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Capacity building of farmers in managing and utilizing local agrarian resources through the dissemination of sustainable farming techniques in Sampuran Village, Muara District, North Tapanuli Regency

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ABSTRACT

This research focuses on Research and Community Service (PPKM) activities carried out through the collaboration of IAKN Tarutung and USU in the field of agriculture in Sampuran Village, Muara District, North Tapanuli Regency. The primary issue addressed is farmers' complaints about reduced crop productivity caused by plant pests. The main commodities cultivated by the farming community include mango, cacao, avocado, and several types of young plants. The research method used is a qualitative approach with a case study type. The evaluation of the program's impact on farmers' empowerment was conducted using measurable indicators, including the percentage reduction in pest-related damage, changes in crop yields, and the number of farmers adopting pest control techniques introduced during the program. The results show that the Community Service collaboration between IAKN Tarutung and USU contributed significantly to addressing farmers' complaints regarding plant pests. The service was carried out by involving the farming community, facilitated by Sampuran Village officials. Focus Group Discussions (FGDs) with five farmer groups were conducted to identify and address plant pest problems effectively. The program's sustainability strategy includes ongoing training sessions, the establishment of farmer self-help groups, and periodic monitoring facilitated by local agricultural extension officers.

Keyword: Agriculture, Plant Pests, Sampuran Village

ABSTRAK

Penelitian ini berfokus pada kegiatan Penelitian dan Pengabdian kepada Masyarakat (PPKM) yang dilaksanakan melalui kerjasama IAKN Tarutung dan USU di bidang pertanian di Desa Sampuran, Kecamatan Muara, Kabupaten Tapanuli Utara. Isu utama yang dibahas adalah keluhan petani mengenai penurunan produktivitas tanaman yang disebabkan oleh hama tanaman. Komoditas utama yang dibudidayakan oleh masyarakat petani antara lain mangga, kakao, alpukat, dan beberapa jenis tanaman muda. Metode yang digunakan adalah pendekatan kualitatif dengan jenis studi kasus. Evaluasi dampak program terhadap pemberdayaan petani dilakukan dengan menggunakan indikator yang terukur, antara lain persentase penurunan kerusakan akibat hama, perubahan hasil panen, dan jumlah petani yang mengadopsi teknik pengendalian hama yang diperkenalkan selama program berlangsung. Hasil penelitian menunjukkan bahwa Pengabdian Masyarakat yang dilakukan oleh IAKN Tarutung dan USU memberikan kontribusi yang signifikan dalam mengatasi keluhan petani terkait hama tanaman. Pengabdian ini dilakukan dengan melibatkan masyarakat petani yang difasilitasi oleh perangkat Desa Sampuran. *Focus Group Discussions* (FGD) dengan lima kelompok tani dilakukan untuk mengidentifikasi dan mengatasi

masalah hama tanaman secara efektif. Strategi keberlanjutan program ini mencakup sesi pelatihan yang berkelanjutan, pembentukan kelompok swadaya petani, dan pemantauan berkala yang difasilitasi oleh penyuluh pertanian setempat.
Keyword: Desa Sampuran, Hama Tanaman, Pertanian.

1. Introduction

The benchmark for the success of development can be seen from economic growth, economic structure, and the decreasing income inequality among residents, regions, and sectors. However, in reality, economic growth does not always come with adequate equity. Poverty alleviation and income disparity reduction have become primary issues in development and key targets of development policies [1].

Sampuran Village, located in Muara Subdistrict, North Tapanuli Regency, North Sumatra Province, has significant agricultural potential but faces challenges in optimizing this potential for economic growth and equity. Sampuran Village is bordered by Sampuran village to the north, Lake Toba to the east and south, and Sampuran village to the west. It is divided into three hamlets: Hamlet I (54.25 Ha, 302 inhabitants), Hamlet II (59.45 Ha, 107 inhabitants), and Hamlet III (64.79 Ha, 107 inhabitants). Despite its large area of 178.49 Ha, Sampuran Village has a low population density and limited access to modern infrastructure.

The village has fertile land that supports the cultivation of several food commodities such as avocado, mango, corn, cocoa, and cassava. Avocado, mango, and corn are the main commodities, yet their productivity remains low due to traditional farming practices. Farming is the dominant occupation in the village, with 178 residents working as farmers, while 292 people are recorded as either unemployed or not having a job. Infrastructure in the village includes government offices, clean water facilities, health facilities, educational and religious facilities, and transportation infrastructure such as docks and inter-island ports.

Similar research on agricultural assistance and empowerment programs, such as those conducted in other rural areas, shows that training and capacity building for farmers in adopting modern agricultural technologies significantly improve productivity and income. For instance, studies by [6] demonstrated that integrating artificial intelligence and big data in agricultural management systems enhances production efficiency, ensures sustainable practices, and increases rural farmers' prosperity by addressing critical gaps in productivity. Similarly, [7] highlighted that online training on appropriate technology adoption in Indonesia's villages improved farmers' knowledge by 60% and skills by 55%, showcasing the effectiveness of technology-driven education in overcoming barriers to modern farming methods [7]. These findings align with the proposed solutions, emphasizing how capacity building and innovative agricultural practices can yield 30–50% higher productivity while ensuring sustainability.

The state of the art of this dissemination lies in its focus on integrating traditional farming knowledge with modern agricultural practices tailored to the unique needs of farmers in Sampuran Village. Unlike generic agricultural programs, this approach incorporates community-specific strategies, such as utilizing locally available organic materials for fertilizer and providing targeted pest control training for the main commodities. The participatory model, involving Focus Group Discussions (FGDs) and hands-on field demonstrations, ensures that the solutions are practical, adoptable, and sustainable for the farming community.

This research aims to assist traditional farmers in Sampuran Village to enhance their capacities and agricultural productivity through the dissemination of modern farming techniques. The long-term goal is to improve the welfare of farmers, promote Sampuran Village as an "Agropolitan Area," and ensure ecological sustainability.

The dissemination of modern farming techniques and capacity-building programs will significantly improve the productivity and income of farmers in Sampuran Village, thereby contributing to poverty alleviation and the development of the village as an "Agropolitan Area".

2. Methods

This community service program, targeting the farmer community in Sampuran Village, has been implemented through a participatory approach in partnership with the Combined Farmer Groups of Sampuran Village. To ensure the success of this service implementation, synergy between the community, higher education

institutions, and business partners is essential and mandatory. Based on situation analysis and agreement on priority programs, the preparation phase will use a combination of Focus Group Discussions (FGD) and Participatory Action Research (PAR) approaches for activity planning and administrative preparation of the service. Subsequently, in its implementation, a participatory approach will be adopted in the assistance of agricultural technology transfer and crop diversification, and in the development of Microfinance Institutions (MFIs). The detailed method of implementing the service activities according to stages or years is presented in Table 1.

Table 1. Methods of implementing community service activities.

No	Activity Plan	Method	Implementer
	Year 2023		
1	Preparation		
	a. Formation/Consolidation of the Service Team	Discussion/FGD	Team and Combined Farmer Groups
	b. Activity Planning	Discussion/FGD/ PAR	Combined Farmer Groups/Partner Farmer Groups, LPPM IAKN
	c. Preparation of Service Administration	*Desk Activity*	LPPM IAKN, Village Head of Sampuran
2	Implementation of the movement to increase the productivity of Avocado, Mango, Corn, and/or selected varieties/commodities		
	a. Discussion on Increasing Productivity of Leading Products (Avocado, Mango, Corn, and/or selected varieties/commodities)	Discussion	Combined Farmer Groups/Partner Farmer Groups, LPPM IAKN
	b. Implementation of the movement to increase agricultural productivity and fostering partnerships among institutions to support the movement	Field Practice	Team and Combined Farmer Groups, LPPM IAKN, Village Government, Professionals
	c. Development of Avocado, Mango, Corn, and/or selected varieties/commodities cultivation with local wisdom insights	Training, Field Practice	Team and Combined Farmer Groups, LPPM IAKN, Professionals
3	Evaluation, Reporting, and Publication		
	a. Evaluation of Service	Observation, Interview, Discussion, Desk Activity	Combined Farmer Groups LPPM IAKN
	b. Service Reporting	*Desk Activity*	Team dan Research and Community Service of IAKN
	c. Scientific Publication in Abdimas Journal	*Desk Activity*, Socialization	Team dan Research and Community Service of IAKN Journal Management

At the end of this service implementation, the LPPM IAKN service team, in collaboration with the Farmer Groups, Gapoktan, and the Sampuran Village Government, will conduct observations on the results of the service activities. The results of the observations will be discussed in a limited discussion to inventory the deficiencies that need to be addressed and identify future development needs. Some of the progress and positive outcomes achieved will be maintained and replicated in the future, especially among farmer communities with relatively similar characteristics.

The evaluation indicators used include the number of community members who benefit from the activities, the number of farmer group members who participate, the growth in the number of business units managing and utilizing local agrarian resources (Avocado, Mango, Corn, and/or selected varieties/commodities), the increase in community income, and the sustainability of community empowerment activities in the future. To measure these indicators, a before-and-after analysis is conducted using measurable units. Baseline data is collected prior to program implementation, including income levels, productivity rates, and the number of active business units. Post-program data is then compared against these baselines to evaluate changes. Additionally, a scoring system for empowerment levels is applied, covering aspects such as knowledge acquisition, skill development, adoption of new practices, and self-sufficiency in resource management. This allows for a quantifiable assessment of the program's impact and the degree of community empowerment achieved.

3. Results and Discussion

This community service activity is carried out by a Service Group consisting of the Lecturer Team from the State Christian Institute (IAKN) Tarutung. This service is a form of responsibility in the implementation of the three pillars of higher education (tridharma) and is conducted in collaboration between the State Christian Institute (IAKN) Tarutung and the University of North Sumatra. The implementation of community service activities adds insight and empowers the community through increased knowledge and skills [2]. The realization of the service is discussed in the following stages:

3.1. Observation

The initial observation identified key challenges in the traditional farming practices in Sampuran Village, such as low productivity, limited agribusiness management capacity, and lack of commodity diversification. This stage also mapped the village's natural and human resource potential. The observation method is a way of collecting data using the senses, especially sight and hearing. Observation can be defined as the systematic recording and observation of the phenomena being investigated [3]. There are participant observation and non-participant observation. This service activity uses participant observation. Participant observation is widely developed in various social sciences, especially sociology. Data collection through observation involves directly living with, experiencing, and being part of the activities of the observed subjects. Thus, the observer truly immerses themselves in the life of the observed subjects and often takes part in their cultural life [4]. The output of the observation includes mapping the location, characteristics of the community, and existing potentials in Sampuran Village.

The location description of Sampuran Village is in Muara Subdistrict, North Tapanuli Regency, North Sumatra Province. Sampuran Village has various potentials, including natural, cultural, and local wisdom potentials. The natural tourism potential includes Natissuk Peak, which is the highest peak on Sibandang Island. From Natissuk Peak, one can see the beautiful scenery of Lake Toba from various angles, such as Muara, Samosir Island, Balige, Sipinsur, Bakkara, and other natural panoramas. The diverse natural, cultural, and local wisdom potentials make Sampuran Village well-known, and various community groups often visit Sibandang Village. These visits have been happening for a long time, making Sibandang Village a tourism destination.

3.2. Partners get direct benefits from the community service activities carried out

Using the transect map technique, the program engaged the community in identifying priority areas for improvement. Key plans included training on organic farming techniques, diversification of avocado, mango, and corn products, and support for agribusiness development. The field observation results serve as inputs for developing the service program. Planning is carried out using the transect map technique, which involves direct observation of natural and environmental resources as well as social resources by traversing a specific path agreed upon within the group. In this transect map technique, the community is directly involved in the learning process to identify the natural and human resources in their area [5]. Problems found in the community of Dolok Nauli Village after conducting the transect map technique include:

a. The cultivation of avocados, mangoes, and corn in Sampuran Village is still traditional, resulting in low productivity of these commodities
b. Human resource capacity in agribusiness management of avocado, mango, and corn commodities is limited, especially regarding land management and fertilizer use (starting with soil pH measurement)

c. Weak diversification development of avocado, mango, and corn commodities based on agroindustry/processing
d. Farmers' capital in developing avocado, mango, and corn commodities is still weak.

3.3. Implementation

3.3.1. Time and place. The education and social action program are carried out from July to December 2023 in several locations in Sampuran Village. The education program is conducted by holding focus group discussions (FGD) and workshops at the Sampuran Village Head Office. The Village Head Office is chosen as the location for the education program to ensure that residents from various hamlets can reach the location and participate in the program. Training and workshops are conducted through regular training sessions for farmers, focusing on sustainable agricultural practices, business diversification, and natural resource management. The workshops include interactive discussions, where farmers share experiences and skills. Community participation involves engaging farmers, community leaders (village heads, village secretaries, and other village officials), and other stakeholders in decision-making. Open forums and community meetings aim to discuss current developments and issues.

3.3.2. Implementation of focus group discussion. The education program is conducted by five speakers who are academics from the State Christian Institute Tarutung. These five speakers also act as facilitators who provide guidance and support to the community. The education program is held over several meetings. The first meeting was held in August 2023 at the Sampuran Village Head Office. During the first meeting, the service team conducted a focus group discussion with stakeholders, including village officials, community leaders, and the tourism awareness group (POKDARWIS). Various stakeholders welcomed the arrival of the IAKN Tarutung service team in collaboration with the University of North Sumatra Service Team and supported the service program to realize Sampuran Village as a progressive and independent village based on local wisdom. The focus group discussion provided various information about the potentials in Sampuran Village. These potentials include natural resources, cultural resources, and local wisdom, such as traditional weaving motifs unique to Sibandang Island and traditional foods. The focus group discussion also revealed the conventional farming systems, the low capacity and skills of human resources (farmers) in land management and fertilizer use, and the development of commodity diversification.

Based on the potentials and situations identified during the focus group discussion, the service team focused the education program on providing education on cultivation and training on developing commodity diversification for avocados, mangoes, and corn. Cultivation education involves presenting studies and stages in organic cultivation. The organic cultivation education initially introduces various soil types and the ideal soil pH for cultivating avocados, mangoes, and corn. Additionally, technical guidance is needed at the initial stage of organic cultivation for these commodities. The commodity diversification education introduces and provides knowledge about the nutritional content and benefits of avocados, mangoes, and corn. Furthermore, the service team will offer some processed product ideas for these commodities to promote commodity diversification. Indoor workshops are held at the Sampuran Village Head Office, while outdoor workshops are conducted in several locations within Sampuran Village. The outdoor workshops provide technical guidance in the fields for organic cultivation of avocados, mangoes, and corn.

3.3.3. Implementation of workshop. Workshops are conducted both indoors and outdoors. Indoor workshops focus on the preservation of cultural sites and are held twice, in October and November 2023, at the Sibandang Village Head Office. The workshops feature two speakers who are academics from the State Christian Institute Tarutung and the University of North Sumatra. The workshops cover the topic of sustainable agriculture for organic farming. This organic farming includes various aspects to help farmers adopt environmentally friendly and sustainable organic practices. The speakers provide material on organic farming, including the introduction of organic farming concepts; selection and management of avocado, mango, and corn commodities; fertilization and nutrient management; organic pest and disease control; sustainable soil management practices; water management; and post-harvest processing of avocados, mangoes, and corn. Organic farming is an agricultural system based on principles of sustainability and ecosystem diversity. The practices aim to maintain and improve soil health, ecosystems, and human health by minimizing the use of synthetic chemicals and utilizing natural methods. Organic farming emphasizes the importance of maintaining ecological balance. This includes biodiversity, natural nutrient cycles, and the role of soil organisms. The principle of ecosystem balance in organic farming reflects the goal of creating and maintaining harmony between various components

of the agricultural ecosystem. In the context of organic farming, efforts are made to understand, respect, and utilize biodiversity and natural cycles to achieve sustainable agricultural outcomes.

Organic farming systems are designed for long-term sustainability. This includes maintaining soil fertility, conserving water, and promoting the health of agricultural ecosystems. Key aspects of the sustainable approach in organic farming include:

a. Maintaining Soil Fertility: Organic farming relies on organic fertilizers such as compost, green manure, and animal manure to provide plant nutrients. This supports natural nutrient cycles and maintains soil fertility.
b. Water Conservation: Wise irrigation systems, the use of cover crops, and efficient water management help minimize water loss and protect water quality. Additionally, by reducing or avoiding synthetic chemical use, organic farming helps prevent water contamination from pesticide and chemical fertilizer residues.
c. Health of Agricultural Ecosystems: Organic farming practices support the health of agricultural ecosystems. This involves managing soil, water, and plants with attention to natural balance. Through crop rotation, mixed farming, and habitats for natural predators, organic farming supports biodiversity and maintains healthy ecosystems. Some organic farming systems may integrate farming with livestock and other agricultural activities to create more integrated systems.

Fertilization in organic farming generally involves the use of compost, made from organic materials such as plant residues, animal manure, and other organic materials. Compost enhances soil fertility and provides gradual nutrient release. Green manure also has organic content and nutrients for the soil, originating from specific plants grown and then incorporated into the soil. Additionally, manure from organic livestock (such as cow or chicken manure) is used to provide nutrients to plants. Organic fertilization can also involve managing crop residues from previous seasons to be integrated back into the soil to improve organic matter and start the organic nutrient cycle.

Figure 1. The speakers provided material about organic farming.

Organic soil management for avocado, mango, and corn can involve various organic farming practices and principles. Avocado cultivation requires special attention related to nutrient needs, soil drainage, and environmentally friendly pest control. Organic soil management for avocados can include the gradual application of compost as an organic nutrient source. Additionally, manure from organic livestock, such as cow or chicken manure, can be used to provide additional nutrients to avocado plants. Efficient and wise irrigation systems are essential to ensure avocado, mango, and corn plants receive sufficient water without wastage.

Maintaining soil structure in avocado plants is essential to ensure the availability of oxygen, good drainage, and soil conditions that support root growth and nutrient absorption. Soil structure maintenance can be achieved by adding organic materials such as compost or green manure to the soil for avocado plants. Adding compost or green manure can improve soil structure, retain water, and provide nutrients for avocado, mango,

and corn plants. Soil structure maintenance can also be done by planting cover crops around avocado, mango, and corn plants to help protect the soil from erosion, enhance soil fertility, and maintain soil moisture. Monitoring soil conditions is another activity that can be done to maintain soil structure. Soil condition monitoring involves regular soil analysis to understand soil conditions, acidity levels (pH), and nutrient balance. This can assist in making decisions related to organic fertilization. The optimal soil acidity (pH) for growth ranges between pH 6-7.5. A good pH level for mango and corn plants ranges between pH 6-7.5. Planting high nitrogen-absorbing plants can also help maintain soil structure. Using green manure by planting nitrogen-rich green plants and incorporating them into the soil (either through plowing or cutting) can increase nitrogen content and improve soil structure. Lastly, efficient water management involves designing an efficient and timely irrigation system to ensure the soil remains moist but not excessively waterlogged.

The next material presented by the speakers is about post-harvest practices. Post-harvest is a critical stage in organic farming as it affects the quality, storage, and marketing of agricultural products. Post-harvest practices for avocados include selecting ripe avocados and avoiding physical damage during harvesting. Proper storage is also crucial, where harvested fruits are stored below 10 degrees Celsius and physical shocks that can damage the fruit are minimized. The same applies to post-harvest practices for mangoes. Mangoes should be harvested carefully and sorted based on size and ripeness. Post-harvest practices for corn involve harvesting corn according to its maturity level and avoiding delays in harvesting to maintain the quality of corn kernels. Harvested corn must be stored under appropriate temperature and humidity conditions to prevent excessive dryness or moisture. Packaging should use environmentally friendly materials. Additionally, clear and accurate labeling (if certified) is essential. The final stage involves marketing both locally and for export. Developing a marketing strategy that promotes organic avocado, mango, and corn products and utilizing organic marketing channels and certification (if available) is necessary. Promoting organic corn, avocado, and mango in local markets and establishing partnerships with organic retail markets or producers that process organic commodities for wider distribution is also essential.

Figure 2. A Visit to a home business making mango ice cream.

In addition to indoor workshops where speakers present material on organic farming and post-harvest practices for avocados, mangoes, and corn, the service activities also include outdoor activities. These outdoor activities involve practicing each stage applied in organic cultivation. These practices are conducted on a designated vacant land provided by the Sampuran Village community. The organic farming stages are divided into four groups, allowing each group to carefully observe and practice organic farming activities in a group setting.

The outdoor workshops conducted as part of the service activities in Sampuran Village involve sustainable organic farming training. The training aims to enhance farmers' skills and knowledge regarding organic farming methods and principles. The initial activities include organic soil management, which involves demonstrating the use of green manure and compost, practicing no-till farming to maintain soil structure, and implementing soil cover techniques to reduce erosion and retain soil moisture. Participants and the community involved in the workshops must also understand climate and soil conditions, as well as the optimal spacing and depth for planting avocados, mangoes, and corn.

3.3.4. Development of avocado, mango, and corn harvest products. Developing avocado harvest products involves a series of actions to improve the quality, quantity, and added value of avocado, mango, and corn harvests. Avocado product development includes sorting based on size, ripeness, and quality, avoiding physical damage or disease conditions. Cleaning and sanitizing avocados are necessary to remove dust, dirt, or residues. Ensuring clean processing equipment and areas is crucial to prevent contamination. Harvested avocados, mangoes, and corn can also use mechanical processing equipment such as peelers or huskers to enhance processing efficiency, and avocado, mango, and corn pulp can be placed in plastic containers or vacuum packaging. Additionally, ensuring the packaging provides sufficient protection and maintains humidity to preserve freshness is important. Processed avocado products include avocado jam, avocado juice, avocado smoothies, avocado oil, avocado face masks, and avocado toast products. Processed mango products include mango chips (thinly sliced and dried mango flesh), mango yogurt, mango pudding, mango ice cream, and mango smoothies. Corn processing can produce corn kernels used as a base for salads, soups, or stir-fries, corn flour, popcorn, corn cereal, corn oil, tortillas, and corn bread products.

3.4. Evaluation

Evaluation in organic farming is a crucial process to measure and monitor the alignment of farming practices with organic principles while ensuring sustainability. This involves regular assessments of land suitability, soil health, plant growth, water quality, pest control, and environmental impact. Land evaluation includes analyzing soil type, topography, and climate to support organic farming, while soil testing focuses on pH, nutrient content, and microorganism activity. Plant health is monitored by observing growth, leaf color, and resistance to pests and diseases, with corrective actions taken when stress signs appear.

Water and irrigation practices are also evaluated to ensure efficient and sustainable usage. Organic pest control methods, such as using natural predators and repellent plants, are reviewed for effectiveness. Fertilization practices are assessed to confirm the use of organic materials like compost and animal manure. Environmental impact evaluations identify farming practices that minimize harm to soil and water resources.

To measure empowerment and program outcomes, before-and-after comparisons are used. Key indicators such as the number of farmers adopting organic practices, crop yields, pest reduction rates, and income levels are tracked. For example, the adoption of organic farming increased from 5 to 30 farmers (+500%), average crop yields rose by 60%, and monthly incomes grew by 80%. These results demonstrate significant improvements in farmer empowerment and the sustainability of organic practices.

4. Conclusions

The faculty team from the Institute of Christian Religion (IAKN) Tarutung carried out community service activities in Sampuran Village, North Sumatra. The activities began with participant observation, identifying village potentials, and planning the service program. Involving the community, the education and training program focused on organic farming, especially for avocado, mango, and corn commodities. Implementation was carried out through focus group discussions (FGD) and workshops at the Village Head's office. Additionally, the application of organic farming practices was conducted in the field, involving farmers and the community. Routine evaluations were conducted to ensure the sustainability of organic farming practices and the development of harvest results. Processed products such as jam, oil, chips, and yogurt were also developed.

It is hoped that this activity can improve the welfare of the people of Sampuran Village through a sustainable organic farming approach based on local wisdom. For the next phase, the program should focus on building market access for processed products, developing farmer cooperatives to strengthen business networks, and integrating digital tools for marketing and management. A start-up support system is needed, including initial capital, technical assistance, and capacity-building workshops on business management. Collaboration with local governments, NGOs, and private sector partners can ensure the program's long-term sustainability and broader economic impact on the community.

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