

PENINGKATAN KAPASITAS SDM PETANI MELALUI PELATIHAN PEMULIAAN TANAMAN UNTUK Mendukung Pengembangan AGRIBISNIS BERKELANJUTAN

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Abstrak

Kegiatan pengabdian masyarakat ini bertujuan untuk meningkatkan kapasitas sumber daya manusia (SDM) petani melalui pelatihan pemuliaan tanaman sebagai strategi penguatan agribisnis berkelanjutan di Kabupaten Deli Serdang, Provinsi Sumatera Utara. Rendahnya pengetahuan dan keterampilan petani dalam teknik pemuliaan tanaman menjadi hambatan utama dalam peningkatan produktivitas dan daya saing komoditas pertanian lokal. Metode yang digunakan dalam kegiatan ini meliputi penyuluhan teori, demonstrasi lapangan, pelatihan praktik langsung, dan pendampingan pasca-pelatihan kepada 40 orang petani peserta. Materi pelatihan mencakup teknik seleksi varietas unggul, persilangan tanaman, perbanyakan benih, dan manajemen agribisnis berbasis teknologi. Hasil kegiatan menunjukkan peningkatan signifikan pada pengetahuan peserta sebesar 72,5% berdasarkan hasil pre-test dan post-test, peningkatan keterampilan teknis sebesar 68,3%, serta terbentuknya kelompok tani inovatif yang secara aktif menerapkan teknik pemuliaan tanaman pada lahan usahatani mereka. Program ini berkontribusi nyata pada penguatan kapasitas SDM pertanian lokal dan mendukung pengembangan agribisnis berkelanjutan di tingkat pedesaan.

Kata kunci: Agribisnis Berkelanjutan, Kapasitas SDM, Pelatihan Pertanian, Pemuliaan Tanaman, Petani

IMPROVING FARMER HUMAN RESOURCE CAPACITY THROUGH PLANT BREEDING TRAINING TO SUPPORT SUSTAINABLE AGRIBUSINESS DEVELOPMENT

Abstract

This community service activity aims to enhance the human resource (HR) capacity of farmers through plant breeding training as a strategy for strengthening sustainable agribusiness in Deli Serdang Regency, North Sumatra Province. The low level of farmers' knowledge and skills in plant breeding techniques is a major obstacle to improving the productivity and competitiveness of local agricultural commodities. The methods used in this activity include theoretical counseling, field demonstrations, hands-on practical training, and post-training mentoring for 40 participating farmers. The training materials covered superior variety selection techniques, plant hybridization, seed propagation, and technology-based agribusiness management. The results showed a significant increase in participants' knowledge by 72.5% based on pre-test and post-test results, an increase in technical skills of 68.3%, and the formation of an innovative farmer group that actively applies plant breeding techniques on their farm land. This program makes a real contribution to strengthening the capacity of local agricultural human resources and supporting sustainable agribusiness development at the rural level.

Keywords: Farmer Capacity Building, Plant Breeding Training, Sustainable Agribusiness, Agricultural Human Resources

1. INTRODUCTION

The agricultural sector is the backbone of the Indonesian economy, especially for rural communities, most of whom depend on farming and plantations for their livelihoods. However, Indonesian agricultural productivity remains relatively low compared to other Southeast Asian countries, partly due to farmers' limited technical knowledge and skills, particularly in plant

breeding (Center for Research and Development of Agricultural Biotechnology and Genetic Resources, 2021). Plant breeding is the science and art of improving the genetic characteristics of plants to increase the quality and quantity of their production (Poehlman & Sleper, 2006). Farmers' mastery of plant breeding techniques enables them to produce superior varieties that are adaptive to local environmental conditions, resistant to pests and diseases, and have high economic value. This ultimately has a positive impact on increasing farmer incomes and developing sustainable agribusiness.

Field conditions indicate that the majority of farmers in Deli Serdang Regency still use conventional varieties with traditional cultivation techniques that have not yet adopted modern plant breeding innovations. Based on an initial survey conducted by the community service team in March 2024 of 60 farmers in three target sub-districts, it was found that only 23.3% of farmers had basic knowledge of variety selection, and only 8.3% had received training related to plant breeding. The average productivity of farmers' land is 3.2 tons/ha, far below the potential of superior varieties, which can reach 6-8 tons/ha. This low human resource capacity of farmers directly impacts their weak bargaining position in the agribusiness chain, their high dependence on imported seeds or seeds from distributors, and their inability to adapt to climate change and market dynamics. This situation is exacerbated by farmers' limited access to scientific information and the latest agricultural technology (Fauziyah et al., 2022).

Sustainable agribusiness development requires competent and innovative agricultural human resources. A community empowerment approach through competency-based training has proven effective in increasing farmer capacity in various regions (Mardikanto & Soebiato, 2019). Structured and systematic training, accompanied by field mentoring, can accelerate the adoption of agricultural technology by farmers and significantly increase farm productivity (Suharyanto et al., 2021). The Indonesian Palm Oil Technology Institute (ITSI), a university renowned for its expertise in plantation agribusiness, and the LP3M Superior Polytechnic, which specializes in information technology and management, are collaborating on this community service program. The synergy between the two institutions is expected to produce a comprehensive training program, encompassing both the technical aspects of plant breeding and information technology-based agribusiness management.

This community service program is specifically designed to address the needs of farmers in Deli Serdang Regency in terms of strengthening technical capacity in the field of plant breeding. The main objectives of this activity are: (1) increasing farmers' knowledge of the principles and techniques of plant breeding; (2) improving farmers' skills in variety selection, crossbreeding, and seed propagation; (3) building farmers' awareness of the importance of innovation-based agribusiness; and (4) encouraging the formation of innovative farmer groups that can become agents of change in their environment. Various previous studies have demonstrated the effectiveness of agricultural training programs in improving farmer capacity. Pratiwi & Hidayat (2023) found that field-based training increased agricultural technology adoption by up to 65% compared to conventional classroom training. Research by Sitorus et al. (2022) in North Sumatra showed that farmer empowerment programs through technical training can increase land productivity by an average of 40% within a single planting season. These research findings reinforce the need for structured and sustainable plant breeding training programs for farmers.

2. METHOD

This community service activity was conducted in Deli Serdang Regency, North Sumatra Province, from April to July 2024, involving 40 farmers from three farmer groups in the districts of Lubuk Pakam, Galang, and Beringin. The program was designed comprehensively, combining an andragogical approach (adult learning) with experiential learning.

2.1 Preparation and Needs Analysis Stage

Prior to the training, the community service team conducted a needs assessment through a structured survey and in-depth interviews with representatives of farmer groups, field agricultural extension workers (PPL), and the local agricultural office. The instrument used was a validated questionnaire that measured farmers' initial knowledge of plant breeding, farming conditions, challenges faced, and expectations regarding the training program. The needs assessment data was analyzed descriptively to develop a relevant and contextual training curriculum. The community service team also coordinated intensively with farmer group administrators and village officials to ensure target readiness and smooth implementation. This phase also included the development of training modules, preparation of learning media, and coordination with expert resource persons in plant breeding from the Indonesian Palm Oil Technology Institute.

2.2 Method of Material Delivery

The training was conducted in three main, interconnected phases. The first phase was counseling and theoretical briefing (4 sessions @ 3 hours) covering the following materials: (a) introduction to genetics and plant breeding; (b) superior variety selection techniques and local adaptation; (c) plant crossing and hybridization methods; (d) quality seed propagation technology; and (e) information technology-based agribusiness management. The material was delivered using audiovisual media, interactive presentations, and group discussions guided by experienced facilitators. The second phase is a demonstration and field practice (6 sessions @ 4 hours) conducted in the participants' experimental gardens and farms. In this phase, participants have the opportunity to directly practice plant breeding techniques under the guidance of instructors. Practical activities include: selecting superior parent plants, emasculation and artificial pollination techniques, harvesting and seed preparation, and recording agronomic data. The Learning by Doing approach is consistently applied to ensure effective skill transfer. The third phase is mentoring and monitoring (lasting eight weeks after the training). The community service team conducts regular field visits to participants' fields, provides technical consultations, and monitors the progress of the application of the knowledge gained. During this phase, a discussion forum is also established via the WhatsApp Group application as a communication and consultation platform that is easily accessible to all participants.

The program evaluation was conducted using three instruments: (1) pre-test and post-test questionnaires to measure the increase in participants' knowledge, consisting of 30 multiple-choice questions and a short essay; (2) an observation sheet to assess participants' technical skills during the field practice sessions; and (3) a participant satisfaction questionnaire to assess the quality of the training implementation. Evaluation data were analyzed using descriptive statistical tests and paired t-tests to measure the significance of the increase in participants' knowledge. The program's success rate was determined if at least 70% of participants achieved post-test scores above the class average and showed a minimum score increase of 60% from the pre-test score.

3. RESULTS AND DISCUSSION

3.1 Participant Profile and Initial Conditions

The training was attended by 40 participants, all of whom were active farmers aged 25-58. Participant characteristics are presented in Table 1 below.

Table 1. Characteristics of Plant Breeding Training Participants

Characteristics	Category	Number (people) / Percentage (%)
Gender	Man	28 (70%)

Level of education	Woman	12 (30%)
	Elementary School/Equivalent	12 (30%)
	Junior High School/Equivalent	16 (40%)
	High School/Equivalent	10 (25%)
	College	2 (5%)
Farming Experience	< 5 years	8 (20%)
	5-10 years	14 (35%)
	> 10 years	18 (45%)
Land Area (average)	< 0.5 ha	18 (45%)
	0.5 - 1 ha	15 (37.5%)
	> 1 ha	7 (17.5%)

Source: Primary Data, 2024

The data in Table 1 shows that the majority of participants (45%) have more than 10 years of farming experience, but their formal education level is still relatively low, with 70% of participants having an elementary or junior high school education. This condition is the basis for the community service team's consideration in designing a training method that is more practical and based on experience (experiential learning) rather than a theoretical academic approach. The majority of land areas are under 1 hectare (82.5%), indicating the characteristics of small-scale farmers who are in dire need of increased efficiency and productivity through the application of superior cultivation techniques.

3.2 Increasing Participant Knowledge

Evaluation of participants' knowledge improvement was conducted by comparing pre-test and post-test scores. The evaluation results are presented in Table 2 below.

Table 2. Pre-Test and Post-Test Results of Training Participants

Knowledge Aspect	Pre-Test Average	Post-Test Average	Increase (%)
Basic Principles of Plant Genetics	42.3	78.6	85.8%
Superior Variety Selection Techniques	38.7	74.2	91.7%
Crossing and Hybridization Methods	31.5	69.8	121.6%
Seed Propagation Technology	45.2	76.4	69.0%
Agribusiness Management and Marketing	50.6	79.8	57.7%
Post-Harvest Management	48.9	77.5	58.5%
Overall Average	42.9	76.1	72.5%

Source: Primary Data, 2024

Based on the data in Table 2, there was a significant increase in knowledge across all aspects of the training material. The highest increase occurred in the cross-breeding and hybridization method (121.6%), which previously had the lowest pre-test score. This indicates that the material was relatively new and unfamiliar to the participants, making the training highly impactful. Overall, the average increase in knowledge reached 72.5%, far exceeding the minimum target of 60%. The paired t-test results showed a t value of 8.43 with a significance level of $p < 0.001$, proving that the difference between the pre-test and post-test scores was statistically significant. This finding is consistent with the research of Suryanto et al. (2023), which stated that field-based agricultural training significantly improved farmers' knowledge scores in a relatively short time. This successful increase in knowledge was also supported by a

varied learning methodology, the use of simple and contextual language, and a conducive and interactive training atmosphere.

3.3 Technical Skills Improvement

Participants' technical skills were evaluated by instructors using observation sheets during field practice sessions. The assessment covered five key technical competencies using a scale of 1-4 (1 = incapable, 2 = less capable, 3 = quite capable, 4 = capable). The skills evaluation results showed an average increase of 68.3% from the initial to the final training conditions. Parent plant selection skills experienced the highest increase (75.4%), followed by seed propagation skills (71.2%), artificial pollination techniques (68.9%), agronomic data recording (65.8%), and preparation of superior planting media (60.2%). The eight-week post-training mentoring process yielded encouraging results. 87.5% of participants (35 out of 40) actively implemented at least one plant breeding technique on their farms. The most progressive farmer group even successfully crossbred their own crops and produced F1 (first-generation) seeds, which will be tested for adaptation in the following planting season. This achievement exceeded the initial expectations of the community service team and demonstrated the participants' high motivation and commitment to adopting agricultural innovations.



Figure 1. Practice of plant character identification in plant breeding activities.

This image shows a hands-on activity between a facilitator and a farmer observing plant parts, a crucial step in plant breeding. Through this activity, participants are trained to recognize plant characteristics, differentiate plant samples, and understand how to select plants with the potential for superior traits. This hands-on approach helps farmers acquire technical skills in a more concrete way, ensuring that the knowledge gained is not merely theoretical but also applicable to cultivation activities and sustainable agribusiness development.

3.4 Formation of Innovative Farmer Groups

One important outcome of this community service program was the formation of the "Maju Bersama" Innovative Farmers Group, comprised of 40 farmer trainees. The group has a clear organizational structure with divisions: plant breeding, cultivation, post-harvest processing, and digital marketing. The group was also facilitated to officially register with the Deli Serdang Regency Agriculture Office, enabling it to access various government assistance and development programs. The formation of this innovative farmer group aligns with Mardikanto & Soebiato's (2019) opinion that the sustainability of community empowerment programs is largely determined by the target community's ability to organize and act collectively. Through this group, farmers can share knowledge, exchange experiences, and collaborate to access broader markets. The community service team also facilitates partnerships between farmer

groups and private plantations in the surrounding area, acting as offtakers of their agricultural products.



Figure 2. Mentoring and field discussions between facilitators and farmer participants in the training.

This image shows a hands-on mentoring activity on a farm, where a facilitator provides guidance to farmers on the application of previously learned plant breeding materials. Through this field discussion, participants can address challenges, record important information, and receive practical explanations regarding plant observation and cultivation management. This activity is crucial in ensuring that the knowledge and skills acquired during the training can be applied effectively to support sustainable agribusiness development.

3.5 Participant Satisfaction and Program Evaluation

Participant satisfaction was evaluated at the end of the program using a questionnaire with a Likert scale of 1-5. The evaluation results showed a very high level of participant satisfaction across all assessed aspects, as presented in Table 3 below.

Table 3. Results of Training Participant Satisfaction Evaluation

Assessment Aspects	Average Score (1-5)	Category
Relevance of material to farmers' needs	4.72	Very satisfied
Quality of instructor delivery	4.65	Very satisfied
Quality of training modules and media	4.48	Very satisfied
Quality of field practice sessions	4.83	Very satisfied
Benefits of training for farming	4.76	Very satisfied
Quality of post-training support	4.55	Very satisfied
Overall Average	4.67	Very satisfied

Source: Primary Data, 2024

The average satisfaction score of 4.67 on a scale of 5 indicates a very high level of satisfaction. The field practice session received the highest satisfaction score (4.83), confirming that the experiential learning approach was highly appreciated and effective for the target group of farmers with many years of farming experience. These evaluation results demonstrate that the training program was designed and implemented with high quality and aligned with the needs and expectations of the participants.



Figure 3. Group photo of the service team and plant breeding training participants.

This image shows the final documentation of a community service activity attended by the service team and the farmer participants. This group photo demonstrates the participants' active involvement in a series of activities, from material delivery and field practice to technical assistance related to plant breeding and sustainable agribusiness development. Through this activity, it is hoped that farmers will improve their knowledge, skills, and motivation in implementing agricultural innovations to support productivity and farm independence.

3.6 Implications for Sustainable Agribusiness Development

Improving the human resource capacity of farmers through this plant breeding training program has significant implications for sustainable agribusiness development in the target areas. First, by increasing farmers' knowledge of plant breeding techniques, they can gradually reduce their reliance on commercial hybrid seeds, the prices of which continue to rise. This will positively impact the cost efficiency of farm production in the medium and long term. Second, farmers' ability to produce local varieties that are adaptive to local climate and soil conditions contributes to stronger local food security. This aligns with the concept of sustainable agriculture, which emphasizes the use of local resources, minimizing external inputs, and conserving agricultural biodiversity (FAO, 2018). Third, integrating plant breeding knowledge with information technology-based agribusiness management opens up opportunities for farmers to access broader markets and increase the added value of their agricultural products.

The success of this program also demonstrates that collaboration between higher education institutions and farming communities is an effective model of community service. The participatory approach implemented, in which farmers are involved as active partners rather than simply objects of guidance, has been shown to result in high technology adoption rates and greater program sustainability. These findings reinforce Chambers' (2015) argument about the importance of the Participatory Rural Appraisal (PRA) approach in rural community empowerment programs.

4. CONCLUSION

A community service program in the form of plant breeding training conducted for 40 farmers in Deli Serdang Regency has significantly achieved all of its targets. This activity succeeded in increasing participant knowledge by 72.5% based on pre- and post-test results, improving participant technical skills by 68.3% based on observational assessments, and achieving a very high level of participant satisfaction with an average score of 4.67 on a scale of 5. The success of

this program is inseparable from its precise methodological approach, which combines theoretical outreach, field demonstrations, hands-on practice, and ongoing mentoring. This experiential learning approach has proven highly effective for the target group of farmers with diverse formal educational backgrounds but rich practical experience.

The establishment of the "Maju Bersama" Innovative Farmers Group as a collective platform for participating farmers ensures the program's sustainability in the future. This group is expected to serve as a center for agricultural learning and innovation at the village level, as well as a strategic partner for local governments and agricultural institutions in developing sustainable agribusiness in Deli Serdang Regency. For future community service programs of this kind, it is recommended to expand the reach of the program to more farmer groups, extend the post-training mentoring period, and integrate components to strengthen access to capital and markets for farmers. Furthermore, advanced training programs are needed for farmers who have mastered basic plant breeding techniques, so they can develop into independent, innovative farmers capable of teaching their peers.

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REFERENCES

- Balai Besar Penelitian dan Pengembangan Bioteknologi dan Sumberdaya Genetik Pertanian. (2021). Strategi Pengembangan Pemuliaan Tanaman untuk Ketahanan Pangan Nasional. Badan Penelitian dan Pengembangan Pertanian, Kementerian Pertanian RI. <https://biogen.litbang.pertanian.go.id>
- Chambers, R. (2015). Participatory Rural Appraisal: Analysis of Experience. *World Development*, 22(9), 1253-1268. [https://doi.org/10.1016/0305-750X\(94\)90003-5](https://doi.org/10.1016/0305-750X(94)90003-5)
- FAO. (2018). Sustainable Food and Agriculture: Indicators to Measure the Sustainability of Food Systems. Food and Agriculture Organization of the United Nations. <https://www.fao.org/3/I9830EN/i9830en.pdf>
- Fauziyah, E., Harini, R., & Widiyanto, A. (2022). Hambatan Adopsi Teknologi Pertanian pada Petani Skala Kecil di Indonesia: Tinjauan Sistematis. *Jurnal Agribisnis Indonesia*, 10(2), 145-162. <https://doi.org/10.29244/jai.2022.10.2.145>
- Mardikanto, T., & Soebiato, P. (2019). Pemberdayaan Masyarakat dalam Perspektif Kebijakan Publik (Edisi Revisi). Alfabeta.
- Poehlman, J. M., & Sleper, D. A. (2006). *Breeding Field Crops* (5th ed.). Iowa State University Press.
- Pratiwi, D., & Hidayat, A. (2023). Efektivitas Pelatihan Berbasis Praktek Lapangan terhadap Adopsi Teknologi Pertanian pada Petani di Kabupaten Bogor. *Jurnal Penyuluhan Pertanian*, 18(1), 32-46. <https://doi.org/10.25181/jpp.v18i1.2578>



- Purwanto, S., Suwanto, & Wardana, I. P. (2022). Peran Pemuliaan Tanaman dalam Mendukung Swasembada Pangan Indonesia. *Jurnal Penelitian dan Pengembangan Pertanian*, 41(1), 1-14. <https://doi.org/10.21082/jp3.v41n1.2022.p1-14>
- Sitorus, A., Pardamean, B., & Suparyono, E. (2022). Dampak Program Pemberdayaan Petani terhadap Produktivitas Lahan di Sumatera Utara. *Jurnal Agribisnis Sumatera Utara*, 15(1), 1-15. <https://doi.org/10.31289/jasu.v15i1.6842>
- Suharyanto, Mulyo, J. H., Darwanto, D. H., & Widodo, S. (2021). Analisis Efisiensi Teknis Usahatani Padi Sawah di Provinsi Bali. *Jurnal SEPA*, 8(2), 132-143. <https://doi.org/10.20961/sepa.v8i2.56043>
- Suryanto, A., Sumardjo, Gani, D. S., & Sadono, D. (2023). Model Pelatihan Partisipatif dalam Meningkatkan Kapasitas Petani untuk Mendukung Pembangunan Pertanian Berkelanjutan. *Jurnal Penyuluhan*, 19(1), 15-30. <https://doi.org/10.25015/penyuluhan.v19i1.43680>
- Undang-Undang Republik Indonesia Nomor 29 Tahun 2000 tentang Perlindungan Varietas Tanaman. Lembaran Negara Republik Indonesia Tahun 2000 Nomor 241. <https://peraturan.bpk.go.id/Details/44912/uu-no-29-tahun-2000>
- Wahyuni, S., Wibawa, W., & Priyambodo, S. (2021). Pelatihan Teknik Perbanyak Benih Tanaman Hortikultura untuk Meningkatkan Kemandirian Benih Petani di Kabupaten Sleman. *Jurnal Pengabdian Kepada Masyarakat*, 7(3), 301-312. <https://doi.org/10.22146/jpkm.61244>
- Widyawati, N., Tohari, Sulistyaningsih, E., & Yudono, P. (2022). Aplikasi Teknologi Pemuliaan Tanaman untuk Peningkatan Produktivitas Tanaman Pangan di Indonesia. *Jurnal Ilmu Pertanian Indonesia*, 27(2), 195-210. <https://doi.org/10.18343/jipi.27.2.195>
- World Bank. (2022). *Agricultural Innovation Systems: An Investment Sourcebook*. The World Bank. <https://openknowledge.worldbank.org/handle/10986/2247>
- Yuniarti, A., Amalia, R., & Nuraini, A. (2023). Peningkatan Kompetensi Petani Melalui Pelatihan Budidaya Tanaman Berbasis Teknologi di Kecamatan Jatinangor. *Dharmakarya: Jurnal Aplikasi Ipteks untuk Masyarakat*, 12(2), 178-186. <https://doi.org/10.24198/dharmakarya.v12i2.42875>
- Zainal, A., & Rahmat, B. (2023). Strategi Pengembangan Agribisnis Berkelanjutan melalui Penguatan Kapasitas Kelembagaan Petani. *Jurnal Manajemen dan Agribisnis*, 20(1), 43-58. <https://doi.org/10.17358/jma.20.1.43>

