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

From Research to Community Impact: Implementing Liquid Complementary Fertilizer Innovation to Promote Sustainable Agriculture in Narumonda III Village

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ARTICLE INFO
Article history:
Received : 04 November 2025
Revised : 18 January 2026
Accepted : 05 February 2026
Available online: 17 July 2026

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

How to cite:
Siburian, R.A.F., Tarigan, K., Herianto, T.J., Lubis, A.S., and Marpaung, J.L. (2026). From Research to Community Impact: Implementing Liquid Complementary Fertilizer Innovation to Promote Sustainable Agriculture in Narumonda III Village. ABDIMAS TALENTA: Jurnal Pengabdian Kepada Masyarakat, 11 (1), 26-33.

http://doi.org/10.32734/abdimastalenta.v11i1.24718

ABSTRACT
Rural agricultural communities in Indonesia face persistent challenges, including dependence on chemical fertilizers, declining soil quality, and increasing production costs. Limited adoption of research-based innovations further constrains sustainable farming practices. This community service program aimed to implement and evaluate a liquid complementary fertilizer innovation through a participatory Focus Group Discussion (FGD) approach in Narumonda III Village, Toba Regency. The program applied participatory methods consisting of pre-test and post-test assessments, FGD sessions, farmer training, field demonstrations, and collaboration with an industry partner, with active community involvement throughout the process. Results showed improved farmer knowledge of sustainable fertilization and nutrient management, along with positive acceptance of the liquid complementary fertilizer. Participants recognized its potential to reduce input costs, improve soil quality, and enhance crop productivity. The program also strengthened collaboration among the university, local community, and industry partner, supporting effective knowledge transfer. These findings indicate that FGD-based community engagement is effective in disseminating agricultural innovation and supporting sustainable rural development.

Keyword: Liquid Complementary Fertilizer, Community Engagement, Sustainable Agriculture, Focus Group Discussion, Rural Development

1. Introduction

1.1 Background of the Study

Agriculture plays a central role in sustaining rural economies in Indonesia, serving as the primary source of livelihood for many communities and contributing significantly to local food security. However, rural farmers continue to face persistent challenges that limit productivity and economic resilience. These challenges include rising fertilizer prices, gradual soil degradation caused by prolonged chemical input use, and limited access to innovative agricultural technologies [1]. As a result, production costs increase while soil fertility and crop performance decline.

Sustainable agriculture has emerged as a strategic approach to address these issues by promoting environmentally responsible practices, improving resource efficiency, and strengthening farmer livelihoods [2], [3]. Despite continuous research conducted by universities on eco-friendly agricultural innovations, a substantial gap remains between scientific outputs and their practical adoption at the community level. Many farmers lack access to applied knowledge, demonstration-based learning, and appropriate dissemination mechanisms that translate research into usable solutions [4], [5].

This situation highlights the need for participatory dissemination models that actively involve farmers in knowledge exchange and technology implementation [6], [7]. Approaches such as Focus Group Discussions (FGD), hands-on training, and field demonstrations provide opportunities for meaningful engagement and contextual learning. Such models also support alignment with Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), by encouraging sustainable farming practices and strengthening rural economies. Despite extensive agricultural research and technological development, adoption of environmentally friendly fertilizer innovations among rural farmers remains limited due to restricted access, insufficient knowledge-transfer mechanisms, and the absence of practical demonstrations [8]. Consequently, farmers continue to rely heavily on conventional chemical fertilizers, hindering sustainable agricultural transformation. The general objective of this community service program was to implement liquid complementary fertilizer innovation to support sustainable agriculture in Narumonda III Village. The specific objectives were:

1. To assess farmers' initial knowledge regarding fertilizer practices.
2. To disseminate liquid fertilizer technology through Focus Group Discussions and training sessions.
3. To evaluate farmers' acceptance and understanding following program implementation.
4. To strengthen collaboration among the university, industry partner, and local community.

This program provides multiple benefits. For farmers, it enhances knowledge of sustainable fertilization practices and introduces cost-efficient alternatives to chemical inputs. For the village economy, improved agricultural productivity contributes to income stability and local development. From an academic perspective, the program strengthens university engagement through applied research dissemination and community partnership. Moreover, the initiative supports the broader sustainable development agenda by promoting environmentally responsible agriculture and fostering collaborative models that can be replicated in other rural settings.

2. Methods

2.1 Location and Participants

This community service program was conducted in Narumonda III Village, Toba Regency, North Sumatra, Indonesia. The village was selected due to its strong agricultural base and the need for sustainable fertilization practices [9], [10]. Participants consisted of local farmers as primary beneficiaries, supported by village officials and community leaders who facilitated coordination and community mobilization. The program was implemented by a team of university lecturers in collaboration with an industry partner, who provided technical support and fertilizer innovation expertise.

2.2 Community Engagement Design

The program adopted a participatory community engagement design centered on Focus Group Discussion (FGD) as the main platform for knowledge exchange. This approach emphasized active involvement of farmers in identifying challenges, discussing solutions, and sharing practical experiences related to fertilizer use [11]. Knowledge-sharing sessions were conducted to introduce concepts of sustainable agriculture and nutrient management. In addition, hands-on demonstrations of liquid complementary fertilizer application were provided to ensure participants gained practical understanding of dosage, timing, and application techniques. This participatory model aimed to enhance learning outcomes and encourage farmer ownership of the innovation process. The program was implemented through several structured stages:

1. Preliminary Survey and Coordination
   Initial field visits and coordination with village authorities were conducted to identify local conditions and organize participant involvement.

2. Pre-test Assessment
   A baseline assessment was administered to evaluate farmers' initial knowledge and practices related to fertilization.

3. FGD and Knowledge Dissemination
   FGD sessions were held to discuss agricultural challenges and introduce liquid complementary fertilizer innovation, supported by interactive presentations and open dialogue.

4. Fertilizer Demonstration
   Practical demonstrations were conducted to illustrate proper application methods and expected outcomes.

5. Post-discussion Evaluation
   Participant understanding and acceptance were assessed through follow-up discussions and questionnaires.

6. Planning for Follow-up Trials
   Future field trials and continued mentoring were discussed to support sustained adoption of the innovation.

2.3 Data Collection and Analysis

Data were collected using questionnaires, direct observation, and qualitative feedback obtained during FGD sessions and training activities. Descriptive analysis was employed to summarize changes in farmer knowledge, perceptions, and acceptance of the liquid complementary fertilizer. Observational notes and participant responses were used to complement quantitative findings, providing a comprehensive understanding of program outcomes.

3. Result and Discussion

3.1 Farmers' Initial Knowledge and Challenges

The pre-test assessment revealed that most farmers had limited understanding of liquid complementary fertilizers and their role in sustainable nutrient management. Agricultural practices in Narumonda III Village were predominantly based on conventional chemical fertilizers, with minimal exposure to alternative inputs. This dependence was largely driven by long-established habits, lack of access to agricultural innovation, and limited technical guidance. In addition, farmers reported economic constraints related to rising fertilizer prices, which increased production costs and reduced profit margins. Soil quality degradation was also identified as a growing concern, as continuous chemical fertilizer use had gradually diminished soil fertility and crop responsiveness. These findings highlight the urgent need for accessible, practical, and cost-effective agricultural innovations supported by structured knowledge dissemination.

Figure 1. Pre-test Assessment

Figure 1 illustrates the pre-test assessment session, where participating farmers completed structured questionnaires prior to the Focus Group Discussion activities. This stage aimed to capture baseline information regarding farmers' existing knowledge, fertilization practices, and perceptions of liquid complementary fertilizer. As shown in the figure, participants were actively engaged in filling out the assessment forms under the guidance of facilitators, reflecting their willingness to contribute to the evaluation process. The pre-test served as an important diagnostic tool to identify knowledge gaps and contextual challenges, which subsequently informed the design of discussion materials and training content. By establishing initial conditions before program implementation, this assessment provided a reference point for evaluating learning outcomes and measuring changes in farmer understanding following the intervention.

Figure 2. Appreciation to the Narumonda III

Figure 2 illustrates the appreciation ceremony conducted at the conclusion of the community service program, symbolizing collaborative partnership among the university team, local community representatives, and stakeholders in Narumonda III Village. The presentation of certificates and commemorative plaques reflects mutual recognition of participation and contribution throughout the program. This moment represents not only formal appreciation but also the strengthening of institutional and community relationships established during the implementation of liquid complementary fertilizer innovation. Such recognition reinforces community engagement, fosters trust, and encourages continued cooperation for future agricultural development initiatives. The figure highlights the importance of social acknowledgment in sustaining partnerships and promoting collective commitment toward sustainable rural development.

3.2 Implementation Outcomes

Following the FGD sessions, training activities, and fertilizer demonstrations, farmers demonstrated increased awareness of sustainable fertilization practices and nutrient management. Participants gained a clearer understanding of the function, application techniques, and potential benefits of liquid complementary fertilizer. The innovation was positively received, with farmers recognizing its potential to reduce dependence on chemical fertilizers, lower input costs, and improve crop performance. Post-discussion evaluations indicated improved comprehension of environmentally friendly agricultural practices, suggesting that participatory learning combined with practical demonstrations effectively enhanced knowledge transfer.

Figure 3. Fertilizer demonstrations

Figure 3 depicts the fertilizer demonstration session, where facilitators introduced the liquid complementary fertilizer and explained its composition, application methods, and potential benefits directly to participating farmers. During this activity, the industry partner presented practical guidance on dosage, timing, and spraying techniques, while addressing farmers' questions in an interactive setting. The demonstration served as a critical experiential learning component, allowing participants to observe the product first-hand and gain practical insight into its use under local farming conditions. This hands-on approach enhanced farmers' understanding of sustainable fertilization practices and strengthened their confidence in adopting the innovation. The active audience engagement shown in the figure reflects strong community interest and highlights the effectiveness of demonstration-based learning in supporting knowledge transfer and technology acceptance.

3.3 Community Response and Participation

Community engagement during the program was notably high. Farmers actively participated in discussions, shared experiences, and raised context-specific questions related to crop management and fertilizer application. Village officials and community leaders also contributed to facilitating dialogue and encouraging participation. This high level of engagement reflects strong community interest in sustainable farming solutions and demonstrates willingness to adopt innovation when supported by hands-on learning and inclusive communication. The participatory FGD format enabled mutual learning and strengthened trust between facilitators and community members, which is essential for sustained adoption.

3.4 Contribution to Sustainable Agriculture

The implementation of liquid complementary fertilizer contributes to sustainable agriculture by supporting soil health through reduced chemical dependency and improved nutrient efficiency. Farmers identified opportunities to decrease production costs while maintaining or enhancing crop productivity. These outcomes align with broader environmental sustainability objectives by promoting responsible input use and reducing ecological pressure. Furthermore, the program supports Sustainable Development Goals, particularly SDG 2 (Zero Hunger) through improved agricultural productivity, SDG 8 (Decent Work and Economic Growth) by strengthening rural livelihoods, SDG 12 (Responsible Consumption and Production) through efficient fertilizer use, and SDG 13 (Climate Action) by encouraging environmentally conscious farming practices. The success of the program was strongly supported by collaborative engagement among the university, industry partner, and local community. The university played a central role in research dissemination, facilitation, and capacity building. The industry partner contributed technological expertise and practical guidance related to fertilizer application and product utilization. Meanwhile, the community acted as active implementers, providing local knowledge and participating directly in innovation adoption. This tripartite collaboration created an effective knowledge-transfer ecosystem, ensuring that research outputs were translated into practical solutions tailored to local needs. The model demonstrates how integrated partnerships can enhance community service outcomes and offers a replicable framework for future rural development initiatives.

3.5 Measurement of participatory dissemination

To quantitatively assess the effectiveness of the participatory dissemination approach, changes in farmers' knowledge levels were evaluated using pre-test and post-test assessments conducted before and after the Focus Group Discussion (FGD). This measurement aimed to capture learning outcomes resulting from interactive discussions, training sessions, and fertilizer demonstrations. By comparing baseline knowledge with post-intervention results, the study provides empirical evidence of how participatory engagement contributes to farmer capacity building and technology acceptance. The comparative analysis of these assessments is presented in Figure 4, illustrating the extent to which the FGD-based intervention enhanced farmers' understanding of liquid complementary fertilizer and sustainable agricultural practices.

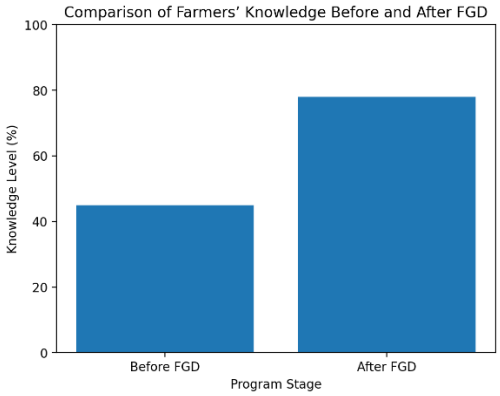

Figure 4. Impact of participatory dissemination

The impact of the participatory intervention is further illustrated in Figure 4, which compares farmers' knowledge levels before and after the Focus Group Discussion (FGD). Prior to the program, participants demonstrated limited understanding of liquid complementary fertilizer and sustainable nutrient management, with an average knowledge level of approximately 45%. Following the FGD sessions, training activities, and field demonstrations, this level increased to about 78%, indicating a substantial improvement in farmer awareness and comprehension. This change highlights the effectiveness of combining interactive discussion with hands-on learning in facilitating knowledge transfer. The observed increase supports earlier qualitative findings from group discussions, where farmers expressed greater confidence in applying the innovation and adopting environmentally friendly practices. These results reinforce the role of FGD-based participatory approaches in bridging the gap between academic research and practical implementation, while strengthening farmer capacity and encouraging sustainable agricultural transformation at the community level.

3.6 Discussion

The findings of this community service program demonstrate that participatory dissemination through Focus Group Discussion (FGD), combined with hands-on training and fertilizer demonstrations, significantly improved farmers' knowledge and acceptance of liquid complementary fertilizer. The observed increase in knowledge levels after the intervention confirms that interactive learning environments are effective in bridging the gap between academic research and field-level application. This outcome aligns with previous studies emphasizing that experiential learning and farmer-centered engagement enhance technology adoption in rural agricultural settings [11], [12]. The results also highlight that prior to the program, farmers relied heavily on conventional chemical fertilizers, largely due to limited exposure to alternative inputs and insufficient access to practical information. Economic constraints further restricted experimentation with new technologies. Through FGD sessions, farmers were able to openly discuss their challenges, exchange experiences, and receive contextualized explanations, which strengthened their understanding of sustainable nutrient management.

Moreover, the collaborative model involving the university, industry partner, and local community played a crucial role in ensuring effective knowledge transfer. The university provided research-based facilitation, the industry partner contributed technical expertise and product application guidance, and the community actively participated in implementations. This integrated approach created mutual trust and enhanced farmers' confidence in adopting innovation. Importantly, the program contributes to sustainable agriculture by promoting improved soil health, reducing dependency on chemical inputs, and supporting environmentally

responsible farming practices. These outcomes are consistent with Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Overall, the findings suggest that participatory community engagement models offer a practical pathway for translating research outputs into meaningful rural impact. Based on the outcomes of this program, several recommendations are proposed:

1. Future initiatives should incorporate longer-term field trials to evaluate the agronomic and economic impacts of liquid complementary fertilizer across multiple planting seasons.
2. Continuous mentoring and follow-up visits are recommended to support sustained adoption and address implementation challenges faced by farmers.
3. Similar participatory dissemination models should be expanded to neighbouring villages to broaden community impact and strengthen regional agricultural resilience.
4. Collaboration between universities and industry partners should be further strengthened to ensure consistent technical support and innovation accessibility.
5. Local government involvement is encouraged to integrate such programs into existing agricultural development frameworks, thereby enhancing scalability and sustainability.
6. These recommendations aim to reinforce community capacity building while promoting sustainable agricultural transformation through inclusive and collaborative approaches.

4. Conclusion

This community service program demonstrated that a participatory Focus Group Discussion (FGD) approach combined with practical training and fertilizer demonstrations is effective in disseminating agricultural innovation to rural farming communities. The implementation of liquid complementary fertilizer in Narumonda III Village improved farmers' understanding of sustainable fertilization practices and nutrient management, while encouraging positive acceptance of environmentally friendly inputs. The program also strengthened collaboration among the university, industry partner, and local community, creating a functional knowledge-transfer ecosystem that supports innovation adoption. Farmers recognized the potential of liquid complementary fertilizer to reduce dependence on chemical fertilizers, improve soil health, and lower production costs, thereby contributing to enhanced agricultural sustainability and rural economic resilience. Overall, the results indicate that community-based, participatory dissemination models play a crucial role in bridging the gap between academic research and field implementation. This collaborative framework offers a replicable model for translating research outputs into meaningful community impact and supports broader sustainable development objectives, particularly in strengthening rural livelihoods and promoting responsible agricultural practices.

5. Acknowledgements

This study funded by Universitas Sumatera Utara under Lembaga Pengabdian Pada Masyarakat scheme Focus Group Discussion EQUITY 2026 (Grant No: 282/UN5.4.11.K/Kontrak/PM.01.02/2025).

REFERENCES

[1] S. Unvaresi, M. Beladona, R. Ayu, S. Yolan, R. Putra, and M. Ratna, "Empowering community on utilizing purun as liquid organic fertilizer in Tuwung Village Pulang Pisau Regency," vol. 6, no. 1, pp. 147–154, 2025.

[2] T. Harefa and Y. Lubis, "Effectiveness of Using Organic and Liquid Fertilizers Based on Palm Oil Mill Waste," 2021.

[3] F. Audia *et al.*, "Liquid Organic Fertilizer Production Training As An Effort To Support Sustainable Agriculture," vol. 9, no. 3, pp. 37–42, 2025.

[4] S. Balqis, R. Anggraini, N. Ulfa, D. Kristianto, and A. Febiana, "Multi-Stakeholder Collaboration in Liquid Organic Fertilizer Production Training for Community Empowerment in Sukakarya Village," vol. 4, no. 3, pp. 15106–15114, 2026.

[5] Tulus, T. J. H. Marpaung, Sawaluddin, M. R. Syahputra, and M. Zarlis, "Utilization of information technology in implementation active learning in private vocational school, PTPN 4 private vocational school Dolok Ilir in dealing with industrial revolution 4.0 era," *ABDIMAS Talent. J. Pengabdi. Kpd. Masy.*, vol. 4, no. 2, pp. 808–813, 2019, doi: 10.32734/abdimastalenta.v4i2.4226.

[6] E. A. Novrimansyah, "Effect of Application of Liquid Organic Fertilizer from Vegetable and Fruit Waste on Lettuce Plants (Lactuca Sativa L .)," vol. 3, no. 01, pp. 307–314, 2025.

[7] E. Samah and I. A. Candra, "JURNAL ONLINE The Impact of Liquid Organic Fertilizer on Growth and Production," vol. 09, no. 01, pp. 9–14, 2022.
[8] K. Keuramat and K. Alam, "PRODUCING LIQUID ORGANIC FERTILIZER TO IMPROVE," pp. 342–349, 2022.
[9] S. Patunah and Z. E. Pradani, "Sustainable Agriculture to Support SDGs Through Innovation of Organic Fertilizer from Livestock Waste Pertanian Berkelanjutan untuk Mendukung SDGs melalui Inovasi Pupuk Organik dari Limbah Ternak," vol. 7, no. 2, pp. 110–117, 2024.
[10] D. R. Isnainy, P. Asnur, M. Ridha, and A. Istiqlal, "Jurnal Biologi Tropis The Application of Liquid Organic Fertilizer Increasing the Productivity of Pakchoy Plants (Brassica rapa L .) in Soil with Low Nutrient Content," 2025.
[11] N. Asiah and S. Khotimah, "Jurnal Biologi Tropis Application of Liquid Fertilizer Trichoderma harzianum (R3) on Siam Citrus (Citrus nobilis var . microcarpa)," 2025.
[12] A. S. Azad, M. S. Md, J. Watada, P. Vasant, and J. A. G. Vintaned, "Optimization of the hydropower energy generation using Meta-Heuristic approaches: A review," *Energy Reports*, vol. 6, pp. 2230–2248, 2020, doi: 10.1016/j.egyr.2020.08.009.