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Development of sustainable coconut bio industrial farming in Raja Ampat Regency, West Papua

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Abstract

Sustainable agriculture in Raja Ampat Regency, West Papua, is the focus of efforts to achieve food security and reduce environmental impacts. This re-search presents the development of coconut bioindustry innovation as a sustainable solution. Agricultural land is considered not only as a natural resource, but also as an industry that utilizes production factors to produce food and bioenergy products with the principles of reducing, reusing and recycling. This research produced an environmentally friendly coconut bio industrial farming model in Raja Ampat Regency. The results showed that the use of gradual heating and vinegar acidification methods produced quality cooking oil. Squeezing and centrifugation methods are used to produce quality virgin coconut oil. Farmers' response to the new technology was high, especially regarding the innovation in cooking oil production. Production of quality coconut oil and VCO increased, indicating that the development of coconut bio industrial agriculture can contribute to food security and waste reduction in Raja Ampat Regency, as well as create sustainable economic opportunities for local communities. This research provides findings to support sustainable agriculture in this and surrounding areas.

Keyword

Sustainable agriculture, Bio industrial, Coconut industry

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Introduction

Indonesia, as an agrarian country, possesses vast agricultural potential and abundant natural resources to produce various agricultural products (Almajid and Sentosa 2022; Nugroho 2021; Nuraini et al. 2023). The agricultural sector in Indonesia encompasses diverse crops, supported by distinct tropical climates in different regions. In the plantation sub-sector, coconut, oil palm, cocoa, rubber, and others contribute significantly. Indonesia can advance economically (Dooley et al. 2020; Sirany et al. 2022), particularly in the agricultural sector, with predictions that it could meet global food needs by 2045 and become a world food barn, earning respect from other nations. Therefore, innovative research and development (Febrian, Weni, and Sukowati 2021;

Pramasari and Hariyati 2018; Zhao et al. 2020) are essential to realize these aspirations. The government aims to address agricultural issues with the sustainable agricultural-bioindustry (Chong, Newman, and Steinmacher 2020; Rawung, Indrasti, and Bakrie 2018) program outlined in Indonesia from 2013 to 2045. To achieve this program's goals in enhancing community economics, a development model needs to be offered to the public as a choice to increase production and simultaneously improve well-being, considering the sustainability of the model.

Raja Ampat Regency, known for its approximately 12 thousand islands, with only about 35% inhabited, relies significantly on coconut cultivation as a source of income. In the broader context of West Papua province (Azizah 2023; Haryani and Fauzi 2019; Tjilen et al. 2022), Raja Ampat ranks as the second-largest coconut-producing region after Tambrauw regency. Recognizing this potential, the introduction of coconut innovation in the form of sustainable agricultural-bioindustry systems is crucial for the region's development. This initiative aims to build a sustainable bioindustry model, contributing to increased product value through coconut processing and waste utilization. The anticipated impact includes enhanced farmer welfare and the availability of competitive coconut products in the global market. The coconut tree, often referred to as the "tree of life," holds vital cultural and economic importance in tropical regions, especially in Indonesia. Various parts of the coconut, such as leaves, roots, trunk, and fruit, find applications ranging from cultural ceremonies to construction materials, furniture, food, and medicinal uses. The economic value of coconuts extends to products like coconut water, coconut husk fiber, coconut oil, and coconut-based items such as mats and coconut charcoal. The demand for coconut-based products, such as nata de coco and VCO, remains high, contributing to promising and lucrative industries. The processing of fresh coconut meat yields products like desiccated coconut, coconut cream, coconut milk, and various coconut oils, providing economic opportunities for farmers. The production of VCO (Borgmans et al. 2022; Mela and Bintang 2021; Suryani et al. 2020) has been proven to increase income and alleviate poverty among coconut farmers in Indonesia.

Coconut plant wastes, such as shells and coir, can be processed into biopesticides (Mashuni et al. 2021; Triasih et al. 2019), providing several advantages including maintaining soil health, sustaining soil organisms, and being safe for the environment. The use of this biopesticide involves the antimicrobial compounds found in coconut shell liquid smoke, which has a significant impact on the growth of fungi that cause plant diseases. In addition, coconut waste can be processed into activated charcoal that functions as a plant-based pesticide with antibacterial and antifungal properties. This innovation not only has agronomic benefits, but also supports the utilization of coconut waste to increase added value and farmers' welfare. The development of a coconut-based sustainable bio industrial farming system in Raja Ampat Regency, West Papua, can be an environmentally friendly model and has the potential to support economic growth in the region.

Methods

This research uses the method of developing sustainable bio industrial agriculture (Kementerian Pertanian 2014) on a pilot unit scale with a zero-waste sustainable bio industrial agriculture model approach. The study was conducted in Raja Ampat district, West Papua province, involving the development of a coconut bioindustry model starting with the establishment of farmer institutions. Subsequently, farmers are supported in the form of a bio industrial farming system development area in the area around the pilot site. The research method used is qualitative which is described from observations of respondents in the study. The materials and tools used in the assessment involved the process of making coconut oil by gradual heating and acidification. Tools and materials included old coconut fruits, vinegar acid, knife, grated coconut, fine sieve, basin, large jar with lid, small hose, wok, wooden stirrer, bottle, or jerry can, and mixer. In addition, VCO and soap making materials are also used with the appropriate tools and materials.

Results and Discussion

Raja Ampat Regency (Azizah 2023; Haryani and Fauzi 2019; Tjilen et al. 2022) there are four sub-districts adjacent to the study area, namely Warwarbomi Sub-district, Supnin Sub-district, Ayau Islands Sub-district, and Ayau Sub-district. The first two sub-districts are on the mainland with North Waigeo sub-district (Waigeo Island), while the other two sub-districts are located on small islands that are part of the outer border areas of the Republic of Indonesia. North Waigeo sub-district, as the research location, has the main activities of the community as farmers and fishermen. Despite having agricultural potential, some communities have not utilized it optimally, especially in coconut oil processing. A small portion of the community is involved in copra processing, but cooking oil processing activities are not visible, possibly due to dependence on imported cooking oil products. The availability of necessities and cooking oil is supplied by large traders who use the seaport facilities that are visited by motorboats from Sorong and Ternate every week.

The inputs, outputs, and profitability ratios to produce coconut oil, VCO, copra, and soap in the North Waigeo and Warwarbomi districts of Raja Ampat Regency in Table 1. The table presents a cost and production analysis of various products manufactured by a company, including coconut oil, VCO using fishing and centrifuge methods, as well as copra with fumigation and drying methods. The Profitability Ratio (R/C) (Omar and Fatah 2020; Sabu, Padma Rani, and Vidhyavathi 2020; Sudhalakshmi et al. 2021), Net Profit (NP) (Ifa et al. 2022; Mawardati et al. 2022; M. Mawardati et al. 2022) ratio is employed to evaluate the net profit of each product. From the analysis, it is evident that the VCO product using the fishing method has a high net profit ratio, despite its relatively small volume. In this context, the company needs to consider an appropriate business strategy, combining product diversification while considering production costs and sales volume to optimize net profits. A profound understanding of these factors can

assist the company in making smarter and more strategic business decisions. From the analysis of the table, it appears that the VCO product using the fishing method has the highest net profit ratio (4.12), followed by the Copra product with the drying method (1.62). A high net profit ratio indicates that these products can yield more significant profits compared to their production costs. Therefore, in this context, the VCO product using the fishing method can be considered the best in terms of net profit. However, the ultimate decision also depends on other factors such as market demand, available resources, and the company's business strategy. In summary, the table encompasses a comprehensive analysis of production costs and outcomes for various products. The VCO product using the fishing method stands out with the highest net profit ratio, signifying considerable profit potential. When formulating a business strategy, the company must weigh factors such as production costs, sales volume, market demand, and available resources. The optimal decision hinges on finding the right balance among these factors, underscoring the importance of a thorough understanding of the table's analysis for informed and strategic decision-making.

Table 1. Cost and production analysis coconut production

No.	Product	Inputs	Outputs	(R/C) – (NP)*
1.	Coconut Oil	Total Variable Costs: Rp 5,634,000 Total Fixed Costs: Rp 10,250,000	3,500 units Selling Price: Rp 2,000 / unit Total Production Value: Rp 7,000,000	1.24 1,366,000
2.	VCO (Fishing Method)	Total Variable Costs: Rp 6,073,000 Total Fixed Costs: Rp 13,200,000	250 bottles Selling Price: Rp 100,000 /bottle Total Production Value: Rp 25,000,000	4.12 Rp 18,927,000
3.	VCO (Centrifuge Method)	Total Variable Costs: Rp 6,223,000 Total Fixed Costs: Rp 14,700,000	250 bottles Selling Price: Rp 100,000 per bottle Total Production Value: Rp 25,000,000	4.02 Rp 18,777,000
4.	Copra (Fumigation Method)	Total Variable Costs: Rp 3,435,000 Total Fixed Costs: Rp 3,150,000	500 kg Selling Price: Rp 9,500 per kg Total Production Value: Rp 4,750,000	1.38 Rp 1,315,000
5.	Copra (Drying Method)	Total Variable Costs: Rp 980,000 Total Fixed Costs: Rp 850,000	167 kg Selling Price: Rp 9,500 / kg Total Production Value: Rp 1,586,500	1.62 Rp 606,500
6.	Soap	Total Variable Costs: Rp 5,634,000 Total Fixed Costs: Rp 10,250,000	3,500 units Selling Price: Rp 2,000 per unit Total Production Value: Rp 7,000,000	1.24 Rp 1,366,000

*Profitability Ratio (R/C), Net Profit (NP), source: analysis results, 2023

*Note: R/C = (Total Revenue - Cost of Sales): Total Revenue X 100%; NP = (net profit / total revenue) x 100%

The improvement of high-quality coconut oil (Mashuni et al. 2021; Mela and Bintang 2021; Suryani et al. 2020) technology is implemented through three methods: gradual heating, centrifugation, and acidification. The response of farmers to the introduced

technological innovations is quite high, especially with the highest acceptance rate observed in cooking oil at 44%. The application of these innovations has the potential to increase income from the coconut oil processing process by 13.95% compared to conventional coconut oil processing methods. This technological advancement not only enhances the quality and efficiency of coconut oil production but also positively impacts the economic aspect. Therefore, the adoption of these technologies not only supports increased efficiency and product quality but also has the potential to improve the livelihoods of farmers and stakeholders involved in the coconut oil production chain.

These figures demonstrate the economic viability (Sirany et al. 2022; Sudhalakshmi et al. 2021) and potential profitability (Arif and Cahyani 2021; Omar and Fatah 2020; Panwar et al. 2019) of coconut oil, VCO, copra, and soap production in the North Waigeo and Warwarbomi districts of Raja Ampat Regency. The most economically viable methods of coconut processing for smallholder farmers in the Raja Ampat Regency of West Papua province are heating and fermentation. The study indicates that these methods can produce high-quality coconut oil and VCO in an economically efficient manner. The heating method, despite being inefficient in terms of time and energy, is commonly used and has been found to produce quality coconut oil. On the other hand, the fermentation method is considered more efficient and economical, with a higher potential for application due to its ease of production and economic feasibility. These methods have shown favorable returns on investment and have garnered a positive response from farmers, particularly in the production of coconut oil. Additionally, the study suggests that the fermentation method is more suitable for adoption due to its ease of production and economic feasibility.

To effectively respond to market dynamics (Gundelach and Hansen 2020), resource constraints (Muñoz-Pascual, Galende, and Curado 2021; Ulug and Horlings 2019), and align with the company's overarching business strategy (Agustina et al. 2020; Aknesia, Daryanto, and Kirbrandoko 2015; Hasibuan 2021), a comprehensive approach is necessary. Beginning with a thorough understanding of market demands through extensive research, the company can tailor its products to meet identified needs. This may involve adjustments to formulations, packaging, or product features to enhance consumer appeal. Concurrently, optimizing available resources, including raw materials, labor, and equipment, is crucial to ensure production can meet demand without undue strain. Crafting a strategic pricing model, rooted in cost analysis and market competition, ensures that the product is both attractive to customers and financially beneficial for the company. Implementing targeted marketing campaigns through suitable platforms, such as social media or local promotions, can significantly boost product visibility and consumer engagement. Optionally, product diversification should be considered judiciously, aligning with the company's capabilities and existing market demand. Streamlining production processes for efficiency gains and maintaining product quality are integral components of this strategy. Lastly, strategic flexibility is paramount, allowing the company to adapt to evolving market conditions and

competitor strategies. Through this comprehensive and well-integrated approach, the company can enhance its product competitiveness, meet customer needs effectively, and pave the way for sustained business success.

Conclusion

The research focused on making coconut farming in Raja Ampat Regency, West Papua, more sustainable. It explored using new methods like gradual heating and centrifugation, which farmers liked. The study also looked at the money side, showing that making things like coconut oil and VCO can bring in good profits. Using efficient methods, like fermentation, was said to be important for making money and getting a good return on investment. Overall, the study suggests that sustainable coconut farming, specially making VCO with the fishing method, could be a promising thing for the region. To respond effectively to market dynamics and resource constraints, a comprehensive business strategy was recommended. This strategy involves understanding market demands, optimizing available resources, implementing strategic pricing models, conducting targeted marketing campaigns, considering product diversification judiciously, streamlining production processes for efficiency gains, and maintaining product quality. This strategic approach aligns with the overarching goal of developing sustainable coconut bio industrial farming in Raja Ampat Regency, ensuring both economic viability and environmental friendliness. The study underscores the importance of integrating innovative technologies, economic analyses, and strategic business approaches to promote sustainable coconut farming practices. By embracing these principles, the region can harness its agricultural potential, enhance the livelihoods of local communities, and contribute to the broader goal of sustainable development in Raja Ampat Regency, West Papua.

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