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Feasibility Analysis of Seaweed Processing Industry Infrastructure Development in Muara Badak, Kutai Kartanegara

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Abstract: This study analyzes the feasibility of developing a seaweed processing industry in Muara Badak, Kutai Kartanegara, by assessing technical, financial, market, social, and environmental aspects. The research adopts a mixed methods approach, combining quantitative financial analysis with qualitative assessments of community dynamics and institutional readiness. Data collection was conducted over three months through field surveys, interviews, and secondary sources. The technical evaluation confirms the adequacy of local infrastructure and raw material availability to support a facility capable of processing 20 tons of wet seaweed per day. Financially, the project shows strong viability, with a Net Present Value (NPV) of IDR 15.05 billion, an Internal Rate of Return (IRR) of 35%, a payback period of 4.16 years, and a break-even point of 19 tons/day. Market analysis highlights significant domestic and international demand growth for value-added seaweed products. Social impacts include increased farmer income, job creation, and greater economic participation of women and farmer groups. Environmentally, the project presents manageable risks, provided that integrated waste management and coastal conservation practices are implemented. The study concludes that the seaweed processing industry in Muara Badak is not only feasible but also strategically aligns with Indonesia's blue economy agenda, offering substantial potential for sustainable coastal development.

Keywords: Feasibility Analysis; Seaweed Industry; Sustainable Development

1. Introduction

East Kalimantan as one of the strategic provinces in Indonesia has a very long and diverse coastline, stretching from north to south, which is rich in potential marine resources (Kaltim, 2024). Kutai Kartanegara Regency (Kukar), as one of the regencies in this province, has a large coastal area and the potential to develop the marine and fisheries sector, especially in the field of seaweed cultivation (Susanto et al., 2023). This potential is growing with the geographical advantages and natural resources that support it, as well as policy support from the local government that strengthens sustainable development in the region.

The coastal area of Kukar has a significant size, with strategic sub-districts such as Samboja, Muara Badak, Marangkayu and Muara Jawa as the main centers of seaweed cultivation (Susanto et al., 2023, pp. 39 & 41). Favorable waters and the availability of fertile pond and coastal land are the main driving factors for the development of this commodity. The dominant seaweed species developed are Gracilaria and Eucheuma cottonii, which are currently showing a trend of gradually increasing production over the past few years (Simamora et al., 2024). One of the sub-districts with the largest production is Samboja, which accounts for almost 50% of the total seaweed production in the region.

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In addition to the opportunities from an agribusiness and marine perspective, the local government has also shown a real commitment to integrating the development of seaweed cultivation in regional development flagship programs (Bone, 2023). Through programs such as Kukar Idaman, area-based agricultural and marine development is the main focus, including the provision of training, mentoring, and the provision of equipment and supporting infrastructure such as boats and auxiliary machinery for seaweed farmers (KukarPaper, 2025). This support aims to improve the productivity, quality and welfare of coastal communities in a sustainable manner.

One of the strategic initiatives being developed is the construction of a seaweed processing plant located in Muara Badak Sub-district and planned to operate starting in 2025 (Fathullah, 2025). This plant is expected to optimize the added value of the seaweed harvest by processing raw materials into high-value products, such as seaweed powder, carrageenan, and other derivative products that have a wide market, both domestically and internationally (Widjaja et al., 2025). The presence of this processing facility will not only increase product competitiveness at the regional and global levels, but also open up new market opportunities with large capacity.

Along with broad market prospects and abundant production volumes, Kukar has great potential to become the center of the seaweed industry in East Kalimantan (Waldron et al., 2024). However, the main obstacle faced at present is the lack of local processing facilities, so most of the harvest is sold in the form of raw materials which are then sent outside the province, such as South Sulawesi, for processing (Ruhon et al., 2023). This practice lowers the economic value accruing to farmers, as well as increasing logistics and distribution costs, which in turn reduces their profit margins and limits the attractiveness of continuing to increase production (Puspita, 2021).

These conditions emphasize the urgent need for the development of adequate seaweed processing industry infrastructure in the East Kalimantan region, especially in Kukar. This infrastructure is expected to ensure the durability of the product's economic value, accelerate distribution flows, and increase the economic growth of coastal communities. The construction of a seaweed processing plant will be an important catalyst in turning this potential opportunity into a tangible economic reality, while supporting the sustainability of natural resource management and the success of regional development programs (Hidayat et al., 2024; Irawan, 2024).

The importance of feasibility studies in this context cannot be ignored. As with all economic and development principles, a major investment project should be based on a comprehensive analysis of its technical, financial, social and environmental aspects. An in-depth feasibility study will help identify risks, assess the balance of costs and benefits, and ensure that the seaweed processing plant project is efficient and sustainable.

2. Materials and Methods

2.1. Research Approach

This study adopted a mixed methods approach combining quantitative and qualitative techniques to gain a comprehensive view of the feasibility and development of the seaweed processing industry in Muara Badak, Kutai Kartanegara. The quantitative component focused on financial feasibility, production capacity, and market analysis, while the qualitative component explored institutional, social, and community-related factors affecting the industry.

2.2. Research Location and Duration

The study was conducted in Muara Badak Ulu Village, selected purposively due to its central role in seaweed farming and the presence of a processing facility. Data collection spanned a period of three months, aligning with the seaweed production cycle and local economic activities.

2.3. Population and Sampling

The target population comprised seaweed farmers, processing industry actors, and government stakeholders involved in the development of the seaweed sector. A purposive sampling method was employed, including respondents from farmer groups, small-scale entrepreneurs, and officials from the Kutai Kartanegara Office of Industry and Trade, to capture diverse stakeholder insights.

2.4. Data Collection Techniques

Primary data collection was conducted through:

- Structured questionnaires administered during field surveys,
- Direct observations of production activities, facilities, and infrastructure,

- In-depth interviews with farmers, business owners, and policy stakeholders to understand challenges, opportunities, and support mechanisms.

Secondary data were compiled from:

- Official reports,
- Production and trade statistics,
- Relevant academic sources.

2.5. Data Analysis

2.5.1. Quantitative Analysis

Quantitative analysis Included:

1. Cost and Revenue Calculation
   - Total Cost (TC):

$$\boldsymbol{TC = Fixed\ Costs\ (FC) + Variable\ Costs\ (VC)} \quad (1)$$

   - Revenue (R):

$$\boldsymbol{R = Output\ Quantity \times Selling\ Price} \quad (2)$$

   - Profit (π):

$$\boldsymbol{\pi = R - TC} \quad (3)$$

2. Net Present Value (NPV)

$$\boldsymbol{NPV = \sum_{t=1}^{n} \frac{Rt - Ct}{(1+r)t}} \quad (4)$$

Where:
Rt = Revenue in year t,
Ct = Cost in year t,
r = discount rate,
n = project lifespan.

3. Internal Rate of Return (IRR)

$$\boldsymbol{NPV = 0 = \sum_{t=1}^{n} \frac{Rt - Ct}{(1+IRR)t}} \quad (5)$$

4. Break-Even Point (BEP):

$$\boldsymbol{BEP\ (unit) = \frac{Fixed\ Costs}{Selling\ Price\ per\ unit - Variable\ Cost\ per\ unit}} \quad (6)$$

5. Market Analysis
   Descriptive statistics were used to analyze supply trends, price volatility, demand fluctuations, and potential market access.

2.5.2. Qualitative Analysis

Qualitative analysis used:

- Data reduction,
- Narrative presentation, and
- Conclusion drawing based on themes arising from interviews and observations.

A SWOT analysis was conducted to synthesize internal strengths and weaknesses with external opportunities and threats, forming the basis for strategic development planning.

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2.6. Validity and Reliability

To ensure data validity and reliability, triangulation was applied by comparing primary and secondary data sources. Consistency checks were conducted through repeated interviews and document validation to ensure accurate and credible findings.

3. Results

3.1. Technical Results

The selected site for the seaweed processing facility in Muara Badak Ulu Village is considered technically feasible. Key findings include:

- Installed processing capacity of 20 tons/day (wet) or 6 tons/day (dry).
- Adequate supporting infrastructure: road access, electricity, and water supply.
- Steady availability of raw materials, supported by increasing seaweed production trends in Kutai Kartanegara.

3.2. Financial Results

1. Net Present Value (NPV)

$$\boldsymbol{NPV = Rp15,053,700,000}$$

- Indicates the project is financially viable.

2. Internal Rate of Return (IRR)

$$\boldsymbol{IRR \approx 35\%}$$

- Exceeds the industry benchmark of 12%, suggesting high profitability.

3. Payback Period (PP)

$$\boldsymbol{PP = 4.16\ years}$$

- The initial investment can be recovered in less than five years.

4. Break-Even Point (BEP)

$$\boldsymbol{BEP = 6,176 tons/year = 18.7 tons/day}$$

- Minimum daily production required to avoid financial loss is approximately 19 tons/day.

The financial feasibility of the seaweed processing plant in Muara Badak was assessed using standard investment evaluation metrics, including NPV, IRR, Payback Period, and Break-Even Point. The results are visualized in Figure 1.

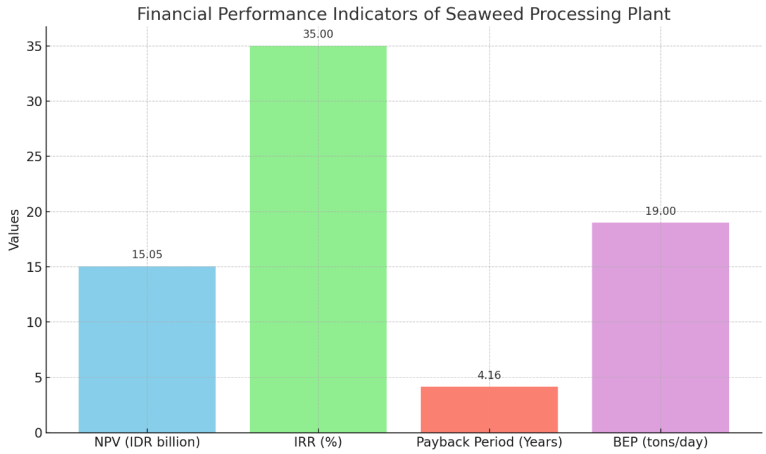

Figure 1. Financial Result

3.3. Market Results

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- Domestic Market: Growing demand for health food, cosmetics, and nutraceuticals based on seaweed-derived ingredients.
- Export Market: Indonesia contributes 16.2% to global seaweed exports, yet mostly in raw form. Value-added processing can significantly enhance global competitiveness.
- Global Outlook: The seaweed-based product market is projected to reach USD 11.8 billion by 2030, offering substantial potential for product diversification and exports.

3.4. Social and Environmental Results

The social impacts observed during the study indicate meaningful improvements in the livelihoods of local communities. Farmers reported an increase in the farm-gate price of seaweed, from Rp 7,000–8,000/kg before the factory's operation to Rp 14,000–16,000/kg afterward. As a result, average seasonal income doubled, from Rp 9 million to Rp 18 million per household. These improvements directly enhance household economic resilience and provide additional motivation for production.

Moreover, the factory has generated new employment opportunities in both processing and logistics, particularly empowering women in local communities who are actively engaged in sorting, drying, and packaging. The formation of cooperatives and farmer groups also reflects growing organizational strength and collective bargaining power.

Environmentally, while the facility has initiated some waste management practices, potential impacts such as increased solid and liquid waste, coastal ecosystem disturbances, and plastic pollution remain critical areas of concern. About 30% of respondents expressed worry over these issues. Integrated and environmentally friendly waste management systems, along with community awareness programs, are essential to mitigate these risks.

4. Discussion

The development of the seaweed processing industry in Muara Badak is proven to be financially, socially, and strategically feasible.

From a financial perspective, the project demonstrates strong viability with an NPV of Rp 15.05 billion, an IRR of 35%, and a payback period of only 4.16 years. These indicators confirm that the investment is profitable and low-risk, provided production remains above the break-even point of 19 tons/day.

Socially, the project has significantly improved community welfare. Farmers' income has doubled, farm-gate prices increased, and job opportunities—especially for women—have expanded. The formation of farmer groups and cooperatives strengthens local capacity and bargaining power.

Strategically, the facility supports Indonesia's downstream marine industry policy by adding value to seaweed products locally. This reduces raw export dependence and enhances regional economic resilience.

However, environmental sustainability must be ensured. Waste management and ecological monitoring should be prioritized to prevent long-term damage. Community participation and green technologies are key to maintaining environmental balance.

In summary, this project has strong potential to become a model for sustainable agro-industrial development in coastal areas, balancing economic growth, community empowerment, and environmental protection.

5. Conclusions

This study concludes that the development of the seaweed processing industry in Muara Badak, Kutai Kartanegara, is highly feasible and strategically beneficial across multiple dimensions:

1. Technically, the project is well supported by the availability of raw materials, appropriate site conditions, and sufficient infrastructure for processing operations.
2. Financially, the investment yields strong performance indicators with an NPV of Rp 15.05 billion, an IRR of 35%, a payback period of 4.16 years, and a manageable break-even point of 19 tons/day.
3. Socially, the project significantly improves local livelihoods through increased seaweed prices, higher farmer incomes, and job creation—especially involving women and farmer groups.
4. Market-wise, the project aligns with both domestic consumption trends and global demand for value-added seaweed products, positioning Indonesia to benefit from export market expansion.
5. Environmentally, while impacts are currently manageable, proactive waste management and sustainability practices are required to protect coastal ecosystems in the long term.

Overall, the seaweed processing plant is not only economically viable but also contributes to regional development, community empowerment, and marine resource optimization. With proper collaboration

among stakeholders and commitment to sustainability, this initiative can serve as a replicable model for coastal agro-industry development in Indonesia.

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