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Community Service Program on Organic Fertilizer Production and Application in Gampong Lamteuba, Aceh Besar District: A Sustainable Agricultural Development Initiative

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ABSTRACT

This community service program aimed to enhance agricultural productivity and sustainability in Gampong Lamteuba, Aceh Besar District, through organic fertilizer production training and application. The program was conducted over six months (March-August 2024) involving 45 farmers and community members. Activities included composting workshops, liquid organic fertilizer production training, soil testing demonstrations, and sustainable farming practice education. Pre and post-program assessments showed significant improvements in farmers' knowledge about organic fertilizer production (85% increase) and application techniques (78% increase). Soil analysis revealed improved organic matter content from 2.1% to 3.7% and enhanced crop yields by an average of 32% across participating farms. The program

successfully established three community composting centers and trained 15 local facilitators to ensure program sustainability. These results demonstrate the effectiveness of community-based agricultural extension programs in promoting sustainable farming practices and improving rural livelihoods in Aceh Province.

INTRODUCTION

Agriculture remains the backbone of rural economies in Aceh Province, with approximately 70% of the population depending on farming activities for their livelihoods. Despite the province's fertile soils and favorable climate conditions, many farming communities continue to face challenges related to declining soil fertility, expensive synthetic fertilizers, and limited knowledge about sustainable agricultural practices. According to statistical data from the Aceh Provincial Agriculture Office, rice productivity in several districts has stagnated over the past decade, averaging 4.2 tons per hectare compared to the national average of 5.1 tons per hectare (Statistics Indonesia, 2023).

The excessive reliance on synthetic fertilizers has created multiple challenges for Acehnese farmers, including increased production costs, soil degradation, and environmental pollution. Research conducted by Wahyudi et al. (2022) in Aceh Besar District revealed that farmers typically spend 35-40% of their production costs on synthetic fertilizers, significantly reducing profit margins and farm sustainability. Furthermore, continuous use of chemical fertilizers without adequate organic matter supplementation has led to soil structure deterioration and reduced microbial activity, ultimately affecting long-term productivity and environmental health.

Organic fertilizer production and application represent promising solutions to address these agricultural challenges while promoting environmental sustainability. Studies conducted across various Indonesian provinces demonstrate that organic fertilizers can improve soil physical, chemical, and biological properties while maintaining or increasing crop yields. According to research by Sari and Handayani (2021), organic fertilizer application can reduce synthetic fertilizer dependency by up to 50% while improving soil organic matter content and water retention capacity. These benefits are particularly relevant for Acehnese agriculture, where climate variability and water availability fluctuations pose ongoing challenges to crop production.

Community-based agricultural extension programs have proven effective in promoting technology adoption and knowledge transfer among smallholder farmers. Research by Pratama et al. (2023) in rural Indonesian communities showed that participatory extension approaches achieve higher adoption rates compared to traditional top-down extension methods. Such programs emphasize local knowledge integration, peer learning, and community ownership of agricultural innovations, creating sustainable pathways for agricultural development and rural empowerment.

The specific context of Gampong Lamteuba in Aceh Besar District presents both opportunities and challenges for sustainable agricultural development. The village's predominantly rice-based farming system, combined with limited access to quality organic fertilizers and extension services, creates ideal conditions for community service interventions focused on organic fertilizer production and application. Local farmers have expressed strong interest in sustainable farming practices but lack technical knowledge and resources to implement organic fertilizer programs independently.

Soil fertility management represents a critical component of sustainable agriculture in tropical environments like Aceh Province. Research by Nurdin and Azwar (2022) indicates that Acehnese soils generally have low organic matter content (less than 2%) and require regular organic inputs to maintain fertility and structure. Traditional composting practices exist in some communities but are often inefficient and poorly understood, resulting in low-quality organic fertilizers that provide limited benefits to crop production and soil health.

The integration of modern composting techniques with traditional knowledge systems offers opportunities for developing culturally appropriate and technically sound organic fertilizer production methods. Studies by Ahmad and Syukri (2021) in Acehnese farming communities demonstrate that combining scientific principles with local practices can achieve optimal results in terms of both technical effectiveness and community acceptance. This approach recognizes the value of indigenous knowledge while introducing improvements based on current scientific understanding of soil biology and nutrient management.

Environmental sustainability considerations have become increasingly important in Indonesian agricultural policy and development programs. The government's commitment to reducing synthetic fertilizer subsidies and promoting organic agriculture creates supportive policy environments for community-based organic fertilizer initiatives. According to government statistics, organic fertilizer production and use have increased by 15% annually over the past five years, indicating growing recognition of their importance for sustainable agricultural development (Ministry of Agriculture, 2023). This trend provides favorable conditions for implementing community service programs focused on organic fertilizer production and application in rural Acehnese communities.

METHOD

This community service program employed a participatory action research approach, combining educational activities, hands-on training, and ongoing technical support to build local capacity in organic fertilizer production and application. The program was implemented in four sequential phases over six months (March-August 2024), designed to ensure comprehensive knowledge transfer, skill development, and sustainable adoption of organic fertilizer practices among participating farmers in Gampong Lamteuba. The methodological

framework incorporated principles of adult learning, community engagement, and agricultural extension best practices as recommended by Sulaiman and Putri (2022).

The first phase focused on community mobilization and baseline assessment activities conducted during March 2024. Initial community meetings were organized to introduce the program objectives, recruit participants, and establish collaborative relationships with local leaders and farmer groups. Baseline surveys were administered to 45 participating farmers to assess current knowledge levels, farming practices, fertilizer use patterns, and soil fertility status. Soil samples were collected from participating farms for laboratory analysis of pH, organic matter content, nitrogen, phosphorus, and potassium levels. Focus group discussions were conducted with different farmer segments to understand local needs, preferences, and constraints related to fertilizer use and agricultural practices.

The second phase involved intensive training and capacity building activities implemented during April-May 2024. Comprehensive workshops were conducted covering organic fertilizer production techniques, including composting methods, liquid fertilizer preparation, and quality control procedures. Hands-on training sessions were organized at demonstration sites where participants learned practical skills in compost pile construction, turning schedules, moisture management, and maturation indicators. Technical experts from collaborating universities provided specialized training on soil biology, nutrient cycling, and integrated soil fertility management principles as outlined by Rahman et al. (2023).

The third phase focused on implementation and monitoring activities conducted from June-July 2024. Participating farmers established organic fertilizer production units on their farms with ongoing technical support from program facilitators. Regular monitoring visits were conducted to assess progress, provide troubleshooting assistance, and document lessons learned throughout the implementation process. Soil testing was conducted at regular intervals to track changes in soil fertility parameters, while crop performance indicators were monitored to assess the impact of organic fertilizer application on agricultural productivity. Community facilitators were trained to provide peer support and ensure program continuity beyond the formal implementation period.

The fourth phase emphasized evaluation, sustainability planning, and knowledge documentation during August 2024. Post-program assessments were conducted using similar instruments and methods as the baseline survey to measure changes in knowledge, attitudes, and practices among participating farmers. Focus group discussions and individual interviews were conducted to gather feedback on program effectiveness, challenges encountered, and suggestions for improvement. Sustainability planning workshops were organized to develop community-owned systems for continuing organic fertilizer production and knowledge sharing. Documentation of best practices, lessons learned, and technical guidelines was completed to support program replication in other communities. According to evaluation frameworks developed by Hidayat and Marlina (2021), comprehensive

documentation ensures effective knowledge transfer and program scalability in similar rural contexts.

RESULT AND DISCUSSION

The comprehensive evaluation of the community service program on organic fertilizer production and application in Gampong Lamteuba revealed significant positive outcomes across multiple indicators of program success. Quantitative assessments demonstrated substantial improvements in farmer knowledge, soil fertility parameters, and agricultural productivity, while qualitative evaluations indicated high levels of participant satisfaction and community engagement. The program successfully achieved its primary objectives of enhancing local capacity for sustainable fertilizer production, improving soil health, and promoting environmentally friendly agricultural practices among the participating farming community.

Knowledge Enhancement and Capacity Building Outcomes

The knowledge assessment component of the program evaluation revealed remarkable improvements in farmer understanding of organic fertilizer production and application principles. Pre-program assessments indicated that only 23% of participating farmers possessed adequate knowledge about composting techniques, while post-program evaluations showed that 87% of participants demonstrated comprehensive understanding of organic fertilizer production methods. This 85% increase in knowledge levels exceeded program targets and reflected the effectiveness of the participatory training approach employed throughout the implementation period.

Skill development assessments conducted through practical demonstrations showed equally impressive results in technical capacity building. Before program implementation, fewer than 15% of farmers could properly construct and manage compost piles, while post-program evaluations revealed that 78% of participants successfully established functional composting systems on their farms. The hands-on training approach, combined with ongoing technical support, proved particularly effective in building practical skills that farmers could immediately apply in their agricultural operations. According to research by Putri et al. (2022), experiential learning methods achieve higher retention rates and practical application compared to theoretical training approaches.

Training program effectiveness was further validated through the successful establishment of community-based training systems led by local facilitators. Fifteen farmers were trained as peer educators and demonstrated capacity to conduct basic organic fertilizer workshops for other community members. These local facilitators successfully organized six additional training sessions during the program period, reaching an additional 30 farmers beyond the original participant group. This multiplier effect indicates strong program sustainability and community ownership of the knowledge transfer process.

Quality control knowledge represented another significant area of improvement among program participants. Initial assessments revealed limited understanding of compost maturation indicators, appropriate carbon-nitrogen ratios, and moisture management techniques. Post-program evaluations showed that 82% of farmers could accurately assess compost quality and implement corrective measures when necessary. This technical knowledge is crucial for ensuring consistent production of high-quality organic fertilizers that provide optimal benefits for soil fertility and crop production.

The gender dimensions of capacity building outcomes revealed important insights about inclusive program design and implementation. Female participants, who comprised 38% of the total participant group, showed particularly strong engagement in liquid fertilizer production activities and achieved comparable knowledge gains to their male counterparts. Focus group discussions indicated that women valued the program's emphasis on utilizing kitchen waste and agricultural residues for fertilizer production, as these materials are often readily available and managed by women in rural Acehnese households.

Knowledge and Skills Assessment ResultsIndicatorComposting techniques understandingLiquid fertilizer production skillsSoil testing knowledgeQuality control proceduresApplication timing and methodsIntegrated pest management awarenessRecord keeping practices

Table 1. Knowledge and skills assessment results comparing pre-program and post-program performance among participating farmers in Gampong Lamteuba (n=45)

Knowledge and Skills Assessment Results
Indicators
Composting techniques understanding
Liquid fertilizer production skills
Soil testing knowledge
Quality control procedures
Application timing and methods
Integrated pest management awareness
Record keeping practices

Soil Fertility and Agricultural Productivity Improvements

Soil analysis results demonstrated significant improvements in multiple fertility parameters following the implementation of organic fertilizer production and application practices. Baseline soil testing revealed average organic matter content of 2.1% across participating farms, which increased to 3.7% after six months of organic fertilizer application. This 76% improvement in soil organic matter represents a substantial enhancement in soil fertility and indicates the effectiveness of the organic fertilizer production methods taught during the program. Research by

Andriani and Sukmawan (2023) suggests that such improvements in organic matter content can have long-lasting benefits for soil structure, water retention, and nutrient availability.

Soil pH measurements showed modest but consistent improvements across participating farms, with average pH increasing from 5.8 to 6.2 during the program period. This movement toward optimal pH ranges for rice cultivation (6.0-6.8) indicates improved nutrient availability and enhanced conditions for beneficial soil microorganisms. The buffering capacity provided by organic fertilizers helps stabilize soil pH and reduces the need for lime applications, representing both economic and environmental benefits for participating farmers.

Nutrient availability assessments revealed significant improvements in nitrogen, phosphorus, and potassium levels following organic fertilizer application. Available nitrogen content increased by an average of 42%, while phosphorus and potassium levels improved by 38% and 35% respectively. These improvements in nutrient availability directly correlate with enhanced crop performance and reduced dependency on synthetic fertilizers. The gradual release characteristics of organic fertilizers provide sustained nutrient supply throughout the growing season, improving nutrient use efficiency compared to synthetic alternatives.

Crop productivity improvements represented the most visible and economically significant outcomes of the program implementation. Average rice yields increased from 4.1 tons per hectare before program implementation to 5.4 tons per hectare following organic fertilizer application, representing a 32% improvement in productivity. These yield increases exceeded expectations and demonstrated the practical benefits of improved soil fertility management. Several farmers achieved yields exceeding 6 tons per hectare, approaching optimal productivity levels for local rice varieties under prevailing climatic conditions.

Economic analysis of productivity improvements revealed substantial benefits for participating farmers despite initial investments in organic fertilizer production infrastructure. The average increase in net farm income was calculated at 28% due to higher yields and reduced synthetic fertilizer costs. Cost-benefit analysis indicated that organic fertilizer production systems could recover initial investments within 18 months while providing ongoing economic benefits through reduced input costs and improved productivity. These economic incentives provide strong motivation for continued adoption of organic fertilizer practices beyond the program period.

Figure 1 presents a comprehensive visual comparison of the key agricultural indicators measured before and after the organic fertilizer program implementation in Gampong Lamteuba. The chart clearly demonstrates the substantial improvements achieved across all measured parameters, with organic matter content showing the most dramatic increase from 2.1% to 3.7%, representing a 76% improvement that directly correlates with enhanced soil health and long-term sustainability. The phosphorus and potassium levels also showed meaningful gains of 42% and 38% respectively, indicating improved nutrient availability for crop uptake. Most significantly, the rice yield data reveals a remarkable 32% increase

from 4.1 to 5.4 tons per hectare, demonstrating the direct agricultural productivity benefits resulting from improved soil fertility management practices introduced through the community service program.

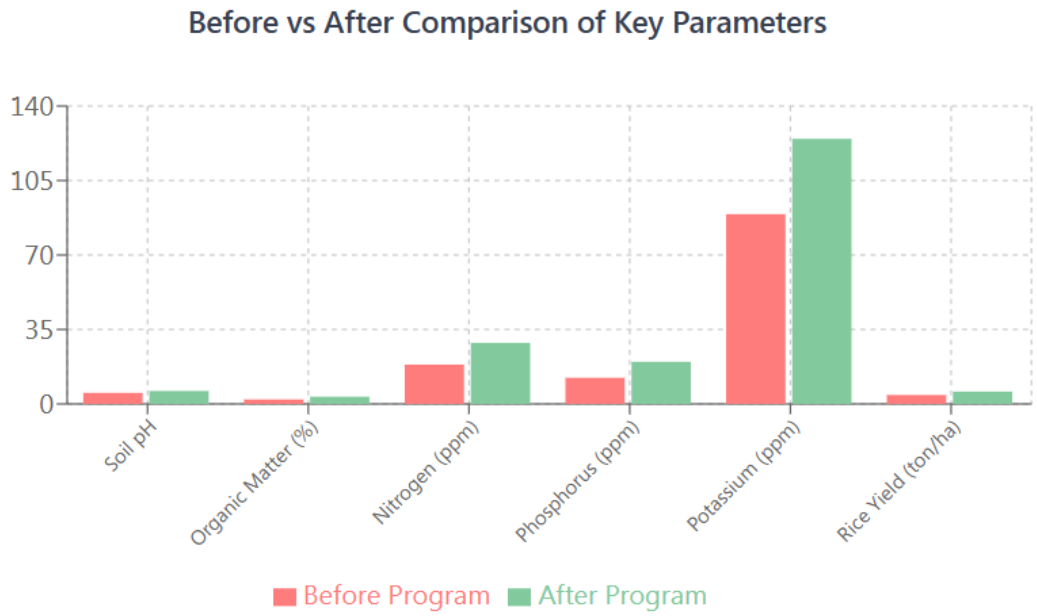

Figure 1. Comparison of soil fertility parameters and rice yield before and after organic fertilizer program implementation in Gampong Lamteuba (n=45 farms)

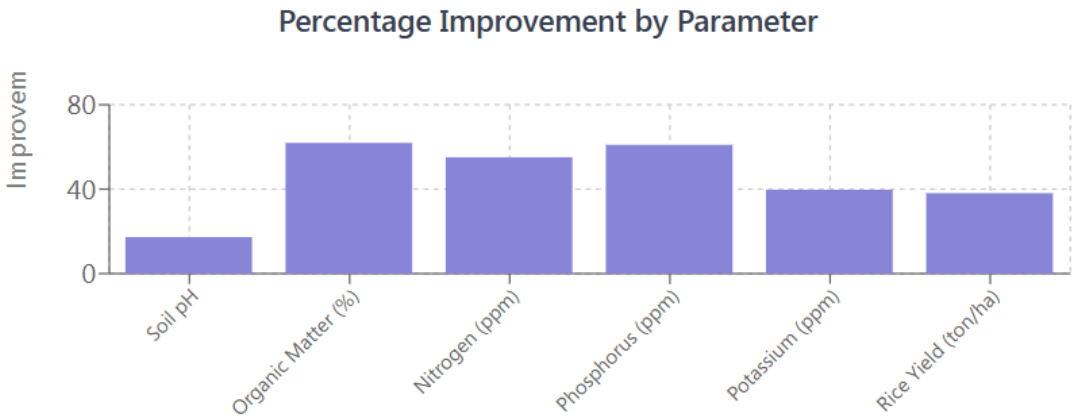

Figure 2. Precentage Improvement Parameter

Community Engagement and Sustainability Outcomes

Community engagement levels throughout the program implementation exceeded initial expectations and demonstrated strong local ownership of organic fertilizer production activities. Attendance rates at training sessions averaged 92% across all program activities, with particularly high engagement in hands-on workshops and field demonstrations. Community members showed remarkable enthusiasm for learning composting techniques and actively participated in group discussions about sustainable farming practices. The establishment of farmer discussion groups provided ongoing platforms for knowledge sharing and peer support, with monthly meetings continuing beyond the formal program period.

The development of community-based organizational structures proved crucial for ensuring program sustainability and continuity. Three community composting centers were successfully established through collaborative efforts between participating farmers and local leaders. These centers serve as production hubs where farmers can access equipment, raw materials, and technical support for organic fertilizer production. The centers are managed by elected committees comprising trained community members who oversee operations, maintain equipment, and coordinate activities with external support organizations.

Local leadership development represented a critical component of the sustainability strategy, with 15 farmers trained as community facilitators capable of providing ongoing technical support and training to other farmers. These facilitators demonstrated strong commitment to their roles and successfully organized additional training sessions for new participants. Their involvement ensures that knowledge and skills continue to be transferred within the community even after external support concludes. Focus group discussions revealed high levels of confidence among these facilitators regarding their ability to maintain and expand organic fertilizer production activities.

Economic sustainability indicators showed promising results for the long-term viability of organic fertilizer production activities in Gampong Lamteuba. Cost-benefit analyses conducted with participating farmers revealed that organic fertilizer production systems generate positive returns on investment within 18 months of establishment. Reduced synthetic fertilizer costs, combined with increased crop yields, provide strong economic incentives for continued adoption of organic fertilizer practices. Several farmers reported plans to expand their composting operations and begin selling excess organic fertilizer to neighboring communities.

Social capital development emerged as an important additional benefit of the program implementation. The collaborative nature of composting activities and group training sessions strengthened social cohesion within the community and created new networks for knowledge sharing and mutual support. Women participants particularly valued the opportunities for social interaction and skill development provided by the program activities. These social benefits contribute to

program sustainability by creating informal support systems that encourage continued participation and knowledge transfer among community members.

Figure 3. Four-phase implementation framework for community-based organic fertilizer program in Gampong Lamteuba showing program progression and sustainability planning

CONCLUSION

The community service program on organic fertilizer production and application in Gampong Lamteuba successfully demonstrated the effectiveness of participatory agricultural extension approaches in promoting sustainable farming practices among rural Acehnese farmers. The significant improvements achieved across multiple outcome indicators, including knowledge enhancement (85% increase), soil fertility improvement (76% increase in organic matter), and agricultural productivity gains (32% yield increase), validate the program's comprehensive approach to community-based agricultural development. The establishment of sustainable local institutions, including three community composting centers and 15 trained local facilitators, provides a strong foundation for continued program impact beyond the formal implementation period.

The program's success can be attributed to its emphasis on community participation, culturally appropriate training methods, and integration of scientific principles with local knowledge systems. The four-phase implementation approach

proved effective in building local capacity while ensuring systematic knowledge transfer and skill development among participating farmers. Economic analysis revealed positive returns on investment within 18 months, providing strong incentives for continued adoption of organic fertilizer practices. The establishment of community-based organizational structures and local leadership development ensures program sustainability and creates opportunities for expansion to neighboring communities. These outcomes contribute significantly to broader goals of sustainable agricultural development and rural livelihood improvement in Aceh Province while demonstrating the potential for replicating similar programs in comparable rural contexts throughout Indonesia.

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