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Community Empowerment through the Development of Lemongrass Essential Oil Soap in Tulasan, Mulyodadi, Bambanglipuro, Bantul

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ABSTRACT

This community engagement program in Tulasan Hamlet, Mulyodadi Village, Bambanglipuro, Bantul, aimed to add value to locally grown lemongrass (*Cymbopogon citratus*), which residents had traditionally used as a living fence and a culinary ingredient. The Universitas Ahmad Dahlan team introduced lemongrass essential oil distillation and demonstrated how the oil could be used as a fragrance ingredient in bar soap. The program comprised an introductory session on 2 September 2023, attended by 15 residents, and a hands-on training session on 9 September 2023, attended by 25 residents. At both stages, the combined proportion of questionnaire responses in the "agree" and "strongly agree" categories was 82% for essential oil distillation and 85% for bar soap making. Mean self-reported understanding was higher after hands-on training than after the introductory session, rising from 63% to 76% for essential oil distillation and from 67% to 81% for bar soap making.

Keywords: Essential oil; Lemongrass; Soap; Tulasan

INTRODUCTION

According to BPS–Statistics Indonesia (2025), agriculture, forestry, and fishing accounted for 13.1% of Indonesia's gross domestic product (GDP) at current prices in 2025 (Badan Pusat Statistik, 2025). Horticultural crops accounted for 1.36% of national GDP. BPS classifies horticultural crops into four groups: vegetables (e.g., chili peppers, shallots, tomatoes, and potatoes), fruits (e.g., bananas, mangoes, pineapples, and durians), medicinal plants (e.g., lemongrass, ginger, turmeric, aromatic ginger, and galangal), and ornamental plants (e.g., orchids, chrysanthemums, roses, and tuberoses). In August 2026, agriculture, forestry, and fishing remained the largest employment sector in the Special Region of Yogyakarta, accounting for 19.35% of all employed residents (Badan Pusat Statistik, 2026).

Tulasan Hamlet is part of Mulyodadi Village in Bambanglipuro District, Bantul Regency. It covers an area of 239,482.67 m² and is home to 227 households. Most residents earn their livelihoods by growing food crops, particularly rice and maize. Lemongrass (*Cymbopogon citratus*) is cultivated primarily in front yards, where it serves as a living fence and a source of flavor and aroma in cooking. During a preliminary consultation, the community engagement team leader met with the head of Tulasan Hamlet and the leader of the local farmers' group to discuss ways to increase the economic value of locally grown lemongrass. Under local growing conditions, lemongrass was considered relatively easy to cultivate and able to grow with less maintenance than staple field crops such as rice and maize. However, selling fresh lemongrass as a culinary ingredient offered limited scope for increasing its market value. The team therefore selected essential oil distillation as a

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value-added processing option, given the potential for lemongrass essential oil to command a higher selling price than fresh lemongrass. The leaves and pseudostems of lemongrass can be distilled to produce a lemon-scented essential oil that is traded internationally (Juried, 2021). The oil can be used as a fragrance ingredient in products such as aromatherapy candles, air fresheners, bar soaps, and liquid soaps. Processing homegrown lemongrass into marketable products could increase the value of this locally available resource and provide an additional source of household incomes.

LITERATURE OR CONCEPTUAL REVIEW

Lemongrass (*Cymbopogon citratus*) is a source of essential oil whose characteristic lemon aroma is associated with citral, a mixture of geranial and neral. Both the origin of the plant material and the extraction conditions can influence the characteristics of the recovered oil. Van Do and Vu, (2024) reported different oil yields and citral contents for lemongrass sourced from two provinces in Vietnam under the same optimized hydrodistillation conditions. This approach provides a technical basis for evaluating whether controlling the steam flow rate during lemongrass (*Cymbopogon citratus*) distillation can improve essential oil recovery and reduce the loss of water-soluble compounds into the aqueous condensate (Masango, 2005). Khasanah et al. (2025) found that pretreatment and distillation method significantly affected citral yield from lemongrass leaf residues, whereas their effects on the proportion of citral in the recovered oil were not statistically significant. These findings distinguish the amount of citral recovered from its concentration in the oil and suggest that operating conditions should be evaluated for the plant material and equipment used locally (Barbosa et al., 2008).

Bar soap provides one application for lemongrass essential oil as a fragrance ingredient. Rita et al. (2018) incorporated the oil into transparent bar soap and evaluated the resulting formulations. The effect on antibacterial activity varied by test organism, and the formulations did not meet the reported quality criterion for the unsaponified fraction. This evidence supports the feasibility of incorporating lemongrass essential oil into bar soap while highlighting the need to assess the quality and performance of each finished formulation. In the Tulasan program, the oil was introduced as a fragrance ingredient.

Community training offers a way to connect essential oil extraction with the development of value-added products. In Tunggularum Hamlet, Yogyakarta, Fitriani et al. (2026) combined an introductory session with hands-on distillation training and reported improvements in participants' knowledge and awareness of business opportunities. They also identified a need for continued mentoring to support longer-term economic outcomes. From an experiential learning perspective, Morris (2020) emphasized the role of active participation and reflection in helping learners connect practical experience with conceptual understanding. Together, these studies provide a rationale for pairing an explanation of the process with guided practice.

The Tulasan program integrated two linked activities: distilling locally grown lemongrass and using the resulting essential oil as a fragrance in bar soap. Its evaluation compared participants' self-reported understanding after the introductory and practical sessions. Research in classroom settings has shown that perceived learning can diverge from performance on objective assessments (Deslauriers et al., 2019). Accordingly, the questionnaire findings are interpreted as differences in perceived understanding between the two sessions. The ability to carry out the procedures independently would require a separate practical assessment.

MATERIALS AND METHODS

The community engagement program was conducted in Tulasan Hamlet, Mulyodadi Village, Bambanglipuro District, Bantul Regency, with approximately 15–25 local residents participating in

each activity. The program comprised two activities. The first was an introductory session on processing locally grown lemongrass into essential oil and using the oil as a fragrance in bar soap. The second was a hands-on training session in which participants used a distillation apparatus to extract lemongrass essential oil and practiced making bar soap. Both activities were facilitated by faculty members from Universitas Ahmad Dahlan: Dr. Nurul Hidayah, S.Si., from the Food Technology Study Program, and Haris Imam Karim Fathurrahman, S.Pd., M.Sc., and Liya Yusrina Sabila, S.T., M.T., from the Electrical Engineering Study Program. Five students assisted with both activities. Kayladinda Zahra Kaulika and Lin Maesyarotul Himmah were from the Food Technology Study Program, while Imam Haris Aulia, Muh. Janwar Bakir, and Sigit Suryo Saputro were from the Electrical Engineering Study Program.

Participation in both sessions was voluntary. Fifteen participants attended the introductory session, and 25 attended the hands-on training session. All 15 participants from the introductory session also attended the training session, along with 10 additional participants. Participants completed identical paper-based questionnaires by hand at each session. Satisfaction with the organization and delivery of the activities was assessed using a four-point agreement scale (4 = strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree). Participants rated their understanding of the material by selecting one of four predefined levels (25%, 50%, 75%, or 100%). Although all 15 participants from the introductory session attended the training session, their individual questionnaire responses could not be matched across sessions. The responses were therefore summarized descriptively for each session. Any differences in self-reported understanding reflect differences between the groups of respondents at the two sessions and cannot establish changes in individual understanding.

RESULTS AND DISCUSSION

Table 1 presents the questionnaire evaluation scores and participants' self-reported understanding following the introductory session, which involved 15 respondents. The evaluation scores reached 82.22% of the maximum possible score for lemongrass essential oil distillation and 84.44% for bar soap making. These percentages were calculated from total questionnaire scores of 592 and 608 points, respectively, against a maximum possible score of 720 points for each topic. The results indicate relatively high evaluation scores for both topics, with bar soap making receiving a slightly higher score than essential oil distillation.

Participants' mean self-reported understanding was 63.33% for essential oil distillation and 66.67% for bar soap making. The difference of 3.34 percentage points indicates that participants reported slightly greater understanding of bar soap making following the introductory session. Although both topics received evaluation scores exceeding 80% of the maximum possible score, participants' perceived understanding remained below 70%. This distinction indicates that the questionnaire evaluation scores and self-reported understanding represent different aspects of the participants' responses and should not be interpreted interchangeably.

Table 1. Questionnaire scores and self-reported understanding after the introductory session

Topic	Valid respondents, *n*	Questionnaire score (% of maximum)	Mean self-reported understanding (%)
Lemongrass essential oil distillation	15	82.22	63.33
Bar soap making	15	84.44	66.67

Note: Questionnaire scores were expressed as percentages of the maximum possible score. Each respondent could earn up to 48 points per topic (12 items scored from 1 to 4), yielding a maximum of 720 points across 15 respondents. The total scores were 592 points for essential oil distillation and 608 points for bar soap making. Mean self-reported understanding was calculated by dividing the sum of the selected percentage ratings by 15 for each topic (950 ÷ 15 for distillation and 1,000 ÷ 15 for soap making)

Table 2 summarizes the evaluation results following the hands-on training session, which involved 25 respondents. The mean evaluation scores were 82% of the maximum possible score for essential oil distillation and 85% for bar soap making. These results indicate relatively high evaluation scores for both training topics, with bar soap making again receiving a slightly higher score.

Mean self-reported understanding following the hands-on training session reached 76.00% for essential oil distillation and 81.00% for bar soap making. The difference of 5 percentage points indicates that participants reported greater understanding of bar soap making than essential oil distillation. The findings describe participants' perceived understanding following practical activities involving the distillation process and soap preparation. However, these self-reported ratings do not independently demonstrate participants' ability to perform the procedures without assistance.

Table 2. Questionnaire scores and self-reported understanding after the hands-on training session

Training topic	Valid respondents, *n*	Mean evaluation score (% of maximum)	Mean self-reported understanding (%)
Lemongrass essential oil distillation	25	82	76.00
Bar soap making	25	85	81.00

Note: For each topic, the evaluation questionnaire comprised 12 items scored from 1 to 4, yielding a maximum of 48 points per respondent. Each respondent's total score was divided by 48 and multiplied by 100. The resulting percentages were averaged across the 25 respondents and are reported to the nearest whole percentage point. For self-reported understanding, respondents selected one of four ratings (25%, 50%, 75%, or 100%). The selected ratings were summed and divided by 25 for each topic, yielding 76.00% for distillation (1,900 ÷ 25) and 81.00% for soap making (2,025 ÷ 25)

A descriptive comparison of Tables 1 and 2 shows that mean self-reported understanding was higher following the hands-on training session than following the introductory session. For essential oil distillation, the mean increased from 63.33% to 76.00%, representing a between-session difference of 12.67 percentage points. For bar soap making, the corresponding values were 66.67% and 81.00%, representing a difference of 14.33 percentage points.

In contrast, the questionnaire evaluation scores remained relatively similar across the two sessions. For essential oil distillation, the score was 82.22% after the introductory session and 82% after the hands-on training session. For bar soap making, the corresponding scores were 84.44% and 85%. These findings indicate that the evaluations of both topics were consistently high, whereas the descriptive differences in self-reported understanding were more pronounced.

Nevertheless, the introductory and hands-on training sessions involved different numbers of respondents (15 and 25, respectively), and the available data do not establish whether the same individuals participated in both evaluations. Therefore, the observed differences should be interpreted as descriptive comparisons between session-level responses rather than evidence of individual learning gains or a causal effect of the hands-on training. Furthermore, because understanding was assessed through self-reported ratings rather than objective knowledge tests or practical competency assessments, the findings reflect perceived understanding rather than independently verified knowledge acquisition or practical proficiency.

DISCUSSION

The community engagement program in Tulasan Hamlet comprised an introductory session and a hands-on training session. Before these activities, the project team, led by Haris Imam Karim Fathurrahman, S.Pd., M.Sc., met with the hamlet head and representatives of local farmer groups. Following the meeting, the team conducted trial runs of lemongrass essential oil distillation using a 500 mL glass apparatus at laboratory scale and a 20 L distillation unit at small-enterprise scale. The team also carried out a trial batch of bar soap in preparation for the hands-on session with residents.

On 2 September 2023, the team held an introductory session on processing locally grown lemongrass into essential oil and using the oil to make bar soap. The session took place at the residence of the head of Tulasan Hamlet, Dimas Fajar Setiawan, S.Pd., and was attended by 15 local residents. Figure 1 shows the presentation and the participants. Dr. Nurul Hidayah, S.Si., gave an approximately one-hour presentation on lemongrass essential oil distillation and bar soap making, followed by a 30-minute question-and-answer session. Participants then completed a questionnaire provided by the project team.



Figure 1. Introductory session on lemongrass essential oil distillation and bar soap making. Presentation (**top**) and group photograph (**bottom**)

The questionnaire elicited feedback on how the session was conducted, measured participant satisfaction, and asked participants to rate their understanding of the material as a percentage.
The program evaluation questionnaire comprised 12 statements covering four dimensions.

1. Relevance of the activity and quality of delivery. This dimension covered the relevance of the material to participants' needs, the extent to which the activity met their expectations, how engaging and clear the presentation was, and whether sufficient time was allocated.
2. Support provided by the project team. This dimension addressed whether the team's support met participants' needs and whether the facilitators followed up on questions, complaints, or concerns.
3. Benefits and continuity of the program. This dimension covered the immediate benefits reported by participants, perceived improvements in well-being or knowledge, program continuity, and interest in attending similar activities.
4. Overall participant satisfaction**.** This dimension assessed participants' overall satisfaction with how the activity was conducted.

The 12 statements were rated on a four-point Likert scale with the response options *strongly disagree*, *disagree*, *agree*, and *strongly agree*. Among the 15 respondents, the combined proportion of *agree* and *strongly* agree responses across the four dimensions was 82% for lemongrass essential

oil distillation and 85% for bar soap making. Mean self-reported understanding after the introductory session was 63% for lemongrass essential oil distillation and 67% for bar soap making (Figure 2).

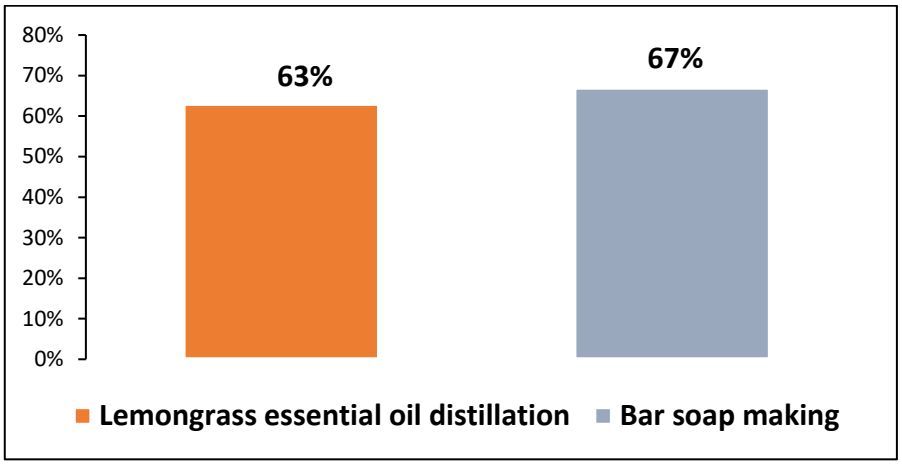

Figure 2. Mean self-reported understanding (%) of lemongrass essential oil distillation and bar soap making after the introductory session



Figure 3. Hands-on training in lemongrass essential oil distillation and bar soap making. Explanation of the procedures (**top**) and group photograph (**bottom**)

The hands-on training session was held on 9 September 2023 at the same residence and was attended by 25 residents of Tulasan Hamlet. Dr. Nurul Hidayah, S.Si., led the session with assistance from Haris Imam Karim Fathurrahman, S.Pd., M.Sc., Liya Yusrina Sabila, S.T., M.T., and five students from the Food Technology and Electrical Engineering study programs (Figure 3). The distillation exercise used 7 kg of lemongrass as raw material. The facilitator explained each step in plain language to help participants understand the process and how to operate the distillation equipment. Distillation took approximately 5–6 hours. While distillation was underway, Dr. Nurul Hidayah, S.Si., guided participants through bar soap making to demonstrate the use of lemongrass essential oil as a fragrance ingredient. The oil used in the soap had been obtained during an earlier laboratory trial with the 20 L distillation unit. The formulation used in the training included cooking oil, stearic acid, sodium hydroxide (caustic soda), and lemongrass essential oil. The team added 10

mL of essential oil per litre of cooking oil. Fitriani et al. (2026) conducted a similar community engagement program that combined essential oil distillation with training in packaging the oil. The Tulasan program linked distillation to bar soap production, using lemongrass essential oil as a fragrance ingredient. This approach introduced participants to a way of adding value to locally grown lemongrass by incorporating its essential oil into a finished product.

As in the introductory session, participants were required to complete an evaluation questionnaire. It covered the conduct of the training, participant satisfaction, and self-reported understanding of the procedures practised. Across the 25 questionnaires, the mean combined percentage of *agree* and *strongly agree* responses were 82% for lemongrass essential oil distillation and 85% for bar soap making. Mean self-reported understanding was higher after the hands-on training than after the introductory session. For lemongrass essential oil distillation, the mean rose from 63% to 76%, a difference of 13 percentage points. For bar soap making, it rose from 67% to 81%, a difference of 14 percentage points (Figure 4).

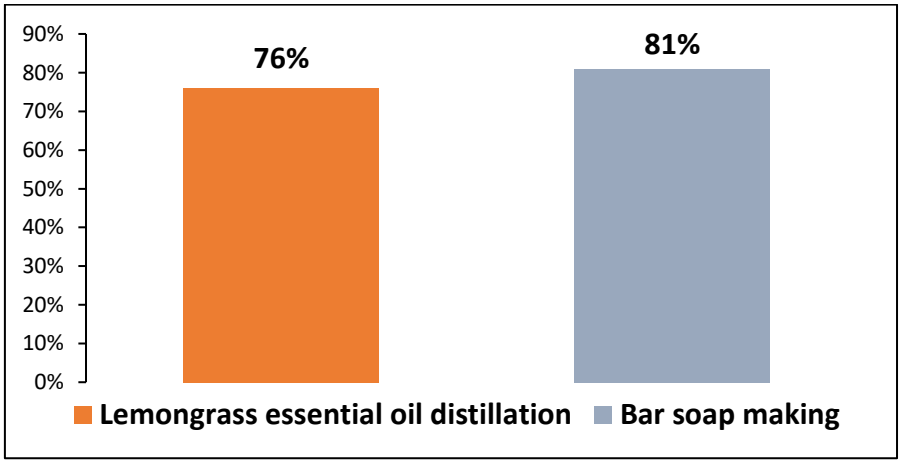

Figure 4. Mean self-reported understanding (%) of lemongrass essential oil distillation and bar soap making after the hands-on training session

CONCLUSION

Mean self-reported understanding was higher after the hands-on training than after the introductory session. For lemongrass essential oil distillation, the mean increased from 63% to 76%, a difference of 13 percentage points. For bar soap making, it increased from 67% to 81%, a difference of 14 percentage points. These findings suggest that hands-on training may reinforce participants' understanding of the material covered in the introductory session.

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Ethics Approval and Consent to Participate

The community engagement program was conducted with the formal approval of the Mulyodadi Village Government (Kalurahan Mulyodadi), as documented in Letter No. 500.10.30/43. The participants were members of the Family Welfare Movement (Pemberdayaan dan Kesejahteraan Keluarga (PKK)) in Padukuhan Tulasan.

Consent for Publication

Permission was granted to publish photographs and other documentation from the community engagement program in Padukuhan Tulasan. All participants identifiable in the materials included in this article consented to their publication.

Availability of Data and Materials

The evaluation data were collected using a paper-based questionnaire that participants completed by hand. The questionnaire used a four-point agreement scale (strongly agree, agree, disagree, and strongly disagree). Participants also rated their own understanding by selecting one of four predefined levels (25%, 50%, 75%, or 100%). A blank copy of the questionnaire and the de-identified survey data are available from the corresponding author upon reasonable request.

Conflicts of Interest Statement

The authors declare that they have no conflicts of interest.

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Artificial Intelligence-Assisted Technology

The authors used ChatGPT (OpenAI) to translate parts of the manuscript from Indonesian into English and to refine English sentence structure and wording.

Authors' Contributions

NH led the preliminary trials, community outreach, and hands-on training in lemongrass distillation and soap making, and drafted the manuscript. **LYS** processed the program evaluation data and reviewed the manuscript draft. **HIKF** was responsible for the efficiency of the distillation equipment, coordinated program administration, and reviewed the manuscript draft. **AF** assisted with the preliminary trials for lemongrass distillation and soap making and reviewed the manuscript draft.

Authors' Information

Nurul Hidayah **(NH),** Food Technology, Universitas Ahmad Dahlan

NH is a lecturer in Food Technology with an academic background in chemistry and expertise in food analysis. Her work includes the development and evaluation of sensors for detecting hazardous substances in food. In the Tulasan community engagement program, she led the preliminary trials, community outreach, and hands-on training in lemongrass distillation and soap making. She also drafted the manuscript reporting the program and its evaluation.

Liya Yusrina Sabila (**LYS**), Electrical Engineering, Universitas Ahmad Dahlan

LYS has expertise in the Internet of Things (IoT). In the Tulasan community engagement program, LYS was responsible for processing the evaluation data collected from participants. This work supported the reporting of questionnaire responses on participants' agreement with evaluation statements and their self-reported understanding of lemongrass distillation and soap making. LYS also reviewed the manuscript draft prepared to report the program and its findings.

Haris Imam Karim Fathurrahman (**HIKF**), Electrical Engineering, Universitas Ahmad Dahlan

HIKF has expertise in the Internet of Things (IoT). In the Tulasan community engagement program, HIKF was responsible for addressing the efficiency of the equipment used to distill lemongrass essential oil. HIKF also coordinated the administrative work required to carry out the

program. In addition to these technical and administrative responsibilities, HIKF reviewed the manuscript draft describing the activities and evaluation findings.

Aprilia Fitriani (**AF**), Food Technology, Universitas Ahmad Dahlan

AF has an academic background in food science and expertise in food analysis. In the Tulasan community engagement program, AF supported the preliminary trials for both lemongrass distillation and soap making. These trials formed part of the team's preparation for training community members in essential oil production and its use in soap. AF also reviewed the manuscript draft reporting the implementation and evaluation of the program.

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