delivered by Dr. Nurul Hidayah, S.Si., for approximately one hour, followed by a discussion and question-and-answer session. At the conclusion of the outreach activity, all participants were asked to complete a questionnaire prepared by the teaching team. The questionnaire consisted of six questions covering aspects of empowerment.

Figure 11. Documentation of the presentation of material on distilling lemongrass plants using a distillation tool.

Furthermore, in conjunction with the outreach activities, a training session on distilling lemongrass into essential oil was held on September 2, 2024, in Tunggularum Hamlet. The event was attended by 24 Tunggularum residents, all of whom were women. The majority of participants in both

the outreach and training were farmers and housewives. Following the lemongrass distillation workshop, the teaching team prepared a questionnaire for participants to complete. Documentation of the distillation training activity is shown in Figure 12.

Figure 12. Documentation of training activities on distilling lemongrass plants using a distillation apparatus, practice (top); group photo (bottom)

Questionnaire results

Sufficient knowledge about lemongrass essential oil

Based on the data processing of the questionnaire results in the socialization activity of distilling kitchen lemongrass plants using a distillation tool, 6 graphs were obtained that interpret empowerment after the socialization activity was carried out.

Based on Figure 13, the majority of respondents assessed their knowledge regarding lemongrass essential oil packaging after participating in the community service and outreach program as being in the "sufficient" category, with a percentage of approximately 21%. Furthermore, only a small proportion of respondents felt their knowledge was "very sufficient," approximately 1%, while almost no respondents assessed their knowledge as "insufficient" or "very insufficient." This indicates that the program has had a positive impact in improving participants' basic understanding regarding lemongrass essential oil. However, this level of understanding is still considered suboptimal because most respondents have not yet reached the "very sufficient" category. This condition indicates that

the material presented is still basic and requires further in-depth study. The low percentage in the "very sufficient" category may also be caused by limited implementation time, a more theoretical delivery method, and a lack of direct practice. Therefore, further efforts are needed, such as practice-based training, ongoing mentoring, and the provision of technical guidance so that the knowledge gained by participants is not only conceptual but can also be optimally applied (Hartati et al., 2022; Pertiwi et al., 2026).

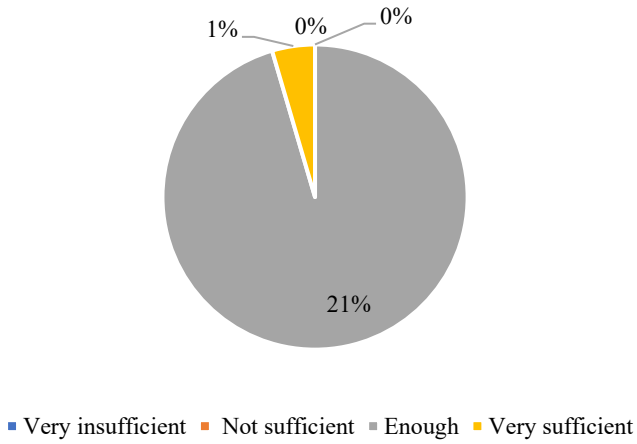

Figure 13. Sufficient knowledge about lemongrass essential oil after participating in the program

Ability to manage lemongrass

Based on the diagram results (Figure 14), the majority of respondents stated that their ability to manage lemongrass after participating in the community service and outreach program fell into the "feeling a little more capable" category, with the largest percentage being around 20%. Meanwhile, only a small proportion of respondents felt "more capable" or "not feeling more capable" (approximately 1% each), and almost none felt "very capable." These findings indicate that the program implemented has had a positive impact on increasing participant capacity, although this increase is still at an initial level or not yet significant. Participants tended to experience increased confidence and basic understanding in lemongrass management, but did not yet feel fully proficient or competent. This could be due to the limited duration of the activity, the lack of direct practice, and the lack of ongoing mentoring after the outreach program. Therefore, to improve participant capabilities to a higher level, further programs such as practice-based training, intensive demonstrations, and ongoing technical mentoring are needed so that participants not only understand the theory but are also able to apply lemongrass management skills independently and optimally (Daud et al., 2025; Kausar, 2024).

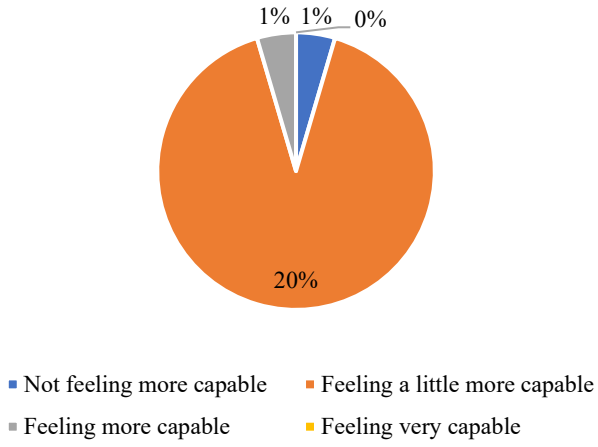

Figure 14. Ability to manage lemongrass after participating in the program

Programs affect income

Based on Figure 15, the majority of respondents stated that the program had a positive impact on their income. Fifteen percent of respondents reported a slight increase, the largest proportion compared to other categories. This indicates that the program has had an initial economic impact, although it is not yet significant for most participants. Meanwhile, only 3 percent of respondents experienced a significant increase, and 1% reported a very significant increase, indicating that the program's optimal impact is still limited to a small proportion of participants. Furthermore, 3% of respondents reported no effect on their income.

These results indicates that the program has the potential to increase income, but its effectiveness is uneven. The dominance of the "slight increase" category indicates that participants are likely still in the early stages of adopting the knowledge or skills provided, thus the impact on income has not been maximized. The low percentages in the significant and very significant increase categories could be due to several factors, such as limited capital, market access, production consistency, or the suboptimal application of technology acquired during the program. In addition, the presence of respondents who did not feel any impact indicates the need for further evaluation regarding the suitability of program materials to participants' needs, as well as continued mentoring so that program results can be more sustainable and have a real impact on increasing community income (Gayatri et al., 2025; Yuninda et al., 2022).

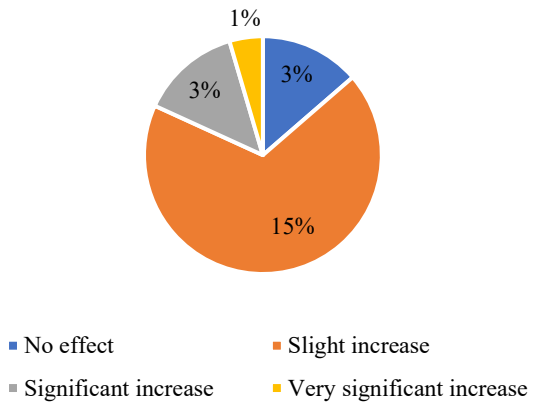

Figure 15. Programs affect income after participating in the program

Program increased economic independence

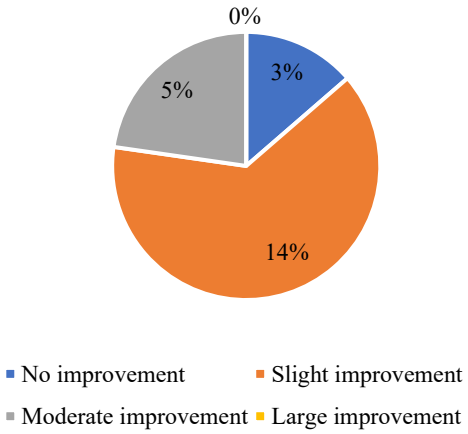

Figure 16. This program has increased economic independence

Based on Figure 16, it is clear that the program has contributed to increasing participants' economic independence, although to varying degrees. The majority of respondents, 14%, reported experiencing slight improvement in economic independence. This indicates that the program is beginning to have a positive impact, particularly in fostering participants' initial ability to independently manage resources or economic opportunities. Furthermore, 5% of respondents reported moderate improvement, indicating that some participants have begun to show more tangible progress in economic independence. Meanwhile, 3% of respondents reported no improvement, and no respondents experienced significant improvement.

These results indicates that the program has the potential to strengthen community economic independence, but its impact is still in its early stages. The predominance of the "slight improvement" category indicates that participants are likely just beginning to apply the knowledge or skills they have acquired, so the results are not yet fully optimal in significantly increasing economic independence. Economic independence itself is a gradual process influenced by various factors, such as access to capital, managerial skills, business sustainability, and environmental support.

The presence of respondents who achieved "moderate improvement" indicates that the program has had a stronger impact on some participants, possibly due to higher levels of engagement or individual readiness to capitalize on economic opportunities. However, the absence of respondents in the "significant improvement" category indicates that the program still needs improvement, particularly in terms of ongoing mentoring, market access, and capital facilitation to enable participants to achieve higher levels of economic independence.

Meanwhile, the presence of respondents who did not experience improvement indicates gaps in the program's effectiveness. This could be due to differences in participant backgrounds, motivations, or limited resources. Therefore, program evaluation and strengthening are needed, such as a more personalized approach, further training, and ongoing monitoring, to ensure the program's impact on economic independence is more equitable and significant for all participants (Fitri and Anwar, 2025; Haris et al., 2023).

Change in mindset about the potential of the lemongrass essential oil business

Based on Figure 17, the majority of participants felt a change in their mindset regarding the potential of the lemongrass essential oil business after participating in the program. This is demonstrated by the dominance of the "Little change" category at 16%, indicating that most participants are beginning to experience a shift in perspective, albeit at a relatively early stage. Furthermore, 6% of participants fell into the "Quite a lot of change" category, indicating a group that has experienced a deeper shift in mindset and is beginning to understand the lemongrass essential oil business opportunity more comprehensively.

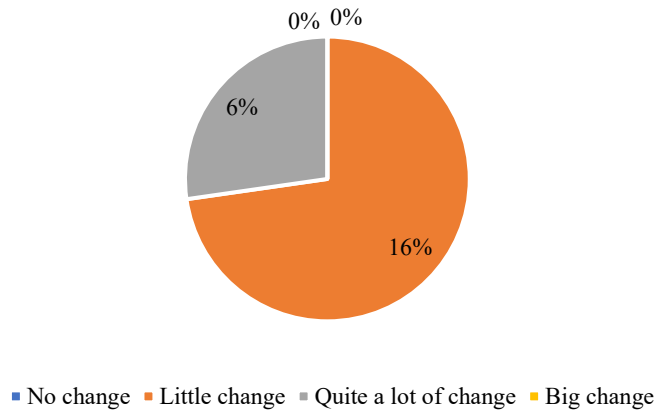

Figure 17. Feeling a change in mindset about the potential of the lemongrass essential oil business after participating in the program

Conversely, no respondents selected "No change" or "Big change" (0%), indicating that the program successfully triggered change in all participants, but was not yet able to produce a very significant transformation. Overall, these results indicate that the program was effective in building awareness and opening initial insights regarding the potential of the lemongrass essential oil business. However, it still requires strengthening through continued mentoring, hands-on practice, and enhanced entrepreneurship materials so that the mindset changes can develop into readiness for real business implementation (Kausar, 2024; Yuninda et al., 2022).

Support provided by the community service team

Based on Figure 18, the majority of participants rated the support provided by the community service team during the program as positive. This is evident in the dominant category of "Very adequate" (13%), followed by "Adequate" (9%). These findings indicate that the majority of participants felt their needs were well met during the program, both in terms of mentoring, material delivery, and responses to challenges encountered in the field.

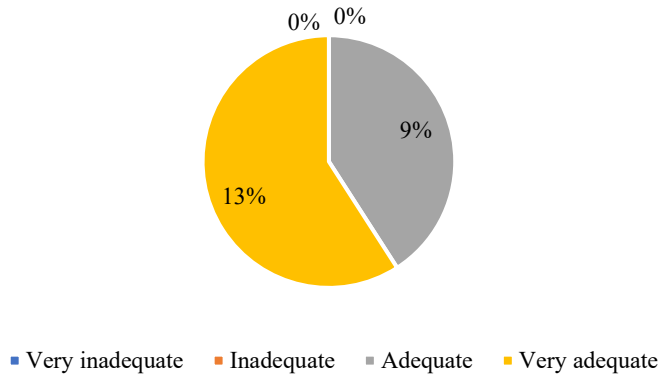

Figure 18. Support provided by the community service team during the program

Conversely, no respondents gave a rating of "Inadequate" or "Very inadequate" (0%), indicating that none of the participants felt the support from the community service team was inadequate. Overall, these results reflect that the community service team successfully provided optimal support throughout the program. However, there are still opportunities to improve the quality of support to ensure a higher and more equitable level of satisfaction for all participants, particularly by strengthening interactions, the intensity of mentoring, and a more personalized approach.

CONCLUSIONS

The community service program conducted in Tunggularum Hamlet, Wonokerto Village, successfully increased community awareness and capacity in utilizing lemongrass as a value-added essential oil product. Through socialization, practical training, and the provision of distillation equipment, participants gained improved knowledge regarding lemongrass essential oil processing, packaging, and business opportunities. The questionnaire results demonstrated positive impacts on participants' understanding, ability to manage lemongrass, economic independence, and entrepreneurial mindset, although most improvements were still at an early or moderate stage.

Furthermore, the strong positive assessment of the support provided by the community service team indicates that the mentoring and implementation approach was well received by participants. Nevertheless, the findings also reveal the need for continuous assistance, practice-based training, and strengthening of entrepreneurship and marketing aspects to ensure more sustainable and significant

economic outcomes. Therefore, future programs should focus on long-term mentoring, business development, market access, and technology application to maximize the economic potential of lemongrass essential oil in the community.

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Conflict of Interests

The authors declared that no potential conflicts of interest with respect to the authorship and publication of this article.

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