Empowering the Community of Dimembe Village Through the Application of Cultivation and Diversification Technology of Papaya Fruit Plants

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Abstract. Dimembe Village has been famous for a long time as a centre for export quality papaya production. However, last few years papaya has papaya prices have decreased. Farmers choose not to pick papaya fruit in the garden because the cost of picking and loading is not comparable to the selling price. Priority problems experienced by most farmer groups in this village are: nursery, planting, fertilizing, and maintenance technology are still conventional; also variations in post-harvest product diversification are still lacking. To answer these problems, the community service program, Program Pemberdayaan Masyarakat Unggulan Perguruan Tinggi (PPMUPT) scheme has been carried out in 2019 (the first year, from a three year plan). The method of conducting the activities includes technology dissemination, training, application, and mentoring for papaya cultivation and diversification. The application of science and technology of cultivation includes, land management, seed and plant preparation, fertilizing, and maintaining, while diversification includes making fruit chips using a vacuum frying machine. The implementation of PPMUPT in the first year had a positive impact on the farming community in the form of increased knowledge, attitudes, and skills in the cultivation and diversification of fruit crops.

1. Introduction

Dimembe Village is one of the eleven villages in Dimembe Subdistrict, North Minahasa Regency, North Sulawesi Province (figure 1). This village is also the capital of the subdistrict and has an area of 7.88 km², 6.42% of the area of the subdistrict. Based on 2018 data, the population of Dimembe Village is 2,478 people, with details: 1,243 men and 1235 women [1]. In general, Dimembe Subdistrict is known as a centre for fruit production. Based on 2016 data, this subdistrict produces fruits, such as papaya (production ranks first with a total production of 289 tons), langsat / duku (216 tons), durian (130 tons), watermelons (51 tons), bananas (45 tons ), rambutan (32 tons), avocado (30 tons), mangoes (16 tons), soursop (7 tons), pomelo / grapefruit (6 tons), breadfruit (3 tons), mangosteen (3 tons), pineapple (2 tons), and rose apple (1 ton) [2].
Figure 1. A series of google satellite scene maps (A to D) and BPS map [2], illustrating the location of Dimembe Village in the hierarchical spatial order of A) the Republic of Indonesia; B) Sulawesi Utara Province; C) Minahasa Utara Regency; D) Dimembe Subdistrict; and E) BPS map of Dimembe Subdistrict (Dimembe Village is marked with a black square).

Dimembe Subdistrict has long been recorded as the largest producer of papaya in North Minahasa Regency, although the data annually show fluctuating values [3]. One of the villages producing papaya in Dimembe Subdistrict is Dimembe Village. Papaya produced in Dimembe Subdistrict is papaya with export quality. However, since the beginning of 2016, papaya fruit prices have been in free fall, experiencing a decline of up to 20% of the initial price. The price of papaya produced in this district dropped dramatically due to overproduction. Thus, farmers choose not to pick papaya in the garden because the cost of picking and loading is not proportional to the selling price [4]. Various domino effects appear, such as: papaya gardens left without maintenance (figure 2 A); fertilization and control of plant-disturbing organisms are no longer carried out due to lack of operational costs; and even if it is harvested to meet the needs of the potluck, papaya is directly sold to collectors at a lower price or passively sold on the edge of the main road waiting for consumers who stop to buy (figure 2 B).

The community service team in the management of Lembaga Penelitian dan Pengabdian Masyarakat (LPPM, Institute of Research and Community Service), Universitas Negeri Manado (UNIMA) was called to provide solutions to the problems faced by papaya farmers. With the support of community service grants through Program Pemberdayaan Masyarakat Unggulan Perguruan Tinggi (PPMUPT, Flagship College Community Empowerment Program) scheme, the team intervened to empower the community through various actions such as dissemination of technology products according to the needs of papaya farmers, mentoring the application of fruit cultivation technology, and assisting in the application of technology fruit products diversification (facilitation of vacuum frying machines for processing fruit into fruit chips). This article aims to describe the efforts of community empowerment carried out in Dimembe Village so that the knowledge, attitudes, and skills related to the cultivation and diversification of papaya fruit change in a positive direction.
Figure 2. Facts and problems faced by Dimembe Village community: A) unproductive, dwarf, non-uniform growing trees, and some trees that grow are female trees, as a consequence of suboptimal handling; and B) minimal production results, also sold passively on the roadside waiting for buyers to stop by, without the support of appropriate diversification.

2. Methods of implementation

2.1. Parties involved in the activity

The parties involved in the activity are the implementation team, village community partners (Kharisma Farmers Group with 25 members, and Dimembe Farmers Group with ten members), village government, Kuliah Kerja Nyata (KKN, Student Study Service) students, and leaders and staff of LPPM UNIMA. The Implementation Team contributes to the application of competencies and research results. Both groups of partners contributed to the provision of field labor and the land to be used. The village government contributes to the preparation of buildings and infrastructure that will be used in training and mentoring activities, as well as repairing village roads using village funds that connect the main road to the planting site. Furthermore, the leadership and staff of LPPM UNIMA contribute to coordinating, monitoring, and evaluating the implementation of activities, as well as providing assistance funds.

2.2. Methods and stages of activity

The methods and stages in the PPMUPT activities include: 1) hearings with village government and socialization with community group partners; 2) dissemination of fruit cultivation technology; 3) assistance in the application of cultivation technology; 4) dissemination of post-harvest product diversification technology; and 5) assistance in the application of diversification technology.

2.3. The technologies applied as a solution to the problems faced by the village community

2.3.1. The technology of fruit crops cultivation. The series of processes in the application of papaya fruit cultivation technology includes land preparation (cleaning, making planting holes, and fencing), preparing and planting seeds, and fertilizing and maintaining [5-8].

2.3.2. The technology of fruit crops postharvest products diversification. There are many variants
of postharvest products that can be created from papaya fruit plants [9-11], but the focus of PPMUPT activities in the first year is fruit chips. Papaya fruit chips are made through vacuum frying technique [12]. Facilitation of a vacuum frying machine was carried out for the group partners. The working principle of vacuum frying machine is the same as ordinary frying, but there is an additional vacuum device that works to make a closed frying tube into a vacuum. The steam that is formed from water molecules in fruit flesh that experiences temperature increase during the frying process will be sucked out of the frying tube into the condensate tube. Healthy frying using vegetable oil will only boil when the temperature reaches around 80 °C, differ with vacuum frying, which only requires 60 °C. Various nutrients contained in fruits will remain in its chips when the frying process takes place at a low boiling point. The resulting product is also guaranteed quality both in terms of visible (colour, taste, and aroma of fruit remain attached) or invisible characteristics (health and safety of product) because there is no addition of preservatives, colourings, and other food additives in the manufacturing process.

3. Results of the implementation of activities

3.1. Application of fruit cultivation technology

The application of fruit cultivation technology was carried out through several sub-activities including cleaning and preparing the land, making planting holes for papaya plants, fencing the location of planting using live fences, making solid organic fertilizer, and seedling (figure 3). These sub-activities are carried out jointly by farmer group partners and KKN students, accompanied by an implementation team.

3.1.1. Land preparation, the making of planting holes, and fencing. The initial stage of the application of fruit cultivation technology is land preparation. The former papaya cultivation land which has been left dormant is cleared again by cutting the growing weeds, as well as the old papaya trees that are getting taller. Next, a cube-shaped planting hole is made with the size of each side is 50 cm. The hole is left open for two weeks, then closed again with the former excavated soil that has been mixed with solid organic fertilizer. Finally, the location of the planting area is surrounded by Uwi Banggai (Dioscorea alata) which is supported by bamboo slits as a place for the stems and leaves of this yam to spread.

3.1.2. Making organic fertilizer. Organic fertilizer is made by mixing manure from laying hens, coarse rice bran, and ash from the burning of leaves and twigs collected from around the papaya planting location, with the same weight ratio, for these three ingredients. The mixture of the three solid materials is spread on the concrete floor and watered with a mixture of effective liquid microorganisms 4 (EM4). A mixture of liquid EM4 is made by adding 1 litre of EM4 and 2 kg of sugar to 50 litres of water; this volume recipe can be used to water a 300 kg solid mixture. The mixture of fertilizers is then covered with plastic and left for two weeks to undergo the fermentation process.

3.1.3. Seeding papaya plants. While preparing the land, papaya seeding plants are also carried out. The seeds used are Bangkok (two types, domestic and foreign products) and California (domestic products) variants. Papaya seedlings are initially soaked for two days in the water with lukewarm temperatures, soaking water is replaced every day. After that, each papaya seedling (Bangkok and California) was placed in a porous container that had been coated with tissue paper, then the top is covered again with tissue paper and moistened with water. Seeding on tissue paper is left for two weeks, while the humidity is maintained every day. After two weeks, the seedlings that have been germinated are transferred to a small polybag that contains growing media in the form of a mixture of soil, manure, and rice husk with the same ratio based on volume.
3.2. Application of post-harvest product diversification technology

The application of diversification technology through PPMUPT activities in the first year is only focused on making fruit chips. In the PPMUPT implementation location, before the activity was carried out there were already fruits that grew, such as avocados, duku, durian, coconut langsat, mango, jackfruit, pineapple, papaya, nutmeg, rambutan, and soursop. When the harvest season arrives, some of these fruits are sold passively on the side of the road; some are consumed by themselves or given as souvenirs to families from other areas who come to visit. With situations and conditions like this, sometimes it causes an imbalance between production and consumption. Generally, the level of production is higher than consumption, so fruits suffer damage, especially when postharvest handling is not optimal.
Figure 4. The series of processes in the application of diversification technology in the form of making papaya chips: A) the initial processing of papaya fruit; B) frying of papaya fruit in vacuum frying; C) draining oil in chips using a spinner, and D) weighing and packing papaya chips.

The use of a vacuum frying machine can be a postharvest handling solution so that no fruit is left to rot. The results of a survey conducted before the implementation of this diversification technology took place; it was found that fruits commonly used as chips were apples, dragon fruit, duku, durian, coconut, mango, jackfruit, pineapple, rambutan, salak, watermelon, and soursop. The fruits found in the PPMUPT implementation location, which have never been found on the market
in the form of chips are avocados, papayas, nutmeg, and langsat. These fruits have good prospects if they are made into chips because they are considered unique and have not been found on the market. Some references are found related to making papaya chips without using vacuum frying [13-14], there are also references to making papaya chips using vacuum frying, but there is a pretreatment beforehand [15], all of them certainly have their respective characteristics.

Community empowerment through the application of diversification technology begins with the assembly of a vacuum frying machine conducted by KKN students according to the manufacturer's manual while being observed by several members of the partner group. At this stage, the skills of KKN students undergo testing; the community also receives a transfer of new and unique knowledge and technology. After the machine was adequately assembled, several members of the partner group tested the use of this machine by directly practicing the making of fruit chips (figure 4), which began with fruit preparation (skin stripping, cutting/slicing, washing, and water draining), initial weighing, frying, draining the oil using a spinner, final weighing, and packaging. Each stage is followed by group members enthusiastically without wanting to miss the transfer of knowledge and skills in making fruit chips. After obtaining the results in the form of fruit chips, the next step which is temporarily taken by the implementation team is the distribution permit.

3.3. Lesson learned

Through this first-year PPMUPT activities, there has been an increase in the number of partner village communities who understand and are skilled in mastering papaya cultivation technology and papaya fruit diversification technology. People who initially only capitalized on traditional knowledge and hereditary in cultivating papaya plants have now mastered the knowledge and skills of cultivation technology that can optimize fruit products. Before this activity took place, processed products as a form of diversification of postharvest products of papaya were only in the form of desserts such as salad and pickles (better known as gohu). With this activity, the processed product variant increases because it produces fruit chips. It is not only community knowledge and skills that are increasing, but also attitudes in the form of building creative and innovative characters in utilizing fruit products as a supplementary source of nutrition and economic income for the family. Papaya fruit chips are still rare, especially in North Sulawesi. This condition raises its own interest for the community in processing the post-harvest yield of papaya plants.

Approach to the application of appropriate cultivation technology as a form of community empowerment through this activity was successfully held and added to the list of empowerment activities which were successfully carried out by the community service team guided by LPPM UNIMA. Previously, the application of appropriate technology for agricultural cultivation of food crops that had been held by the implementation team was soybean [16], vegetables [17], field rice [18], corn [19], and taro [20] cultivation. The achievement of the implementation of community empowerment activities cannot be separated from the compatibility between the technology applied and the problems faced by the community, of course, by considering the characteristics of the community itself. Each region has its own characteristics that should be taken into account so that the transfer of technology to overcome problems can take place correctly.

4. Conclusions

The first year PPMUPT activities that have been carried out in Dimembe Village in the form of the application of cultivation and diversification technology have succeeded in increasing the knowledge, attitudes and skills of the community members of the partner groups. This positive impact has other derivative impacts, mainly related to the increase in economic income for the family of fruit farmers. For the next funding year, the application of cultivation technology will be further optimized by considering the constraints faced in the first year, while for diversification there will be more variants of postharvest products of fruit crops.
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