Lesson Learned for Arenga Pinnata: Analysis and its Opportunities in Forestwise Collection Area.

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Background

As one of the NTFP that abundantly available in tropical areas. The sugar palm (*Arenga pinnata*) is a versatile plant with significant economic value. Found throughout Indonesia and Southeast Asia, the sugar palm remains largely underutilized in many regions. While not widely cultivated in most parts of Indonesia, an estimated 2.5 million households in Java rely on palm sugar production, contributing 85% of Indonesia's total palm sugar output.

In West Kalimantan, the development of sugar palm offers substantial potential for both environmental sustainability and socio-economic benefits for local communities. This document outlines the lessons learned from various experiences in developing the sugar palm sector in the region.

This report provides a comprehensive overview of lessons learned from the feasibility study conducted on the potential of Arenga/Palm Sugar. Building on past experiences, the study identifies key factors that influence the successful harvesting, processing, and marketing of this product. Key considerations include:

- **Product usage**: Particularly in the cosmetics and food industries.
- **Market demand**: Understanding current and future opportunities.
- **Processing technologies**: Assessing existing and needed innovations.
- **Legal frameworks**: Navigating regulations and compliance.
- **Production volume**: Evaluating potential scalability.
- **Environmental sustainability**: Ensuring minimal ecological impact.
- **Livelihood impact**: Supporting local communities' welfare.
- **Lesson learned**: Challenges and opportunities of Natural Latex in the area.

Building on these considerations and drawing from past experiences, this report delivers practical insights to overcome challenges and seize emerging opportunities. It presents strategic recommendations for channeling efforts toward the most promising natural rubber/latex prospects, optimizing both economic outcomes and social impact. By emphasizing key achievements, identifying hurdles, and narrowing down the most feasible options, the report outlines a clear path for future growth and development.

Objective

The objective of this lesson learned report is to evaluate the potential of Arenga sugar for sustainable harvesting, processing, and marketing. It aims to explore the advantages and challenges of diversifying Forestwise's product portfolio beyond Illipe nuts. Centered on Forestwise's collection areas in West Kalimantan, the report draws on past experiences to uncover opportunities that align with the company's mission of rainforest preservation and community empowerment. The findings offer valuable insights into sustainable practices, market potential, and the economic viability of Arenga sugar as a key addition to the product lineup.

Arenga Pinnata / Arenga Sugar

1. Introduction

Arenga Pinnata Palm is a valuable source of Arenga sugar, a palm sugar found in Indonesia and Southeast Asia. In Kalimantan, especially in the West Kalimantan region, it can be found in the rainforest area or small plantations in the villages. The sugar is extracted from the juice tapped from the sugar palm trees. While the trees are widespread in Indonesia, they are mostly untapped. The process of tapping the trees is labour-intensive and requires specific skills. Each Arenga palm can produce 10 to 50 litres of juice per day, containing 12-17% sugar concentration. This makes it a highly productive crop, with an average yield of 2-3 kg of Arenga sugar per day or 25 tons per hectare annually. Arenga sugar has a distinct flavour and is considered healthier than white sugar, with slow absorption in the blood and the presence of antioxidants, amino acids, and vitamins.

The Arenga Pinnata palm is unique and differs from oil palms. It thrives in biodiverse forests and has symbiotic relationships with various plant, tree, and animal species. Unlike oil palms, the Arenga Pinnata does not require fertilizers and contributes to soil fertility. Palm offers a wide range of products beyond sugar, including biofuel, strong fibres for roofing, medicine, and quality wood. It has an efficient leaf structure that maximizes sunlight absorption and can be harvested throughout the year without harming the tree. The palm's deep root system protects against soil erosion, landslides, and fire or flood damage. Arenga sugar, derived from palm juice, has a unique flavour, and a slow absorption rate in the blood, and contains beneficial compounds for overall health.

2. Usage/Benefits of Arenga Pinnata

Arenga Pinnata has significant benefits and applications in the cosmetics industry. The palm produces extremely strong fibres that can be incorporated into cosmetic products such as brushes, applicators, or exfoliating products. Additionally, Arenga Pinnata possesses medicinal properties that make it a valuable ingredient in skincare formulations. Extracts or derivatives from the palm can be used for their potential antioxidant, anti-inflammatory, or

other beneficial effects on the skin. Furthermore, Arenga Pinnata provides a source of natural ingredients for cosmetics, allowing for the creation of creams, lotions, and other skincare products that offer a sustainable and natural alternative.

Picture 1: Utilization of Arenga sugar in beauty products such as lip scrub and mask

In the food industry, Arenga Pinnata and its derived Arenga sugar have various uses and advantages. Arenga sugar, made from palm juice, serves as a natural and flavorful sweetener. It can be utilized as an alternative to white sugar in a wide range of food and beverage applications. Moreover, Arenga sugar offers a healthier option compared to white sugar, as it has a slower absorption rate in the blood, preventing unhealthy blood sugar spikes. The sugar also contains antioxidants, amino acids, and vitamins that contribute to the overall health benefits of food products. Additionally, Arenga Pinnata and its derived sugar can be employed as organic and sustainable ingredients, aligning with the growing demand for natural and environmentally friendly options in the food industry.

3. Potential Volume

The collected data from 58 villages in West Kalimantan indicates the potential for Arenga sugar production. Out of these villages, 18 are considered suitable for 34 establishing mini-processing units based on the criteria of having more than 40 productive Arenga palm trees.

Name of Villages	Kribupaten	Distance from Sintang		# Adult Trees	# Farmers willing to produce juice/sugar	# Farmers who knows to tap	Experience level for tapping tree	Average tree/farmers	Juice price (target: Rp 1000/L)	Avejuice /tree (target: 20L/tre	Income now	Road conditions	Willing protect forest	Forest area (Ha)
		Kilometer	Hours											
Langan	Melawi	130	4	1.000+	38	38	4	10	1.000	80-100L	>3M	50% Bad	Yes	6.215
Sekabuk	Mempaw	352	8	1.022	247	6	2	4	1.000	10-20L	>2M	50% Bad	Yes	6.633
Padi	Sanggau	210	5	714	107	5	4	7	1.000	10-15L	>2M	80%Good	Yes	4.232
Nanga	Sintang	130	4	150	3	20	2	2	1.000	30-50L	> 2M	50% Bad	Yes	9.025
Sungai	Sintang	130	4	38	6	6	2	2	1.000	30-50L	> 2M	60% Bad	Yes	4.321
Tertung	Sintang	20	1	60	10	30	5	2	> 5.000	10-30L	> 3M	90%Good	Yes	1.074
Gurung	Sintang	68	25	48	8	8	4	7	1.000	20-30L	> 2M	50% Bad	Yes	2.002
Termawan	Sintang	110	4	100	3	3	5	2	1.000	15-20L	> IM	60% Bad	Yes	3.417
Jaya	Sintang	93	3	50	3	20	2	2	1.000	20-SOL	> 2M	50% Bad	Yes	4.208
Nanga	Kapuas	291	6	115	24	24	4	4	4.000	10-20L	>2M	50% Bad	Yes	31.549
Rantau	Kapuas	289	6	122	17	17	3	7	5.000	10-20L	>2M	50% Bad	Yes	2.157
Nanga	Kapuas	283	6	276	18	18	4	15	6.000	10-30L	>2M	50% Bad	Yes	17.395
Melapi	Kapuas	264	55	289	23	23	4	10	4.000	10-20L	>2M	50% Bad	Yes	5.368
Nanga	Kapuas	252	55	163	16	16	3	10	6.000	10-20L	>2M	50% Bad	Yes	9.398
Nanga	Kapuas	183	4	235	16	16	4	10	5.000	10-30L	>2M	50% Bad	Yes	1.678
Pelimpin	Kapuas	51	15	50	2	2	5		1.000	10-15L	> IM	100%Goo	Yes	2.823
Balai agas	Melawi	1SO	6	50	5	10	1	3	1.000	10-15L	> 2M	70% Bad	Yes	34.000
Semabl	Sekadau	130	4	215	8	8	3	20	1.500	20-30L	>3M	50% Bad	Yes	3.182

Source: Ecosia research, survey Credit Union Keling Kumang and https://data.kalbarprov.go.id/dataset/

Table 1: Potential of Arenga Sugar Production

Three villages with significant potential for business development are identified:

- Langan: Located in the Melawi district, Langan has a population of 1.833 people in 478 households, with 43.75% of the population working as farmers. The village has over a thousand Arenga palms, most of which are difficult to access due to hilly terrain. 38 farmers who have been involved in the Arenga sugar business since 2016, producing an average of 80 to 100 litres of juice and 10 to 12 kg of sugar per day. The sugar is sold locally and has gained recognition in the surrounding regions.
- Sekabuk: Situated in Mempawah district, Sekabuk has a population of 2.311 people in 620 households, with 25.48% engaged in farming. The village has over a thousand Arenga palms, but only six farmers have utilized them for palm sugar production since 2017. Most residents use sugar palms as raw materials for traditional alcoholic drinks. However, the village's proximity to the capital, Pontianak, and the substantial number of Arenga palms present a great opportunity for developing it as a centre for Arenga sugar production.
- Padi Kaye: Located in Sanggau district, Padi Kaye has a population of 2.147 people in 596 households, with 43.5% engaged in farming. The village possesses 714 Arenga palms owned by 107 individuals, but only five farmers have been involved in the palm sugar business since 2017. Similar to Sekabuk, most residents use Arenga for traditional drinks. Nonetheless, Padi Kaye's significant number of Arenga palms and proximity to the capital makes it a promising location for Arenga sugar production.

Additionally, opportunities exist for setting up sugar businesses outside of West Kalimantan, particularly in other parts of Indonesia with high densities of Arenga palms, such as Sulawesi, Java, and Flores. The traditional method of producing Arenga sugar using wok pans on an open wood fire is prevalent in these areas. After successfully implementing the concept in Langan, expansion to other villages in West Kalimantan and other Indonesian regions can be considered.

It's worth noting that the Indonesian government has introduced the "Perhutanan Sosial" (Social Forestry) mechanism, a sustainable forest management system implemented by local communities to improve welfare and environmental balance. This mechanism

encourages the production of non-timber forest products through Social Forestry Business Groups (KUPS). Over 310 registered KUPS in Indonesia focuses on Arenga sugar, with 58 KUPS holding full licenses for legal production. Encouraging KUPS registration in villages like Langan can facilitate the establishment of Arenga sugar production.

4. Market Analysis

- **Market demand and potential**

The market research conducted focused on the overall palm sugar market, which encompasses sugars derived from various palm trees, including the coconut palm, palmyra palm, date palm, nipa palm, and Arenga palm. Among these, coconut palm sugar holds the largest share of palm sugar production. The annual market demand for palm sugar is substantial in different regions. In Europe, the demand ranges from 1,500 to 3,000 metric tons (MT), representing a mere 0.02% of the total sugar market. The United States shows demand for 6,000 MT of Arenga sugar alone, valued at USD 22 million. Indonesia's demand stands at 5,475 MT, while the global demand for palm sugar reaches a staggering 170 million MT. Importers of natural products, including palm sugar, concentrate mainly in northwestern Europe, encompassing the United Kingdom, the Netherlands, and Germany. Consumers in this region display greater interest in such products. Additionally, the organic food market is experiencing growth, with a 40% increase in Sweden's organic market in 2015. Palm sugar, by default, tends to be organic as palm trees are often cultivated without the use of chemicals. This presents an opportunity to cater to the rising demand for organic palm sugar.

The Arenga palm sugar offers more than just its sweetening properties. It has benefits for skin care due to its higher levels of potassium and iron compared to white sugar. These attributes make the skin cleaner, fresher, and younger-looking. Moreover, the nutrients present in Arenga sugar can aid in treating menstrual cramps and alleviating pain.

- **SWOT**

Analyzing the market through a SWOT (Strengths, Weaknesses, Opportunities, Threats) perspective reveals valuable insights. Arenga sugar is considered a healthier option with a low glycemic index, catering to the growing demand for natural products. However, its low market awareness poses a challenge, as does ensuring a sustainable supply. On the bright side, the increasing number of diabetics seeking alternatives, the general concern about sugar's impact on health, and the growing demand for organic products provide opportunities for Arenga sugar. Furthermore, exploring applications in the personal care sector and catering to consumers' experimental approach to cooking ingredients open up new possibilities. On the downside, competition from coconut sugar and cheaper, adulterated products, as well as the trend of reduced sugar consumption, pose threats to the Arenga sugar market. Below is the SWOT table for Arenga Sugar.

Strengths	Weaknesses
Healthier option	Not well known in the market
Low Glycemic Index	Challenging to secure sustainable supply
Growing demand natural products	
Unique flavour	
Opportunities	**Threats**
Number of diabetics are increasing	Coconut sugar competition
Consumers are looking for alternatives	Cheaper, adulterated product competition
Sugar is a health concern	Consumers using less sugar
Growing demand for Organic products	
Expertimenting with cooking ingredients	
Applications in personal care sector	

Table 2: SWOT analysis of Arenga Sugar

- **Pricing**

The retail prices of various types of palm sugar range from €7.32/GBP 6.27 to €46.33/GBP 39.69 per kilogram, which is significantly higher compared to conventional refined sugar (€0.70/GBP 0.60 per kg) and raw cane sugar (€5/GBP4.28 per kg) in 2016. However, palm sugars have a distinct advantage in niche segments that prioritize natural and healthy products.

With their 100% natural composition, absence of artificial additives, low glycemic index, and potential for organic and fairtrade certification, palm sugars can position themselves as a healthier alternative to traditional sugars. By appealing to consumers who value sustainability and quality, palm sugars can establish a market presence beyond price considerations and find success in these specific market segments.

Brand details	Retailer	Price and package size (in GBP)	Price per kg (in GBP)
Gula Java Blocs coconut blossom sugar cubes (organic coconut sugar)	AMANVIDA, Europe/Belgium	5.95/150g	39.68/ kg
Lucovitaal Super raw food palm suiker (sugar palm)	Albert Heijn, Netherlands	1.71/170g	10.07/ kg
Mattisson Arenga Palm suiker (sugar palm)	De Tuinen, Netherlands	5.82/ 450g	12.93/kg
Rying Goose Patmzuck (type unclear)	Amazon.de, Germany	2.39/ 225 g	10.62/kg
Verival Patmzucker (organic, type unclear)	Rewe, Germany	3.42/ 250g	13.71/kg
Sainsbory's Palm Sugar (type unclear)	Sainsbury's, United Kingdom	3.00/125 g	23.98/kg
Biona Organic Coconut Palm Sugar	Ocado, United Kingdom	3.32/ 250g	13.29/kg
Sucrede coco bio (organic coconut sugar)	Bien Manger, France	7.11/ 500g	14.22/kg
Kokospalmsocker (organic coconut sugar)	Bodystore.com, Sweden	5.40/ 400g	13.52/kg

Table 3: Examples of end market prices for palm sugar in various European countries

Based on the price breakdown for small lots (5 tonnes) of coconut palm sugar, which includes various stages such as sap collection, processing, export, shipment, import, packaging, distribution, and retail, we can analyze the cost structure. With a minimum retail price of €11.76/GBP 10.07 per kg for granulated palm sugar, we can estimate the cost at the tappers' level to be around €1.17/GBP 1.00 per kg and up to €2.35/GBP 2.01 per kg for the export-ready product. These figures align with the target prices set by potential buyers such as Trading Organics (€2.00/GBP 1.71) and Smart Organic (€2.15/GBP 1.84) per kg for organic certified sugar. Considering these factors, our selling price is set at €2.10/GBP 1.80 per kg FOB Jakarta.

- **Market Outreach**

Buyers in the European Union have strict requirements for palm sugar, encompassing food safety, pesticide residues, GMOs, certification, documentation, labelling, and packaging. Meeting these requirements is crucial for accessing the European market. In terms of market outreach, several potential partners and customers have been identified, including Mahorahora, Smart Organic, Tradin Organics, and Haldin. Collaborations, discussions, and trial orders are currently underway to establish a foothold in the Arenga sugar business.

5. Legal Aspect

To determine the necessary permits and licenses for the production of Arenga sugar in Indonesia, a legal analysis was conducted to identify the relevant business activities according to Indonesian law. The analysis identified three business activities associated with Arenga sugar production:

- ➢ 10722: Palm sugar production in the form of granulated sugar, blocks or syrup
- ➢ 10729: Palm sugar in other forms
- ➢ 46331: Trading of palm sugar

The legal study has shown that 10722 is 100% closed for foreign investment, whereas 46331 and 10792 are 100% open for foreign investment. Looking further into 46331 for sugar trading, the legal study reveals that the only activities that a trading company such as Forestwise is allowed to do are receiving, repacking, storing and selling. It would not be allowed to make any modifications to the product, even the drying of the sugar, which would be crucial for good quality control. We then also looked into a business activity specifically for the packaging of food (82920). However, this does not include packaging of sugar, and also would not allow for drying.

6. Processing Technology

This part explains the findings of our research on the most efficient processing technologies for producing Arenga sugar. Our goal was to identify the best methods for evaporating the sugary juice and converting it into granulated sugar.

To start, we calculated the energy required to evaporate 1000 litres of sugary juice with 10% moisture content into sugar. We found that using an evaporator was the recommended approach. It involves heating the juice from 22°C to 70°C and utilizing the heat of vaporization. Based on the specific heat of water, it would take approximately 201 MJ of energy to boil 1000 litres of Arenga juice.

For the initial processing step, we selected an evaporator that can handle 220 litres and evaporate 150 litres of juice per hour. This system can be powered by a steam generator or electricity, requiring 118 kW of input. In a day, we plan to run the evaporator for two batches of 660 litres each, with each batch taking about 3 hours and 40 minutes. From 660 litres of juice, we estimate the production of at least 80 kg of sugar with 1% moisture content, resulting in a total sugar production of 160 kg for two batches.

The evaporator process involves evaporating 150 litres of water per hour, leaving behind 70 litres with a sugar concentration of around 38%. After three runs of one hour, the remaining 210 litres will undergo a second round of evaporation, reducing it to 110 litres within 40 minutes and reaching a sugar concentration of 72%. The 110 litres of sugar syrup, with a concentration of 72%, will then be transferred to a wok pan connected to the evaporator for further heating. In the wok pan, an additional 22 litres of water will be evaporated to produce the final product: 88 kg of sugar with 10% moisture content. Our target is to process 1.320 litres of juice in the sugar production unit every day, operating for 8 hours.

To ensure a reliable power supply, we explored different options such as solar panels with battery storage, micro hydropower, diesel generators, connection to the national power grid, natural gas, and biomass/wood steam generators. We compared the energy production costs and initial investments for each option.

After analyzing the costs, the following options stood out:

- Biomass steam generator + evaporator: Requires an initial investment of USD 20,140/GBP 15,839. The energy cost is USD 0.02/GBP 0.016 per kg of sugar, with a total investment cost of USD 0.05/GBP 0.039 per kg of sugar over 10 years.
- Wood steam generator + evaporator: Requires an initial investment of USD 20,140/GBP 15,839. The energy cost is USD 0.04/GBP 0.031 per kg of sugar, with a total investment cost of USD 0.07/GBP 0.055 per kg of sugar over 10 years.
- Rocket stove (wood): Requires an initial investment of USD 2,667/GBP 2,098. The energy cost is USD 0.06/GBP 0.047 per kg of sugar, with a total investment cost of USD 0.07/GBP 0.055 per kg of sugar over 10 years.

- PV + BESS + evaporator: Requires an initial investment of USD 178,350/GBP 140,280. The energy cost is USD 0.00 per kg of sugar, with a total investment cost of USD 0.31/GBP 0.24 per kg of sugar over 10 years.
- Micro Hydro + evaporator: Requires an initial investment of USD 126,350/GBP 99,380. The energy cost is USD 0.00 per kg of sugar, with a total investment cost of USD 0.22/GBP 0.17 per kg of sugar over 10 years.
- Diesel generator + evaporator: Requires an initial investment of USD 29,150/GBP 22.929. The energy cost is USD 1.84/GBP 1.45 per kg of sugar, with a total investment cost.

7. Environment and Livelihood Impact

The production of Arenga sugar from the Arenga Pinnata palm can have both environmental and social/economic/livelihood impacts. Let's differentiate these impacts:

- **Environmental Impact:**
  1. Forest Conservation: Arenga Pinnata palms can contribute to forest conservation efforts by providing economic value to standing rainforests. By offering an alternative income source from sustainable Arenga sugar production, communities are incentivized to preserve the forest instead of resorting to deforestation for other economic activities such as logging or palm oil plantations.
  2. Reforestation: Arenga Pinnata can be included in reforestation projects due to its ability to thrive in diverse tropical ecosystems. Its deep roots help prevent erosion and landslides, and the plant can store large quantities of rainwater, making it suitable for planting on steep slopes.

- **Social, Economic, and Livelihood Impact:**
  1. Community Empowerment: Arenga sugar production can empower local communities by providing them with a substantial income. Engaging in Arenga sugar production can increase monthly income by at least 50%, depending on the community's current major income source. Assuming one family has an annual income of IDR 12 million/GBP 627.68 per year (IDR 1 million/GBP 52.30 per month), by supplying Arenga they will receive IDR 6 million/GBP 313.83 per year. Moreover, it also creates job opportunities, as Arenga sugar production is a labour-intensive process. The cultivation of Arenga palms can enhance food security by reducing the need to import sugar and lowering household expenses.
  2. Alternative Livelihoods: Arenga Pinnata offers various products besides sugar, such as fruits, fibres, starch, palm heart, leaves, and wood. These additional products provide opportunities for diversified income streams and utilization of different parts of the plant.

Overall, sustainable Arenga sugar production can contribute positively to the environment by supporting forest conservation and reforestation efforts. It can also have significant social and economic benefits by empowering local communities, providing alternative livelihoods, and promoting food security. However, addressing challenges and implementing improvements in production processes are necessary to maximize the potential of Arenga sugar production.

Lesson Learned

The journey of integrating Arenga sugar into Forestwise's portfolio has provided valuable insights into sustainable NTFP management and market development. As a high-potential product, Arenga sugar aligns with the mission of rainforest preservation and community empowerment. However, its cultivation and processing have highlighted the importance of consistent quality control, robust farmer training programs, and the need for advanced infrastructure to meet international standards. These lessons underscore both the challenges and opportunities in scaling Arenga sugar as a sustainable product with global market appeal.

Opportunities:

1. **Abundant Natural Resource:** The widespread availability of the Arenga Pinnata palm across Indonesia, especially in West Kalimantan, provides an untapped resource for sustainable utilization. Villages such as Langan, Sekabuk, and Padi Kaye demonstrate the potential for scaling production with the presence of thousands of Arenga palms.
2. **Versatility and High Yield:** Arenga Pinnata offers a wide range of products, including sugar, biofuels, fibers, and medicinal compounds. Its ability to produce up to 25 tons of sugar per hectare annually highlights its efficiency compared to other crops.
3. **Sustainability and Environmental Benefits:** The sugar palm thrives naturally without fertilizers or pesticides, contributing to soil fertility, reducing erosion, and preventing water contamination. This positions it as an eco-friendly alternative to other high-maintenance crops like oil palm.
4. **Market Potential:** Increasing global demand for healthier, organic sweeteners opens opportunities for Arenga sugar, particularly in Europe and the United States. The U.S. alone shows demand for 6,000 metric tons annually, valued at $22 million, with opportunities to expand in organic and natural product markets.
5. **Health and Cosmetic Benefits:** Arenga sugar's low glycemic index, antioxidant content, and nutrients cater to health-conscious consumers. Additionally, its properties make it a valuable ingredient for skincare products, aligning with trends in natural cosmetics.
6. **Social Forestry Support:** Government-backed mechanisms such as Social Forestry encourage local communities to engage in sustainable forest management and production of non-timber forest products, providing a regulatory framework to expand Arenga sugar production legally and sustainably.

Challenges:

1. **Labor-Intensive Tapping Process:** Extracting juice from Arenga palms requires specialized skills and is time-consuming, which can limit scalability without sufficient training and workforce availability.
2. **Difficult Accessibility:** Many Arenga palms are located in hilly or remote areas, posing logistical challenges for collection and transport. This is particularly evident in villages like Langan.
3. **Limited Market Awareness:** Despite its potential, Arenga sugar lacks widespread recognition compared to other sweeteners, necessitating significant investment in marketing and consumer education.
4. **Traditional Production Methods:** The reliance on traditional methods, such as wok pans over open fires, affects production efficiency and consistency. Modernizing processing techniques is essential to meet international quality standards.
5. **Competitive Market Landscape:** Coconut palm sugar dominates the palm sugar market, requiring strategic positioning and differentiation for Arenga sugar to capture market share.
6. **Fragmented Supply Chain:** The absence of organized collection and processing infrastructure in many areas limits the potential to meet large-scale demand and ensure quality control.

Key Learnings for Future Development:

1. **Capacity Building:** Train local farmers in efficient tapping and processing techniques to enhance productivity.
2. **Infrastructure Development:** Establish mini-processing units in key villages to improve accessibility and streamline operations.
3. **Market Positioning:** Highlight the health, environmental, and cosmetic benefits of Arenga sugar to increase awareness and demand.
4. **Policy Advocacy:** Encourage community groups to register under "Perhutanan Sosial/Social Forestry" mechanisms to secure legal production rights and financial support.
5. **Technology Integration:** Invest in modern equipment to improve production efficiency and quality, enabling scalability for global markets.

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