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Developing Sacha Inchi Cultivation in Tabongo Timur Village: An Empowerment Strategy for Food Security and Economic Improvement

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ABSTRACT

Tabongo Timur Village, located in the Tabongo Subdistrict, Gorontalo Regency, has significant potential for developing Sacha Inchi as a leading commodity to support food security and enhance the local economy. This empowerment program aims to increase the productivity and quality of Sacha Inchi plants through social, technical, and technological interventions. The program employs the Participatory Rural Appraisal (PRA) approach to actively engage the community in the planning and implementation processes. The methods used include cultivation socialization, technical guidance, product innovation training, and technology implementation for post-harvest processing. The results of the program showed a significant increase in plant productivity and the quality of Sacha Inchi products, achieved through the application of semi-organic cultivation techniques, the use of modern tools, and education related to product innovation. The training provided also improved partners' skills in processing Sacha Inchi into high-value products, such as oil, milk, jam, and snack bars. The discussion shows that this program successfully shifted farmers' mindsets towards better utilization of local potential and strengthened community involvement in productive agricultural activities. Collaboration between the village government, university, and farmer groups was key to the program's success, making Tabongo Timur Village a competitive Sacha Inchi processing center. This program can serve as a model for other villages in empowering local resources to support food security and improve community welfare.

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INTRODUCTION

Food self-sufficiency is a critical issue faced by many rural communities in Indonesia. Tabongo Timur Village, located in the Tabongo Subdistrict, Gorontalo Regency, is striving to enhance food self-sufficiency by utilizing its local potential. The main commodities of this village, such as coconut, rice, and corn, dominate the local agricultural sector and must be maintained to support food security. According to Hanafie (2018), strategies for achieving food security include empowering the community, developing agribusiness systems and enterprises, and fostering synergy between the community as key actors and the government as a facilitator. These efforts aim to strengthen household-level food security, effectively manage food production, and channel surplus production for fair economic value. One of the promising agricultural commodities being developed in Tabongo Timur Village is the Sacha Inchi plant (Plukenetia volubilis L.), also known as Inca peanut or star nut. Sacha Inchi is a member of the Euphorbiaceae family originating from the Amazon region of South America, growing at altitudes between 200 and 1500 meters. Over the past five years, this plant has been cultivated in Indonesia after being successfully grown in countries such as China, Vietnam, Malaysia, and Thailand. Morphologically, the Sacha Inchi fruit has a star shape, containing 4-5 seeds inside, and is highly nutritious, containing 25-27% protein, 41-54% oil (mainly unsaturated fatty acids), and is rich in vitamins E and A (Wang et al., 2018). Sacha Inchi seeds contain omega-3, an essential fatty acid that plays a crucial role in the body, particularly in anti-inflammatory functions and maintaining cell membrane integrity (Pratiwy & Pratiwi, 2021). In addition to its health benefits, Sacha Inchi oil also holds high economic value, being used in both food products and the cosmetics industry as a moisturizer and skin brightener. This economic value is one of the main reasons for promoting Sacha Inchi as a leading commodity in Tabongo Timur Village.

FIGURE 1. Sacha Inchi seeds

Sacha Inchi was first introduced to Tabongo Timur Village in 2021, but initially, it was not cultivated seriously. Since 2023, Gorontalo State University, through the MBKM Community Service Program, followed by the Village Empowerment Program (PDB) in 2024, has intervened to optimize the cultivation of Sacha Inchi. This empowerment program aims to change the mindset of farmers who previously relied only on corn and to provide education on the potential of cultivating Sacha Inchi, which is relatively easy and has high economic value. The intervention lasted for eight months and included activities such as socialization, technical guidance, training, and technology implementation from upstream to downstream. The focus of these activities was on production aspects, social community management, and marketing.

METHODS

This assistance program employed the Participatory Rural Appraisal (PRA) approach, a participatory method that involves the community as active partners in gathering information, planning, and making decisions related to rural development. This community service program focuses on empowering the assisted village, located in Tabongo Timur Village, Gorontalo Regency. The primary targets of the program

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are members of the Village-Owned Enterprises (Bumdes), totaling 25 people, and the Hutakiki Jaya Farmers Group, consisting of 20 members.

Partners played an essential role in supporting the implementation of the activities, including providing space, land, and raw materials needed for the cultivation and post-harvest processing of Sacha Inchi. Active participation from partners was crucial for the program's success. Members of Bumdes Sinar Usaha and the Hutakiki Jaya Farmers Group were directly involved in every stage of the activities, ranging from surveys, socialization, training, to technology implementation.

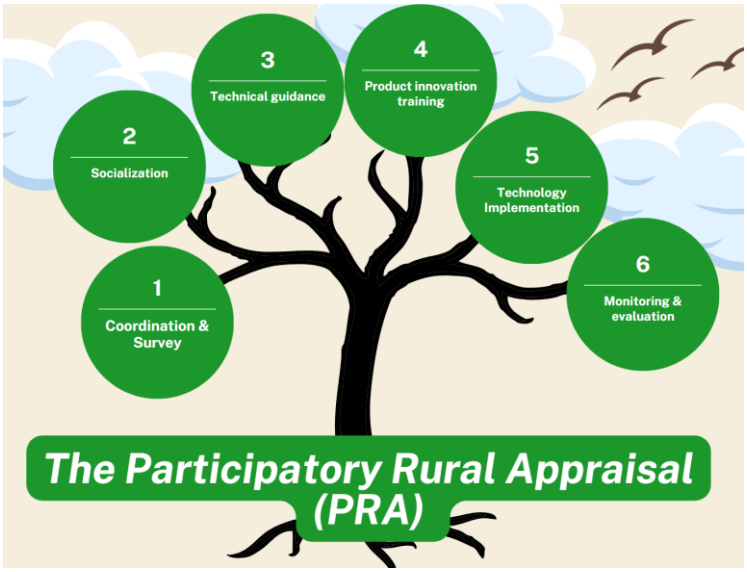

FIGURE 1. Flowchart of method

1. Coordination and Survey Stage

   In this stage, coordination was carried out with partners and the Tabongo Timur Village government regarding the planned empowerment program. Preparations included determining the location, socialization, training, scheduling activities, and preparing raw materials and production equipment. Data collection on Sacha Inchi plants was conducted through surveys and interviews to gather information related to the cultivated area, growth conditions, and other factors affecting the plant's yield. Students participating in KKN (community service program) assisted in data collection and inventorying land conditions as well as local farming practices.

2. Socialization Stage

   Socialization was conducted to improve the community's knowledge of Sacha Inchi cultivation. Over eight months, partners were given education on cultivation techniques, from seedling production to planting and maintenance. In addition, socialization with Bumdes members included training on processing Sacha Inchi-based products such as oil, milk, jam, and other processed products. The goal was to enhance the partners' skills in developing high-value products.

3. Technical Guidance for Sacha Inchi Cultivation Stage

   In this stage, partners were trained in planting and maintaining Sacha Inchi to increase productivity. Sacha Inchi seedlings were distributed to partners for planting, either in their home gardens or in central plantations.

4. Product Innovation Training Stage

   Product innovation training was provided to enhance the economic value of Sacha Inchi. Partners were taught how to process Sacha Inchi into various food products such as milk, jam, cakes, and snack bars. This training was conducted twice at the village hall, attended by Bumdes members, farmer group members, and members of the PKK (Family Welfare Program).

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5. Technology Implementation Stage

Technology to support the processing of Sacha Inchi was implemented by providing tools such as cultivators and oil processing equipment. Training on how to use these tools was conducted after handover, allowing partners to immediately practice their use. This technology was designed to increase production capacity and the quality of processed products.

6. Monitoring and Evaluation Stage

Monitoring and evaluation were carried out regularly through visits to partner fields and processing centers. Plant growth was monitored weekly, while the processing activities were evaluated based on productivity and product quality. Evaluation was conducted to ensure the program was progressing as planned and achieving its objectives.

RESULT AND DISCUSSION

Coordination and Survey

The results of coordination with the village government, Bumdes, and the Hutakiki Jaya farmers' group showed a strong commitment to enhancing the potential of Sacha Inchi cultivation in Tabongo Timur Village. Coordination activities and focus group discussions (FGD) resulted in agreements to collaborate on this empowerment program. The activity schedule, implementation locations, and number of participants for socialization, education, and training activities were meticulously arranged with the approval of all partners.

FIGURE 2. Survey of the Sacha Inchi Plants

Sacha inchi, also known as Plukenetia volubilis, is a plant native to South America, specifically the Amazon region (Yanti et al., 2022). This plant is renowned for its seeds, which are rich in omega-3 and omega-6 fatty acids, as well as protein and fiber, and have been utilized by indigenous peoples in the region as a source of food and traditional medicine (Joseph, 2023). The omega-3 fatty acids found in sacha inchi have also been linked to mental health benefits, such as reducing the risk of depression and anxiety (Cárdenas Sierra et al., 2021).

In addition to its health benefits, sacha inchi has garnered attention in the agro-industrial and environmental sectors. This plant thrives in tropical and subtropical areas, and its seeds are resistant to oxidation (Cárdenas Sierra et al., 2021; Goyal et al., 2022). It can also grow well in less fertile soils, and its cultivation can promote agricultural diversification and help alleviate pressure on natural resources (Khasanah, Nurani, et al., 2022). Consequently, the development of sacha inchi as a commercial crop has become an important topic in efforts to improve the economic well-being of local farmers and reduce deforestation in the Amazon region (Cárdenas Sierra et al., 2021).

Socialization of Sacha Inchi Cultivation

The Village Empowerment Program (PDB) program team conducted socialization on Sacha Inchi cultivation techniques, including seedling production, planting, and fertilization. In addition, the community was educated on the health benefits of Sacha Inchi, such as its omega-3 content and its potential uses in

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the food and cosmetics industries. Participant understanding was evaluated using questionnaires before and after the socialization, which showed a 90% increase in comprehension.

The sacha inchi plant can grow in various soil types, ranging from clay to sandy soils. It has distinctive features that set it apart from other plants (Kodahl & Sørensen, 2021), including:

- Sacha inchi seeds are lenticular in shape, measuring approximately 1.8 x 0.8 x 1.6 cm, with a hard, brown shell.
- The leaves are oval-shaped with pointed tips and smooth surfaces.
- The fruit is star-shaped, starting as green and fleshy, later turning brown, woody, and cracking open.
- It is a climbing plant that can grow to a height of 2-4 meters.
- The stem is brownish-green with shallow roots.

FIGURE 3. Sosialization Program

Technical Guidance and Cultivation Training

Technical guidance was provided over three weeks, including direct education during seed distribution, seedling production, and planting at partner locations. Cultivation was carried out using organic or semi-organic methods, emphasizing the use of natural fertilizers and environmentally friendly pesticides. The best Sacha Inchi seeds were selected based on the age of the parent plant, with careful treatment to ensure optimal germination rates.

Cultivation is carried out either organically or semi-organically, where factory-made fertilizers are allowed, but toxic chemical pesticides are prohibited. Seeds that are suitable for planting are those from parent trees that are at least three years old, as they have a better germination rate. The selected seeds should be sufficiently large, well-filled, and firm. Sacha Inchi seeds have a dormancy period or a "resting"

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phase for the embryo. To break this dormancy, there are two practical methods: soaking the seeds for two days in regular water or soaking them in warm water at 50°C and letting it cool for 24 hours. After that, drain them for 12 hours. The seeds are then soaked in a solution of 2% fungicide and 2% insecticide for 10 minutes or can also be soaked with red onion. The seeds are then transferred to growing media in polybags measuring 10x17 cm. The planting method is similar to planting germinated jengkol seeds, with the seed positioned upright, where one-third of the seed is embedded in the growing medium, while two-thirds remains visible. The growing medium should be a mixture of fertile soil and rice husk charcoal or cocopeat (shredded coconut husk), with a ratio of 2:1. Seedlings should be placed in a spot that is not too hot and watered every afternoon and after rainfall. Fertilization is done using NPK 16-16-16-0.2 fertilizer by dissolving 100 grams in 10 liters of water, then pouring it over 100 polybags every 20 days. Leaf spot disease control is carried out with the application of biological fungicides such as Trichoderma or Gliocladium, while pest control is performed using biological insecticides. After 45 days to two months, the seedlings are ready to be planted in the open field. The ideal soil type is mineral soil, such as black humus soil, red clay, yellow clay, yellow sandy soil, or black sandy soil. The optimal elevation for growth is between 600 and 1,500 meters above sea level, with annual rainfall ranging from 1,000 to 2,500 mm. The ideal temperature is between 0 and 36°C; if the temperature is too hot, the flowers will easily fall, and the fruits will not mature properly. At temperatures below 0°C, plant growth will slow.

Sacha Inchi requires full sunlight. If the plant is shaded, or if the leaves are too dense, fruit production will decrease.

The planting of Sacha Inchi is quite simple and similar to planting long beans, but without the need for ridging. The land should be cleared of weeds and then plowed until loose to a depth of 30 cm, and 500 kg of dolomite per hectare should be spread across the soil. Stakes are then installed to determine the planting distance, with a recommended spacing pattern of 2x3 meters, which results in approximately 1,666 planting points per hectare. However, in China, a planting distance of 1.5x1.5 meters has been proven to produce the highest yield of seeds and oil. Planting holes are made with a depth of 25 cm, and then 3 kg of mature dried manure is mixed with two-thirds of the excavated soil and placed into the holes. The seedlings are carefully planted, and 50 grams of TSP fertilizer is sprinkled around the base, with the soil compacted afterward. Water adequately after planting.

Installing support poles for the climbing vines is very important, as Sacha Inchi is a semi-perennial plant with an indefinite lifespan and can produce well for many years. If using concrete poles, they must be installed before planting; however, if funds are not available, wooden or bamboo stakes can be used and replaced when they decay. Strong supports are crucial for optimal fruit production.

Subsequent fertilization is performed when the plant is two months old by sprinkling 50 grams of NPK 16-16-16-0.2 evenly around the plant, at a distance of 15 cm from the stem to a radius of 40 cm. The next fertilization is done every two months with the same dosage, with the radius extended to 50 cm. Every six months, 3 kg of dry organic fertilizer and 50 grams of dolomite are applied, and complete microfertilizer is added if possible.

Pest and disease control is done according to the symptoms observed, similar to the seedling care stage. Watering is required in areas with low rainfall, and planting should ideally begin in early or mid-rainy season. Weed control should be carried out manually using tools such as rakes.

The plants usually start flowering at 3-4 months of age, with the first harvest taking place at 7-8 months when the fruit turns brown and splits at the base. The fruit is then dried for eight days before peeling, and the seeds are dried again for four days under adequate sunlight. The seeds can be roasted and eaten; if roasting, the seed coat should not be removed before roasting.

A Sacha Inchi plant typically yields 300-500 grams of seeds per tree in the first harvest, and up to 2 kg when it is three years old. This plant bears fruit year-round, with the first harvest followed by random

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flowering and monthly harvests. Peak harvest usually occurs during the rainy season, while smaller harvests occur during the dry season unless there is sufficient irrigation.

Sacha Inchi is a semi-perennial plant whose lifespan is not limited, but it can die due to pests, diseases, drought, and other external factors. Pruning is done annually to prevent the foliage from becoming too dense, which can reduce the number of flowers and fruit. Branches and twigs that are weak, small, damaged, or grow inward should be pruned.

Training in Product Innovation Based on Sacha Inchi

Sacha inchi is primarily composed of seeds, which offer various benefits, including its seeds, leaves, and even the shell. The seeds contain a high oil content, ranging from 35-60%, rich in linolenic and linoleic acids (Gutiérrez et al., 2011). Additionally, the seeds are one of the best plant-based protein sources, providing 25-30% protein, including essential and non-essential amino acids (Joseph, 2023). Essential amino acids found in sacha inchi seeds include leucine, tyrosine, isoleucine, lysine, and tryptophan (Mhd Rodzi & Lee, 2022), along with vitamin E, polyphenols, and minerals (Wang et al., 2018).

The leaves contain various bioactive compounds such as terpenoids, saponins, phenolics (flavonoids), and antioxidants, which can be used to make tea. Although the leaves have relatively low nutritional content, they show potential as herbal medicine alternatives (Mhd Rodzi & Lee, 2022).

The shell has higher levels of α-tocopherol than the seeds, though it contains the same amounts of omega-3 and omega-6 fatty acids (Wang et al., 2018). It is also rich in bioactive compounds such as tannins, phenolic acids, flavonoids, and lignans (Kittibunchakul et al., 2022).

Product innovation training was provided to enhance the economic value of Sacha Inchi by teaching partners how to process it into products such as milk, jam, cakes, and snack bars. This training was attended by Bumdes members, farmer group members, and PKK (Family Welfare Program) women, with questionnaire results indicating an 80% increase in participants' skills after the training. This demonstrates the success of the training in enhancing partners' capacity to produce high-value products

FIGURE 4. Sacha inchi product manufacturing training

Technology Implementation and Production Evaluation

The implementation of technology in Sacha Inchi cultivation included the use of tools such as cultivators and oil processing machines in accordance with *Good Manufacturing Practices* (GMP) standards. These technologies helped improve processing efficiency and product quality. The tools were handed over to the partners, and training on their use was conducted to ensure they could be utilized effectively.

Overall evaluation was conducted through regular visits to the farmers' fields and processing centers. Monitoring of plant growth was carried out weekly, while the processing activities were evaluated to ensure that production met the established targets. Productivity and product quality showed improvement, contributing to the establishment of Tabongo Timur Village as a competitive Sacha Inchi industrial center.

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FIGURE 5. Agricultural tool assistance and technology application

This empowerment program demonstrated that interventions at the technical, social, and technological levels could significantly enhance the productivity and quality of Sacha Inchi products. The socialization and training provided not only increased partners' knowledge and skills but also shifted farmers' mindsets toward optimizing the existing local potential. The implementation of processing technologies also played a crucial role in improving efficiency and product quality, which supports Tabongo Timur Village in becoming a sustainable industrial center.

Collaboration between the university, the village government, and farmers' groups was key to the program's success. The participatory approach (PRA) enabled the community to actively participate in every stage of the program, thereby fostering a sense of ownership of the activities. Thus, the success of this program could serve as a model for empowering other villages to optimize local resources for food security and economic improvement.

CONCLUSION

The empowerment program implemented in Tabongo Timur Village successfully enhanced the potential of Sacha Inchi as a leading local commodity. Through interventions in the form of coordination, socialization, training, technical guidance, and technology implementation, there was a significant increase in the productivity and quality of Sacha Inchi products. Strong commitment from the partners, combined with the application of the participatory approach (PRA) successfully increased community involvement at every stage of the program and fostered a sense of ownership over the efforts undertaken. The training in product innovation and Sacha Inchi processing successfully transformed this commodity into a high-value income source for the community, both in the food and cosmetics industries. The implementation of processing technology further improved production efficiency and product quality.

With increased capacity, product quality, and production efficiency, Tabongo Timur Village is now ready to become a competitive Sacha Inchi processing center, contributing to local food security and the economy. This program can serve as a model for other villages to develop their local resources for community welfare.

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APPENDIX

FIGURE 6. Technical guidance of sacha inchi cultivation

FIGURE 7. Sacha inchi product innovation

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