ABDIMAS TALENTA
Jurnal Pengabdian Kepada Masyarakat
Journal homepage: https://talenta.usu.ac.id/abdimas

Liquid Smoke-Based Pest and Disease Control for the Sekar Wangi Farmer Group in Padang Cermin Village, Selesai District, Langkat Regency

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ARTICLE INFO
Article history:
Received : 23 January 2026
Revised : 15 April 2026
Accepted : 23 April 2026
Available online: 17 July 2026

E-ISSN: 2549-418X
P-ISSN: 2549-4341

How to cite:
Tarigan, K., Siburian, R.A.F., Simbolon, T.R., Hutabarat, L.F.H., Hulu, D.J., Lawolo, N., Domini, J., and Situmorang, R.S. (2026). Liquid Smoke-Based Pest and Disease Control for the Sekar Wangi Farmer Group in Padang Cermin Village, Selesai District, Langkat Regency. ABDIMAS TALENTA: Jurnal Pengabdian Kepada Masyarakat, 11(1), 40-44.

http://doi.org/10.32734/abdimastalenta.v11i1.26139

ABSTRACT
The excessive use of synthetic pesticides remains one of the major challenges in developing environmentally friendly agriculture. This community service program aimed to improve the knowledge and skills of members of the Sekar Wangi Farmer Group in producing and applying liquid smoke as a botanical pesticide. The activity was conducted in Padang Cermin Village, Selesai District, Langkat Regency, involving 20 active farmer group members. The methods included counseling, hands-on training on liquid smoke production through coconut shell pyrolysis, field demonstrations, mentoring, monitoring, and evaluation using pre-test and post-test instruments. The results showed a significant increase in participants' understanding and practical skills. The average level of knowledge increased from 58% before the training to 89% after the activity. Participants were able to independently produce liquid smoke and apply it as an alternative pest and disease control agent. The program also resulted in a simple standard operating procedure (SOP) for liquid smoke production and application. The activity contributed to reducing dependence on synthetic pesticides while encouraging the utilization of local biomass waste and sustainable agricultural practices.

Keyword: Liquid Smoke, Botanical Pesticide, Farmer Group, Community Service, Appropriate Technology

1. Introduction

Modern agriculture remains highly dependent on synthetic pesticides for controlling plant pests and diseases. Continuous and excessive use of chemical pesticides can lead to pest resistance, environmental pollution, the destruction of natural enemies, and harmful residues that threaten both human health and ecosystems [1]. In addition, the increasing cost of synthetic pesticides contributes to higher production expenses and reduces farming efficiency [2]. One promising alternative is the use of botanical pesticides derived from locally available resources. Liquid smoke is a condensate produced from biomass pyrolysis that contains various bioactive compounds, including phenols, organic acids, and carbonyl compounds, which exhibit antimicrobial, antifungal, and natural insecticidal properties [3]. Several studies have demonstrated the potential of liquid smoke as an environmentally friendly agent for controlling plant pests and diseases [4][5].

The Sekar Wangi Farmer Group, located in Padang Cermin Village, Selesai District, Langkat Regency, consists of 20 active members engaged primarily in food crop and horticultural production. Preliminary assessments revealed several major challenges faced by the farmers, including frequent pest and disease infestations, rising expenditures on chemical pesticides, and the underutilization of abundant coconut shell waste available in the surrounding area. These conditions indicate the need for the transfer of appropriate technology that is simple, affordable, and easily adopted by local farmers. Previous community empowerment programs have shown that training and mentoring activities on liquid smoke technology can significantly improve community skills in converting biomass waste into valuable products [6][7]. Therefore, this community service program aimed to enhance the capacity of members of the Sekar Wangi Farmer Group to produce and apply liquid smoke as a botanical pesticide in support of sustainable agricultural practices.

2. Method

This community service program was conducted from July to August 2025 in Padang Cermin Village, Selesai District, Langkat Regency. The participants consisted of 20 active members of the Sekar Wangi Farmer Group involved in food crop and horticultural cultivation. The implementation method employed a participatory approach consisting of several stages, as recommended in community empowerment programs based on appropriate technology [8][9].

2.1 Needs Assessment

Field observations and Focus Group Discussions (FGDs) were conducted to identify the major challenges faced by farmers regarding pest and disease management.

2.2 Educational Counseling

Participants received educational materials covering the negative impacts of synthetic pesticide use, environmentally friendly agricultural practices, the benefits of liquid smoke, its active compounds, and the potential utilization of biomass waste as raw material for botanical pesticides [3].

2.3 Liquid Smoke Production Training

Hands-on training sessions were conducted using a simple pyrolysis unit with coconut shells as the primary feedstock. The production process involved limited-oxygen combustion, smoke condensation, condensate collection, filtration, and storage [6][10].

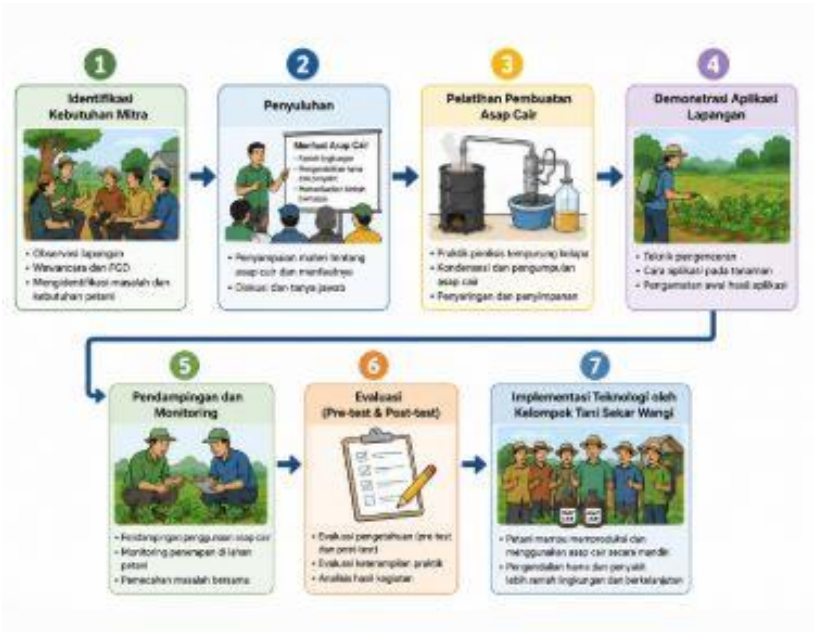

Figure 1. Liquid Smoke Production Process

2.4 Field Demonstration
The liquid smoke produced during the training was applied to cultivated crops using various dilution levels to demonstrate its proper use as a botanical pesticide.

2.5 Mentoring and Monitoring
Follow-up mentoring activities were conducted for one month to ensure that participants were able to independently implement the technology on their own farms.

2.6 Evaluation
Program evaluation was carried out using pre-test and post-test assessments to measure improvements in participants' knowledge. Practical skills were evaluated through direct observation during training activities. The collected data were analyzed descriptively using percentage-based measurements of knowledge and skill improvement.

3. Results and Discussion

The program was attended by all members of the Sekar Wangi Farmer Group, resulting in a participation rate of 100%. This high level of participation reflected the farmers' strong interest in alternative pest and disease management technologies that are both environmentally friendly and economically feasible. The training materials included sustainable agriculture concepts, liquid smoke production techniques, filtration methods, dilution procedures, field application practices, and occupational safety measures during the production process. Participants demonstrated high enthusiasm throughout the activities, particularly during the practical sessions involving the production of liquid smoke from coconut shells.

The training program significantly improved participants' knowledge and technical skills, as presented in Table 1.

Table 1. Improvement in Participants' Knowledge and Skills

Indicator	Before (%)	After (%)
Knowledge of liquid smoke technology	58	89
Liquid smoke production skills	25	90
Understanding of field application techniques	40	88

The evaluation results indicated that participants' knowledge increased by 31 percentage points, while production skills improved by 65 percentage points. Similarly, understanding of field application techniques increased by 48 percentage points. These findings suggest that the participatory training approach effectively enhanced both theoretical understanding and practical competencies among participants. The results are consistent with previous studies by Rastono and Wahyuni, which reported that hands-on training methods significantly improve community knowledge and technical capacities [5][6].

Beyond capacity building, the program successfully produced liquid smoke with characteristics suitable for use as a botanical pesticide. The product was applied in demonstration plots as an alternative means of controlling plant pests and diseases. Through these activities, farmers gained direct experience in determining appropriate dilution rates and application techniques.

Another important outcome of the program was the development of a simple Standard Operating Procedure (SOP) covering liquid smoke production, filtration, storage, and application. The availability of this SOP is expected to support the sustainability of the technology after the completion of the program. According to

Harini et al, the long-term adoption of appropriate technologies is strongly influenced by the availability of practical and easily understood operational guidelines [7].

Overall, the program successfully enhanced farmers' ability to convert coconut shell waste into a value-added agricultural product while reducing dependence on synthetic pesticides. These results support the broader implementation of sustainable agriculture practices based on locally available resources.

3.1 Activity Documentation

Figure 3. Educational counseling activities for participants.

Figure 4. Demonstration of liquid smoke application in cultivated crops.

Figure 5. Mentoring and monitoring activities conducted in farmers' fields.

4. Conclusion

The community service program successfully improved the capacity of members of the Sekar Wangi Farmer Group in producing and applying liquid smoke as a botanical pesticide. Participants' knowledge increased from 58% to 89%, while production skills improved from 25% to 90%. The results demonstrate that liquid smoke technology can be independently adopted by farmers using locally available coconut shell waste. Furthermore, the program contributed to reducing reliance on synthetic pesticides, increasing biomass waste utilization, and strengthening sustainable agricultural practices at the community level.

5. Acknowledgements

The authors would like to express their sincere gratitude to the Community Service Institute of Universitas Sumatera Utara for providing financial support for this program. Appreciation is also extended to the members of the Sekar Wangi Farmer Group in Padang Cermin Village, Selesai District, Langkat Regency, and all parties who contributed to the successful implementation of this community service activity.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the implementation of this program or the preparation of this manuscript.

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