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Optimizing the Potential of Local Tubers of Banten Province (Xanthosoma undipes K. Koch) to Realize a Circular Green Economy in Baros Village, Serang, Banten

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Abstract
Beneng taro (*Xanthosoma undipes* K. Koch) is a local tuber crop from Banten Province with large yellow tubers and considerable potential as both a food and feed resource. However, its utilization remains limited, and by-products such as tuber skins are generally discarded as organic waste. This study aimed to optimize the utilization of Beneng taro and its by-products to support a circular green economy model in Baros Village, Serang Regency, Banten. The study employed a descriptive survey and participatory training approach involving 33 members of the "Setia Kawan" farmer group. Activities included surveys of farmers' knowledge regarding Beneng taro, training on processing Beneng taro into food products (chips and traditional dishes), and the utilization of taro skin waste as silage for ruminant livestock feed and as a substrate for maggot cultivation. The survey results showed that all respondents (100%) were initially unaware of the potential benefits of Beneng taro growing around their area. Following the program, farmer group members gained knowledge and practical skills in processing Beneng taro into food products and converting its by-products into silage feed. The integration between Beneng taro processing activities, silage production for ruminant livestock, and maggot cultivation demonstrates the potential to reduce organic waste while improving feed availability and creating new economic opportunities. These findings indicate that optimizing the utilization of Beneng taro can contribute to the development of a village-based circular green economy model.

INTRODUCTION

Beneng taro (*Xanthosoma undipes* K. Koch) is a local tuber originating from Banten Province that has recently gained attention as a potential export commodity. The plant is characterized by its large yellow tubers, which inspired its local name derived from the words *beuneur* (large or dense) and *koneng* (yellow). Beneng taro grows well in areas around Mount Karang in Pandeglang Regency (Susilawati, 2021). Despite its economic potential, many communities are still unfamiliar with this plant, and it is often considered a wild crop that grows naturally without significant utilization (Rusdiyana et al., 2025). This condition indicates that the potential of Beneng taro as a local commodity has not been optimally integrated into community-based food systems and agricultural development. Baros Village in Serang

Regency has a farmer group (poktan) called Setia Kawan that is pioneering a Joint Business Group (Kelompok Usaha Bersama/KUB) focusing on maggot cultivation to support livestock production. The group consists of farmers and livestock breeders who have been involved in agricultural and livestock activities since 2014. The background of establishing the Joint Business Group (Kelompok Usaha Bersama/KUB) by the Setia Kawan farmer group was the limited availability of quality feed for their livestock. Farmer group members generally relied on natural grasses collected from the surrounding area, with uncertain quality and quantity depending on seasonal availability. If this practice continues, it may negatively affect the productivity and health of the livestock, including both ruminants and poultry raised by the farmers. However, the maggot cultivation that has been developed as an alternative feed source has not yet been optimally managed due to limited knowledge of local feed resources and insufficient technical skills in maggot cultivation management. As a result, further improvements are needed so that the business pioneered by the farmer group can be sustained in the long term and contribute to meeting the daily feed requirements of livestock.

Another challenge faced by the community is organic waste management. Organic waste is generated daily from households and small-scale food processing activities, yet it is often not properly sorted or utilized. Improper waste management can lead to environmental problems such as unpleasant odors, groundwater contamination, flooding, and the growth of pathogenic microorganisms. Waste management has therefore become one of the government's priority programs, particularly in response to the global triple ecological crisis of climate change, biodiversity loss, and pollution (PPID, 2024). Data from the National Waste Management Information System indicate that waste generation in 368 cities and regencies in Indonesia reached 38.4 tons in 2023, with 14.8 tons remaining unmanaged (SIPSN, 2024). These conditions highlight the need to increase community awareness and introduce appropriate technologies for organic waste utilization.

In addition to households, organic waste can also originate from agro-industrial activities that process plant-based food products. One example is the micro, small, and medium enterprises (MSMEs) engaged in Beneng taro processing in Tanjung Kulon Village, Serang Regency. These processing activities mainly utilize the leaves and tuber flesh of Beneng taro, while other parts such as the tuber skin are often discarded as organic waste. . The by-products of Beneng taro processing by MSMEs in Tanjung Kulon Village, Serang Regency, provide a potential organic substrate for maggot feed. In this program, the Setia Kawan farmer group was encouraged to utilize these by-products while also being trained to process Beneng taro into food products. This integration supports organic waste utilization, strengthens maggot cultivation, and creates additional economic opportunities for farmer group members.

Based on these conditions, efforts are needed to optimize the utilization of Beneng taro not only as a food resource but also as part of an integrated system involving waste utilization and livestock production. Although several studies have reported the nutritional potential and food processing opportunities of Beneng taro, most of them focus primarily on product development or physicochemical characteristics of the tuber. Limited attention has been given to the integrated utilization of Beneng taro within community-based systems that combine food processing, livestock feed production, and organic waste management. Therefore, this study aims to optimize the utilization of Beneng taro and its by-products through community-based training and technology introduction for the Setia Kawan farmer group in Baros Village, Serang Regency. The program focuses on developing Beneng taro-based food products and utilizing its by-products as feed for livestock and maggot cultivation. Through this integrated approach, the study contributes to the development of a circular green economy model based on local resources that can improve feed availability, reduce organic waste, and create new economic opportunities for rural communities.

RESEARCH METHODOLOGY

The research was conducted from July to August 2025 in Baros Village, Serang Regency, involving members of the Setia Kawan Farmer Group. The materials used included Beneng taro tubers, herbs and spices as ingredients for producing processed food products (chips and opor), and Beneng taro tuber skins as raw materials for silage production supplemented with molasses and rice bran.

This study applied a descriptive survey combined with a participatory action approach to identify community knowledge and develop practical solutions for optimizing the utilization of Beneng taro. A total of 33 members of the Setia Kawan farmer group participated as respondents.

The research implementation consisted of several stages:

(1) Survey and socialization stage, which involved field observations and structured discussions to identify the initial level of farmers' knowledge regarding the characteristics, benefits, and potential utilization of Beneng taro. The survey results were used as the basis for designing the training materials and program interventions.

(2) Training stage, in which the research team demonstrated the processing of Beneng taro into food products as well as the utilization of its by-products.

(3) Workshop or practical stage, where farmer group members independently practiced processing Beneng taro into food products and converting its waste into feed ingredients.

(4) Demonstration and mentoring stage, which included the establishment of a Beneng taro planting area and assistance in implementing feed processing practices to ensure that the introduced technologies could be applied sustainably by the community.

Farmer group members were actively involved throughout the program, including in identifying community needs, determining program priorities, participating in training activities, and evaluating the implementation process. Periodic evaluations were conducted at each stage to monitor progress and identify any challenges encountered during the activities. Survey data were analyzed using descriptive statistical analysis, primarily in the form of percentages, to describe the level of knowledge, perceptions, and interest of farmer group members in utilizing Beneng taro as a food and feed resource. The results were presented in tables and graphical illustrations to facilitate interpretation.

One of the technologies introduced in this program was silage production technology using Beneng taro skin waste as an alternative feed source for livestock. The silage preparation procedure was as follows:

1. Fresh Beneng taro skins free from mold and rot were selected.
2. The skins were washed thoroughly to remove sap, dirt, and soil, then soaked in salt water for 2 hours and drained.
3. The skins were chopped into pieces of approximately 3–5 cm.
4. The chopped skins were air-dried or sun-dried until wilted to reduce moisture content.
5. The skins were mixed with rice bran in a ratio of 1:0.5 kg.
6. EM4 was mixed with water and molasses in a bucket (2 cc EM4, 2 cc molasses, and 1.5 L water) and stirred until homogeneous.
7. The mixture was placed in a drum in alternating layers of taro skins and bran and compacted to remove air.
8. The drum was tightly sealed to prevent air entry and stored in a cool, dry place.
9. Fermentation was carried out for 21–30 days to produce silage.

This study has several methodological limitations. The survey analysis was descriptive and conducted on a relatively small number of respondents within a single farmer group, so the findings primarily reflect local conditions. However, the participatory approach allowed the program to directly address community needs and demonstrate practical applications of Beneng taro utilization.

RESULTS AND DISCUSSION

Beneng taro is a local tuber from Pandeglang Regency that has potential economic value based on its nutritional content (Rostianti et al., 2018 and Rahmansyah et al., 2025). Beneng taro tubers are buried in the soil and some appear above the surface of the soil in the form of elongated stems, with brown skin, light yellow flesh, and small tubers attached to the edges of the 9-12 month old stem with white fibrous roots. Beneng taro is a wild plant or grows naturally in the area around Mount Karang, Pandeglang Regency. This plant is generally found in cliff areas with humus soil or around swamps (Budiarto et al., 2017). Taro can thrive in tropical lowland areas with rainfall ranging from 175 to 250 cm per year, and generally grows at altitudes between 250 and 700 meters above sea level (Kusumasari et al., 2019). However, Beneng taro cannot survive in extremely cold or freezing temperatures (Fauziyah, 2021). The nutritional content and oxalic acid levels in the skin of Beneng taro tubers are thought to be influenced by the altitude at which they grow (Ningsih et al., 2018). Beneng taro is explored in this study as a local resource that can support feed availability for ruminant livestock (such as goats and cattle) as well as poultry, while its by-products can also be utilized as organic substrates for Black Soldier Fly (BSF) maggot cultivation. The integration of these components creates opportunities to develop a more sustainable livestock production system based on local resources.

The survey results indicate a substantial knowledge gap among members of the Setia Kawan farmer group regarding the potential utilization of Beneng taro. All respondents (100%) stated that they had never recognized Beneng taro as a typical tuber from Banten Province, indicating that this local commodity has not yet been widely acknowledged as a valuable resource at the community level. Similarly, most respondents were unaware of its potential as an alternative animal feed (90.91%) and did not fully understand which parts of the plant could be utilized for feed (48.48%). In addition, the majority of respondents had limited knowledge regarding appropriate processing techniques (93.94%), feeding practices (54.55%), and the potential benefits of Beneng taro for livestock (87.88%).

These findings demonstrate that although Beneng taro grows naturally in the surrounding environment, its utilization has not yet been integrated into local food and livestock production systems. The lack of knowledge about processing techniques and feeding methods highlights the need for capacity-building activities among farmer group members. Interestingly, despite the limited initial knowledge, all respondents (100%) expressed interest in utilizing Beneng taro as animal feed, and 96.97% agreed that further training and dissemination regarding its processing and utilization were necessary. This high level of interest indicates strong community acceptance and suggests that introducing appropriate processing technologies could facilitate the adoption of Beneng taro as a local feed resource. The detailed results of the pre-test survey are presented in Table 1.

Table 1. Survey Questions and Answers

No	Question	Answer		
		Yes (a)	No (b)	c
1	Have you ever heard of the Beneng Taro plant before?		33	
2	Did you know that Beneng Taro is a typical tuber from Banten Province?		33	
3	Did you know that Beneng Taro can be used as animal feed?	3	30	
4	Do you know which part of the Beneng Taro plant can be used as animal feed?	16 (Tubers)	8 (Skin)	9 (Stems)
5	Do you know how to process Beneng Taro so that it is safe to give as animal feed?		33	

6	Have you ever tried the practice of giving Beneng taro as livestock?	2	31	
7	Do you believe that using Beneng Taro can help save on livestock feed costs?	15	18	
8	Do you know the benefits of Beneng Taro for livestock growth and health?	4	29	
9	Are you interested in trying to use Beneng Taro as animal feed?	33		
10	Do you agree that information about the use of Beneng Taro as animal feed needs to be disseminated more widely?	32	1	

Figure 1. Processing of Beneng Taro Skin using the Silage method

The Beneng taro processing training aims to produce farmer group members with business ideas for Beneng taro-based products and initial processing skills. This step not only expands the diversification of Beneng taro utilization but also opens up new business opportunities that can increase community income, thus encompassing both the animal feed and food processing sectors. The training activities not only demonstrated increased knowledge but also demonstrated an increase in partners' abilities in processing Beneng taro into chips and opor (a traditional Indonesian dish). Another study related to the use of Beneng taro, conducted by Putri et al., 2022, involved the production of Beneng taro chips using various methods to achieve a texture and flavor that resonated with the community. Five methods were used, combining experiments with varying percentages of lime and salt solutions, as well as varying soaking times.

The impact of the activity, which introduced the potential and practices for making processed Beneng taro products, has resulted in more than 70% of members ultimately developing Beneng taro-based business ideas as a foundation for pioneering local food businesses. This increased confidence in members' ability to utilize local potential, strengthened their entrepreneurial spirit, and opened up opportunities for collaboration in developing competitive value-added products in the market. The continuity between the use of Beneng taro as animal feed and the development of processed food products is expected to create an integrated business ecosystem that can increase the economic value of local commodities. This integration not only strengthens feed independence for livestock farmers but also expands market opportunities for Beneng taro-based processed products. The success of this program demonstrates that innovation based on local resources can provide numerous

benefits, both in increasing livestock productivity and empowering the community's economy in a sustainable manner.

The waste generated from the processing of Beneng taro tubers by the Matahari Group of Farmers (KWT Matahari) is the Beneng taro skin. This waste, or byproduct, is then used as animal feed using silage processing technology (Figure 1). The advantages of silage are that it has a longer shelf life and can be used as a feed reserve when there is a shortage, the availability of feed ingredients is more guaranteed (reducing dependence on commercial feed), fermentation reduces anti-nutritional factors and is safer for livestock. This silage product, in addition to utilizing by-products from the skin of the Beneng Taro, has a longer shelf life so it can be used when there is a shortage of feed, guaranteed availability, and better nutrient quality. The utilization of skin waste was obtained due to the good cooperation between the Setia Kawan Farmer Group and the Matahari Farmer Group with the Beneng Taro plantation owner (Kang Arif Beneng Taro) as the supplier of raw materials for the Beneng Taro. After the assistance, all partners have now been able to make silage from the Beneng Taro skin as a source of animal feed, and those responsible for livestock and maggots have implemented the processing of Beneng Taro waste as feed.

Prepupa maggots contain 42.99% crude protein (CP), 36.13% crude fat (FF), 20.27% crude fiber (CF), 35.53% neutral detergent fiber (NDF), and 29.27% acid detergent fiber (ADF) (Nafisah et al., 2019). These nutrients are sufficient to meet the daily needs of livestock with the right amount and can substitute for relatively expensive imported protein feed ingredients such as fish meal. In addition to their high nutrient content, prepupa maggots also have good digestibility and fermentability profiles in the rumen. This is demonstrated by the dry matter digestibility (KcBK) of 72.38%, organic matter digestibility (KcBO) of 65.07%, NH3 of 12.48 mM, and volatile fatty acids (VFA) of 78.41 mM (Nafisah, 2019). These results indicate that prepupal maggots are digestible by the ruminant digestive system and contribute significant energy to the livestock that consume them, as indicated by the VFA value.

Livestock production from modern, intensive, and extensive livestock farming businesses is a reflection of the rations they receive. Limited feed will reduce livestock capacity in an area or can lead to production disruptions and suboptimal ruminant reproductive parameters (Setiawati and Armelia, 2025). Furthermore, increasing livestock productivity and economic efficiency is closely related to feed quality, reproductive management, and mitigation of external factors such as disease and supply chain disruptions. A study of the socio-economic impact of the pandemic on broiler farming by Armelia et al. (2020) found that disruptions in the feed supply chain were one of the causes of decreased productivity and income for farmers. Therefore, utilizing local waste as an alternative feed is crucial in creating a resilient and cost-effective system. Research on reproductive disorders in beef cattle in East OKU Regency by Armelia et al. (2018) found that low feed quality and availability were among the main causes of decreased reproductive performance, which was directly and indirectly related to livestock productivity. The surge in imported feed prices triggered price instability and squeezed farmers' profit margins. Therefore, the use of alternative local raw materials is a strategic solution to reduce production costs, maintain business stability, and increase the competitiveness of local farmers in the face of market dynamics and inflation (Budiyanti et al., 2024). Research on strategies to reduce native chicken mortality by Ismoyowati et al. (2022) emphasized the importance of proper management in livestock farming activities, including the provision of feed and housing. This program supports this aspect with a circular green economy approach, namely utilizing local waste as a productive resource, which has a direct impact on the efficiency and sustainability of livestock businesses (Figure 2).

The farmer group had never processed silage from Beneng taro skins. After mentoring, the partners are now able to make silage from Beneng taro skins as livestock feed. This silage product, in addition to utilizing local plants, also offers the following advantages: (1) a longer shelf life, making it suitable for use during the dry season, which can lead to feed shortages; (2) guaranteed feed availability; and (3) improved nutrient quality, as the silage process involves beneficial bacteria that benefit the livestock's bodies and digestion. The fermentation process in silage production also reduces antinutritional factors in the ingredients used, making the feed safer for livestock consumption. According to Anjalani (2020), taro plants have a limiting factor in the form of calcium oxalate. One way to reduce this is by boiling and fermentation, which is the most effective way to reduce the calcium oxalate content in taro stems and leaves (Hang and Preston, 2010).

Previously, Baros Village did not have Beneng taro gardens. Beneng taro was left to grow wild on riverbanks or in vacant lots. Now several plots of land have been planted with Beneng Taro as a demonstration garden that partners can later develop and increase the number of other plant variations that can be utilized. Beneng taro plants are currently a new prima donna export commodity, but some people are still unaware of it so its existence is still considered a wild plant (Rusdiyana et al., 2025). The existence of this garden is a source of sustainable raw materials for food and feed processing, while increasing group independence in utilizing productive land. In addition, according to Darmayanti, (2015) taro leaves have a crude protein content of 14.84%, crude fat 18.15%, crude fiber 22.51%, ash 11.61%, and carbohydrates 12.3%. According to (Sulastri et al., 2023) reported that the water content is 84.65%, starch content is 6.97%, protein content is 8.77%, ash content is 8.53%, fat content is 0.46%, Oxalate content (ppm) is 61787.75% and flour yield is 10.24%. Beneng Taro (Xanthosoma undipes) is a typical Banten plant that has great potential to be developed as an alternative food and feed source. The tubers contain complex carbohydrates with a low glycemic index, so they can be processed into various healthy food products, such as flour, chips, noodles, and other modern processed foods. Meanwhile, the leaves, stems, and skin of Beneng Taro tubers contain crude protein and fiber that can be used as feed for ruminants and poultry.

The integration of Beneng taro cultivation, food processing, waste utilization, and livestock production forms a circular green economy model in Baros Village. In this system, Beneng taro is processed into food products, while the by-products such as tuber skins are utilized as raw materials for silage production and maggot cultivation. These feed resources are then used to support ruminant and poultry production. Furthermore, livestock manure and organic residues can be returned to agricultural land as organic fertilizer, thereby supporting sustainable Beneng taro cultivation. This circular system reduces organic waste, improves feed availability, and creates additional economic opportunities for farmer group members.

CONCLUSIONS AND SUGGESTION

Members of the Setia Kawan farmer group are unaware of the potential of Beneng taro as a food and feed crop. Optimizing Beneng taro processing can strengthen the availability of animal feed in limited and easily accessible areas, generate new business ideas based on local food, and realize a circular green economy model based on village potential. Members of the farmer group are expected to continue to care for their Beneng taro plantations and utilize them optimally. Sustainable livestock management and the Beneng taro processed food business must be business-oriented and synergistic to support the realization of a circular green economy.

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