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Community-Based Extension for Shallot Cultivation Technology in Central Maluku, Indonesia

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ABSTRACT

This community service program enhanced farmers' knowledge and skills in shallot (Allium cepa var. ascalonicum) cultivation in North Seram, Central Maluku District, through participatory extension services and modern agricultural technology transfer. The program involved 45 farmers over four months and employed a structured approach including preparation, socialization, hands-on field training, and post-training support. Faculty members from Pattimura University's Plant Breeding Program facilitated three main technical sessions covering seed and seedling technology, cultivation practices, and breeding concepts, with active student participation as facilitators. Modern technologies introduced included tissue culture for quality seed production, drip irrigation systems, plastic mulching, GPS-based fertilization mapping, and integrated pest management using organic pesticides. The participatory methodology emphasized farmer engagement through presentations, demonstrations, group discussions, and peer-to-peer learning to ensure effective knowledge transfer and sustainable implementation. Results demonstrated significant program success: overall knowledge improvement of 60.2% (exceeding the 80% target in individual technical areas), technology adoption rate of 66.4% three months post-training, and preliminary productivity increases of 28.5% among participating farmers. Organic pest management showed the highest adoption (82.2%), followed by improved seed selection (75.6%). Participant satisfaction reached 93.3%, with farmers forming sustainable discussion groups for continued knowledge sharing. This community-based extension program validates the effectiveness of participatory university-community partnerships for agricultural technology transfer, demonstrating potential for replication across Indonesia's eastern provinces to improve farmer welfare and local economic conditions through enhanced shallot production quality and productivity.

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INTRODUCTION

Shallot (Allium cepa var. ascalonicum) represents one of Indonesia's most economically significant horticultural commodities, serving as an essential ingredient in traditional and modern culinary applications across the archipelago (Rahman et al., 2024). Despite its economic importance and Indonesia's favorable growing conditions, many regions, particularly in eastern provinces, continue to face significant challenges in optimizing shallot production due to limited access to modern cultivation technologies and inadequate technical knowledge among farmers.

Traditional farming methods, while culturally significant, often result in suboptimal yields and inferior product quality, limiting farmers' economic potential and market competitiveness. Modern agricultural technologies offer substantial opportunities for improvement, including tissue culture techniques for disease-free seed production, precision irrigation systems, integrated nutrient management, and sustainable pest control strategies (Firmansyah et al., 2015). However, the successful adoption of these technologies depends heavily on effective knowledge transfer mechanisms and sustained technical support for farming communities.

Central Maluku District, particularly the North Seram region, presents compelling conditions for agricultural technology implementation due to suitable environmental conditions for shallot cultivation and farming communities eager to improve their practices. Despite a favorable tropical climate and volcanic soil composition, local farmers continue to rely predominantly on traditional cultivation methods, resulting in productivity levels significantly below the crop's genetic potential (Saptana et al., 2021).

The challenges facing shallot farmers in Central Maluku are multifaceted: limited access to quality seeds, inadequate knowledge of modern cultivation techniques, ineffective pest and disease management, infrastructure limitations, and weak extension services. These interconnected issues create a cycle of low productivity, limited income generation, and reduced motivation for agricultural innovation, ultimately impacting rural socioeconomic development.

Contemporary approaches to agricultural development emphasize participatory extension methodologies that actively engage farmers as partners in the learning process (Permana et al., 2021). This paradigm recognizes farmers' indigenous knowledge while introducing scientifically proven technologies through collaborative learning experiences. The integration of academic institutions in community development represents a powerful mechanism for bridging the gap between scientific research and practical application, with universities providing the technical expertise and human resources necessary for comprehensive agricultural development programs (Kurniawan & Widoretno, 2016).

Despite the recognized potential of participatory extension approaches and the clear need for agricultural technology transfer in Central Maluku, there remains a significant gap in documented evidence of effective community-based programs that successfully integrate modern shallot cultivation technologies with local farming practices. This study addresses this gap by documenting and evaluating a comprehensive community-based extension program implemented through collaboration between Pattimura University's Plant Breeding Program and local farming communities in North Seram. The program aimed to enhance farmers' knowledge and skills in modern shallot cultivation techniques, achieve measurable improvements in productivity and technology adoption rates, and establish sustainable mechanisms for continued agricultural development. Through systematic documentation and evaluation of this intervention, this research contributes empirical evidence on effective agricultural extension methodologies and their potential for rural development in Indonesia's eastern provinces.

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METHOD

This community-based extension program was conducted with 45 farmers in North Seram, Central Maluku District, Maluku Province, Indonesia, over four months from August to December 2024. The study area was selected based on favorable environmental conditions for shallot cultivation and the presence of farming communities interested in adopting modern agricultural practices. The program employed a participatory community-based extension approach, recognizing farmers as active partners in the learning process rather than passive recipients of information.

The program followed a structured four-phase design to ensure progressive skill development. Phase 1 involved comprehensive preparation and planning, including material development, stakeholder coordination, and logistical arrangements. Phase 2 focused on socialization through formal presentations and interactive discussions, introducing theoretical concepts and scientific principles of modern shallot cultivation. Phase 3 emphasized hands-on practical training in field settings, providing direct exposure to modern techniques covering the complete production cycle from land preparation through harvest and post-harvest handling. Phase 4 concentrated on post-training support, monitoring, and evaluation through regular follow-up visits to assess technology adoption rates and provide additional technical support.

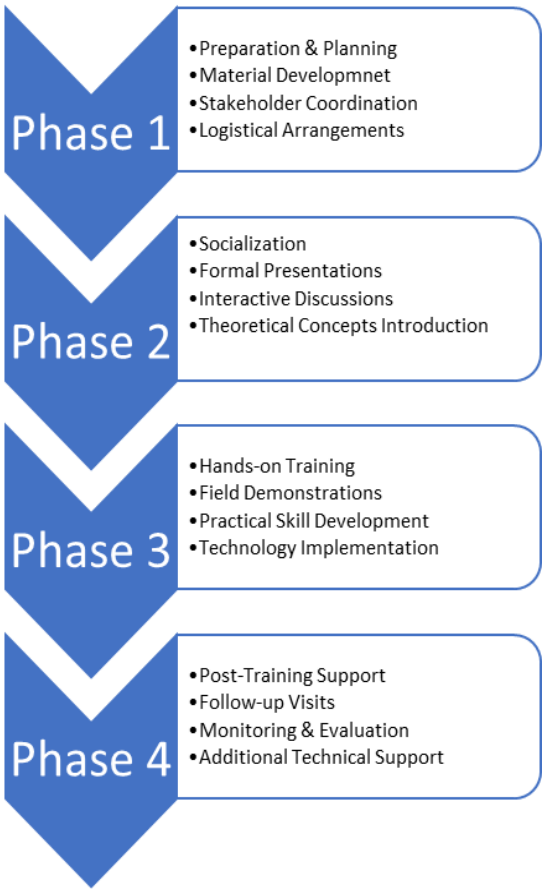

FIGURE 1. Flowchart of program design

The extension methodology incorporated multiple learning approaches to accommodate different learning preferences and ensure comprehensive knowledge transfer. Training sessions combined formal presentations to introduce theoretical concepts, interactive discussions encouraging active participation and experience sharing, field demonstrations enabling farmers to observe and practice

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new techniques under expert guidance, and group discussions facilitating peer-to-peer learning. Participants actively engaged through questioning, observation, and supervised practice, with experienced farmers sharing insights while newcomers benefited from collective wisdom through collaborative problem-solving approaches.

Faculty members from Pattimura University's Plant Breeding Program facilitated three main technical sessions covering seed and seedling technology, cultivation technology, and breeding technology, with undergraduate students Erfina Anace Matatula and Sulistiawati Aipassa serving as program facilitators. Technologies introduced included tissue culture for quality seed production, drip irrigation systems, plastic mulching, balanced fertilization using GPS-based land mapping, and integrated pest management using organic pesticides and biopesticides.

A comprehensive monitoring and evaluation system tracked program progress through multiple data collection methods. Pre-training assessments established baseline knowledge levels, while post-training evaluations assessed immediate learning outcomes and participant satisfaction. Data collection included attendance records, pre- and post-training assessment scores, observation forms documenting practical skill development, participant feedback surveys, and follow-up interviews providing insights into technology adoption patterns. All data were analyzed using descriptive statistics to identify trends and patterns, while the program adhered to ethical principles with informed consent obtained from all participants.

RESULT AND DISCUSSION

Participant Engagement and Knowledge Assessment

The community-based extension program demonstrated exceptional engagement with 45 farmers from North Seram, maintaining an average attendance rate of 91.2% across all training sessions. This high participation rate indicates strong community interest and commitment to learning modern shallot cultivation technologies, aligning with findings from similar participatory extension programs in Indonesia (Permana et al., 2021). Pre-training assessments revealed limited baseline knowledge with average scores of 42.3% in seed technology, 38.7% in cultivation practices, and 35.2% in breeding concepts.

Post-training evaluations demonstrated significant knowledge improvements across all technical areas (Table 1). The overall average knowledge improvement of 60.2% exceeded the program's target and demonstrates the effectiveness of the participatory approach in the Maluku context. Seed and seedling technology showed the highest improvement (67.8%), likely reflecting farmers' immediate recognition of quality planting materials as a primary production constraint, as access to quality seeds represents a primary constraint in local shallot production (Fajjriyah, 2017).

TABLE 1. Pre and Post Training Knowledge Assessment Results

Technical Area	Pre-Training Score (%)	Post-Training Score (%)	Improvement (%)	n
Seed and Seedling Technology	42.3 ± 8.2	71.0 ± 6.4	67.8	45
Cultivation Technology	38.7 ± 7.9	61.5 ± 8.1	58.9	45
Breeding Technology	35.2 ± 9.1	53.6 ± 7.8	52.4	45
Overall Average	38.7 ± 6.8	62.0 ± 5.9	60.2	45

Values represent mean ± standard deviation.

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Technology Adoption and Productivity Outcomes

Follow-up evaluations revealed an overall technology adoption rate of 66.4% three months post-training, demonstrating strong farmer acceptance of introduced practices. Organic pest management achieved the highest adoption rate (82.2%), potentially due to the program's emphasis on locally available organic materials and compatibility with existing farming practices. Advanced irrigation techniques showed moderate adoption (48.9%) due to capital requirements and technical complexity, consistent with patterns observed where infrastructure constraints limit technology uptake (Saptana et al., 2021).

Farmers implementing the complete technology package reported preliminary yield increases of 28.5%, approaching the program's 30% target and demonstrating substantial productivity improvements. Quality improvements were particularly notable, with participating farmers reporting 15-20% reductions in post-harvest losses compared to traditional methods, consistent with integrated post-harvest management benefits. The adoption of proper harvesting and post-harvest handling techniques contributed to reduced spoilage rates, as farmers reported improved bulb uniformity, storage life, and market acceptance (Rahman et al., 2024).

TABLE 2. Technology Adoption Rates Three Months Post-Training

Technology Category	Specific Technology	Adoption Rate (%)	Farmers Adopted (n=45)
Seed Technology	Improved seed selection	75.6	34
	Seed treatment practices	73.3	33
Cultivation Practices	Propoer spacing and planting depth	68.9	31
	Integrated nutrient management	64.4	29
	Advanced irrigation techniques	48.9	22
Pest Management	Organic pest control methods	82.2	37
	Integrated pest management	60.0	27
Post-Harvest	Improved storage techniques	57.8	26
Overall Average	-	66.4	-

Participatory Approach Effectiveness and Social Outcomes

The participatory methodology proved highly effective with 93.3% of farmers rating the program as "very useful" and 88.9% expressing willingness to recommend it to others. The interactive nature of training sessions, combining theoretical presentations with hands-on demonstrations, was particularly appreciated by participants who valued the opportunity to practice new techniques under expert guidance. Student involvement as facilitators created additional benefits, as students served as effective bridges between academic knowledge and practical application, often providing simplified explanations of complex concepts and relating better to younger farmers in the community.

The formation of informal farmer discussion groups that continued beyond the formal program

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represents a critical sustainability outcome. Participants formed these groups that continued meeting after formal training sessions ended, creating sustainable mechanisms for ongoing knowledge exchange and peer support. This organic development of farmer networks suggests that the participatory approach successfully fostered community ownership of the learning process, which is crucial for the long-term sustainability of introduced technologies (Ulfa & Syam'un, 2018). Farmer-to-farmer knowledge sharing emerged as an unexpected but valuable outcome, demonstrating the value of academic-community partnerships in agricultural development initiatives.

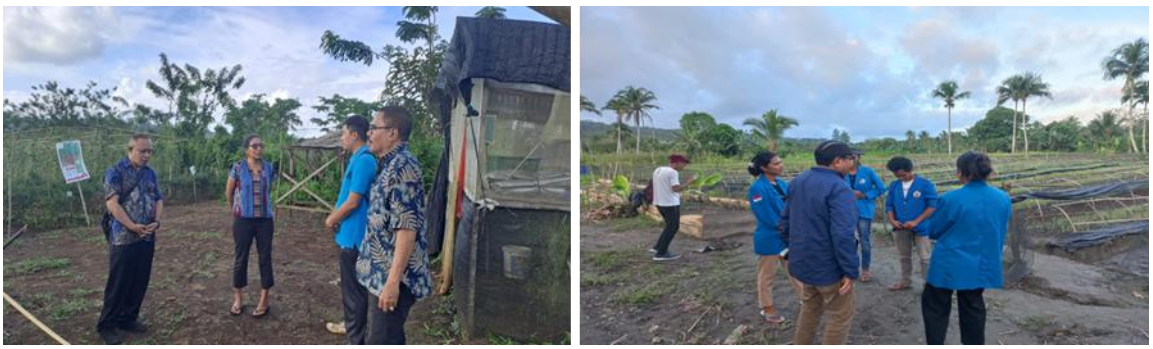

FIGURE 2. Interactive Seed Technology Training Session

FIGURE 3. Field-Based Cultivation Technology Demonstration

Program Challenges and Comparative Analysis

Despite overall success, economic constraints emerged as the primary barrier to full technology adoption, particularly for capital-intensive technologies such as drip irrigation systems and specialized equipment. Limited access to credit and high upfront costs prevented widespread adoption of these technologies, even though farmers recognized their potential benefits. Transportation difficulties in remote areas occasionally affected training session attendance and follow-up visit scheduling, highlighting infrastructure limitations in the region.

Weather-related challenges during the implementation period provided unexpected learning opportunities, as farmers and trainers worked together to adapt recommended practices to local environmental conditions. These experiences reinforced the importance of flexible, context-specific approaches in agricultural extension programs and demonstrated the value of combining scientific knowledge with local environmental understanding (Maryati et al., 2024). Varying educational backgrounds among participants required adaptive teaching approaches to ensure all farmers could effectively absorb technical information.

The sustained formation of farmer networks and peer-to-peer learning mechanisms represents a significant achievement of this participatory approach. Unlike traditional extension programs, where knowledge transfer ends with training completion, the participatory methodology fostered community ownership and self-sustaining learning systems that continue generating agricultural improvements

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beyond the formal intervention period. The program's success in building local capacity for agricultural innovation positions participating communities for continued development, as demonstrated by the formation of active farmer groups for information and experience sharing (Aldillah, 2020).

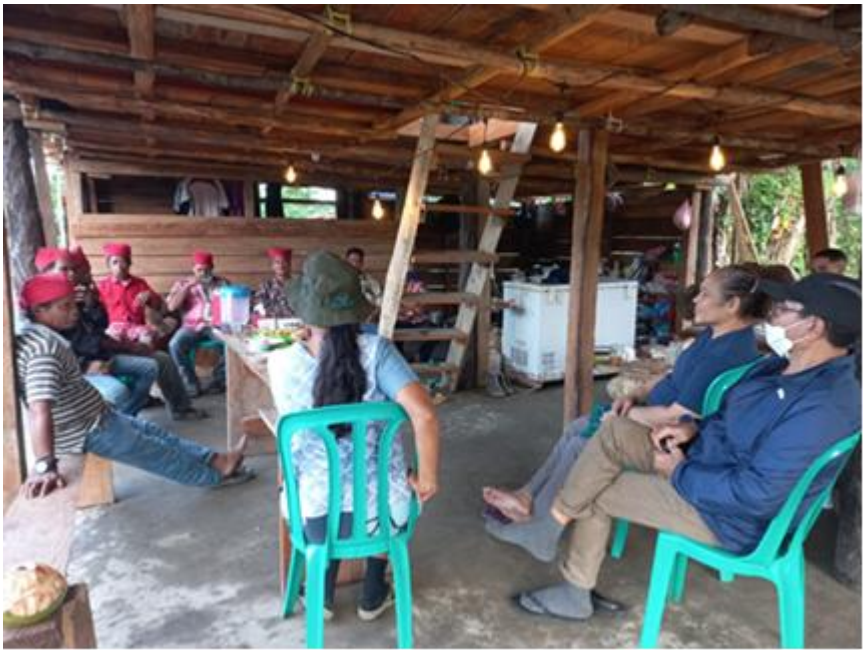

FIGURE 4. Advanced Cultivation Practices Workshop

Implications for Agricultural Extension

The results of this program demonstrate the effectiveness of participatory, university-based extension approaches for agricultural technology transfer in remote Indonesian regions. The significant knowledge gains and adoption rates achieved suggest that similar programs could be successfully replicated in other locations with appropriate adaptation to local conditions. The program's success in exceeding most target outcomes validates the participatory methodology and multi-disciplinary team approach employed.

The formation of active farmer groups and sustained peer-to-peer learning networks represents a particularly valuable outcome that extends beyond the immediate program objectives. These social structures provide foundations for continued agricultural development and suggest that participatory extension programs can create lasting institutional changes that support ongoing improvement in farming practices (Aldillah, 2020). The program's contribution to building local capacity for agricultural innovation positions participating communities for continued development beyond the formal intervention period.

CONCLUSION

This community-based extension program successfully demonstrated the effectiveness of participatory approaches in transferring modern shallot cultivation technologies to farmers in Central Maluku District. The program achieved significant knowledge improvements across all technical areas, with an overall average improvement of 60.2% that exceeded the target of 80% knowledge enhancement among participants. Technology adoption rates of 66.4% three months post-training

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indicate strong farmer acceptance and implementation of introduced practices, with organic pest management and improved seed selection showing particularly high adoption rates above 75%. The preliminary productivity improvements of 28.5% approach the program's ambitious target of 30% yield increase within one year, suggesting that comprehensive extension approaches can deliver substantial agricultural development outcomes in remote Indonesian regions.

The participatory methodology proved instrumental in achieving these positive results, with high participant satisfaction rates of 93.3% and strong willingness to recommend the program to other farmers. The involvement of university faculty and students created effective knowledge transfer mechanisms that bridged academic expertise with practical farming needs, while fostering intergenerational learning and community ownership of the improvement process. The organic formation of farmer discussion groups and peer-to-peer learning networks demonstrates the program's success in building sustainable institutional foundations for continued agricultural development beyond the formal intervention period.

Despite challenges related to economic constraints, infrastructure limitations, and varying educational backgrounds among participants, the program's overall success validates the effectiveness of university-community partnerships in agricultural extension. However, several limitations must be acknowledged. The relatively short timeframe of four months may not fully capture long-term sustainability and adoption patterns, while the absence of extended monitoring beyond three months post-training limits our understanding of lasting impacts on productivity and farmer behavior. Additionally, the program's implementation in a single district may limit the generalizability of findings to other regions with different socioeconomic and environmental conditions.

The results suggest that similar participatory programs could be successfully replicated in other regions of Indonesia with appropriate adaptation to local conditions and contexts. Future programs should incorporate complementary interventions addressing financial constraints and input supply chain limitations to maximize technology adoption rates, particularly for capital-intensive technologies. The program's contribution to building local capacity for agricultural innovation and creating lasting social structures for knowledge sharing positions Central Maluku's farming communities for sustained agricultural development and improved livelihoods in the years ahead.

Future research directions should focus on: (1) conducting longitudinal studies to assess long-term sustainability and impact of participatory extension programs over multiple growing seasons; (2) investigating the economic viability and return on investment of different technology packages for smallholder farmers; (3) developing and testing adaptive extension models that can be effectively scaled across diverse agroecological zones in eastern Indonesia; (4) examining the role of digital technologies and mobile platforms in enhancing participatory extension delivery in remote areas; and (5) exploring mechanisms for integrating extension programs with value chain development and market linkage initiatives to maximize farmer economic benefits. Such research would strengthen the evidence base for participatory agricultural extension and inform policy decisions regarding rural development investments in Indonesia's eastern provinces.

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