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Assessing Economic Carrying Capacity through Financial Feasibility Analysis for Sustainable Seaweed and Pearl Oyster Mariculture in the Dampier Strait Conservation Area

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ABSTRACT
A financial feasibility analysis in mariculture activities is necessary to ensure the business can provide economic benefits and operate sustainably. The Dampier Strait Conservation Area has the potential to develop seaweed and pearl oyster cultivation businesses. However, as a conservation area, its utilization must consider environmental carrying capacity. This study aims to assess the financial feasibility of seaweed and pearl oyster cultivation in the Dampier Strait Conservation Area as a basis for optimal, environmentally friendly business planning that provides economic benefits for the local community. Financial feasibility is measured using a cost-benefit analysis method. The first step is to determine the efficiency of component use and cost structure in the aquaculture business planning scheme. The results of the cost and benefit calculations are used to determine the capacity for developing the aquaculture business, which includes an assessment of several aspects of future investment. Based on the results of the cost-benefit analysis, the marine aquaculture business for both commodities is feasible for development, having met business feasibility requirements based on the comparison of cost and benefit values, the percentage of profit, the rate of return on assets, the difference and comparison between expenses and revenues, and the payback period. All stages of the analysis have been able to produce comprehensive results to achieve optimal and sustainable utilization of the area through the development of mariculture activities. This has taken into account the continuity between environmental potential and human demands for utilizing ecosystem services in an integrated manner.

Keywords: Dampier Strait, financial feasibility, pearl oyster, seaweed, mariculture

INTRODUCTION

Assessing the financial feasibility of the aquaculture sector is an important step to ensure that the business is able to provide economic benefits, both the added value of the cultivator's economy and the improvement of the regional economy (Talakua, 2017; Maryunus *et al*. 2018). In mariculture activities, all production factors need to be considered because they are a form of short-term and long-term investment that will ultimately affect the assessment of economic feasibility (Rahman 2022; Ahmad 2023). Therefore, a careful evaluation is needed regarding the amount of costs incurred and how much income can be generated. By doing so, business actors and policy makers can assess that the cultivation activities carried out are feasible to be developed and have the potential to provide economic benefits.

The financial feasibility aspect is part of a step in planning and developing cultivation activities. In addition, financial feasibility also serves as a basis for assessing economic carrying capacity (Byron and Costa-Pierce, 2013). This is to measure the ability of the environment and the market to

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support sustainable business expansion. That way, business actors can consider the availability of production inputs, market access, and price stability as part of the evaluation to ensure that the cultivation activities carried out can run in the long term and sustainably.

Fiscal feasibility evaluation in aquaculture involves determining the efficiency of the use of components and cost structures in the business planning scheme as well as determining business development capacity from the perspective of long-term investment. The use of this method allows for a more objective and measurable assessment of the company's profit opportunities and risks. With the right calculations, cultivators can make rational decisions, such as determining the appropriate commodities, optimal production capacity, and the right marketing strategy.

The potential for the development of seaweed and pearl oyster cultivation in the Dampier Strait Conservation Area is one of the promising marine economic opportunities, especially in supporting the local economy. This region has water characteristics that are able to support the growth of these two high-value commodities (Wibowo *et al*. 2023). However, to ensure that the development of aquaculture can provide economic benefits without causing pressure on the environment, considering the status of the area as a marine conservation area that has several technical limitations on utilization that are specifically described in, a comprehensive financial feasibility analysis is needed (KKP 2014)

Overall, the application of financial feasibility analysis in aquaculture aims not only to assess the profit aspect, but also to ensure economic and environmental sustainability. Cultivation decisions that are not based on the right measures can lead to financial losses, ecosystem damage, and market price volatility. Therefore, this study aims to assess the financial feasibility of seaweed and pearl oyster cultivation in the Dampier Strait Conservation Area, West Papua Province. The results obtained are expected to be a very important foundation in planning, developing, and managing aquaculture businesses in order to be able to provide optimal benefits for business actors, communities, and the local economy. In addition, it is also expected to be an important basis in calculating the economic carrying capacity of the region, so that resource management can be carried out in a sustainable manner.

MATERIAL AND METHOD

Financial feasibility is assessed using the cost-benefit analysis method (Byron and Costa-Pierce, 2013) which is a way to assess the efficiency of the use of components and cost structures in aquaculture business planning schemes based on income and profit levels (Kadariah *et al*. 1999; Soekartawi 2002).

There are several stages of analysis carried out to assess financial feasibility. The first step is to determine the efficiency of using components and cost structures in the cultivation business planning scheme. It begins with identifying and calculating costs and benefits (Kadariah *et al*. 1999; Arkham *et al*. 2020). Then, tabulation in cash flow is carried out. The tabulation in cash flow includes several calculations which are outlined as follows.

Total Cost

$$TC = TVC + TFC$$

Description:
TC = total cost (Rs)
TVC = total variable cost (Rs)
TFC = total fixed cost (Rs)

Total Revenue

$$TR = P \times y$$

Description:
TR = total revenue (Rs)
P = product price (Rp/Kg; Rp/spat)
y = production volume (Kg/cultivation unit; spat/cultivation unit)

Total Gross Profit

$$\pi = TR - TC$$

Description:
π = gross profit (Rs)
TR = total revenue (Rs)
TC = total cost (Rs)

With the criteria of financial eligibility:

- Total revenue > Total costs, profits, use of components and cost structures in cash flow are efficient
- Total revenue = Total cost, business at break-even where TR = TC, efficient use of components and cost structures in cash flow
- Total revenue > Total costs, operating losses, use of components and cost structures in cash flow are inefficient

Furthermore, the results of the cost and benefit analysis were used to assess the development capacity of the aquaculture business by evaluating several investment feasibility indicators for future business expansion. The assessment was conducted using the

calculation formulas proposed by Soekartawi (2002) and Azis *et al*. (2022), as described below.

Gross Profit Margin

$$\text{GPM} = \frac{\pi}{\text{TR}} \text{ x } 100$$

Description:
GPM = gross profit margin (%)
π = gross profit (Rs)
TR = total revenue (Rs)

Business eligibility criteria:
- Gross Profit Margin ≤ 5%, low profit revenue retention
- Gross Profit Margin > 5%-10%, good profit receipt retention
- Gross Profit Margin > 10%, high profit revenue retention

Revenue/Cost Ratio (R/C Ratio)

$$\text{R/C Ratio} = \frac{\text{TR}}{\text{TC}}$$

Description:
TR = total revenue (Rs)
TC = total cost (Rs)

Business eligibility criteria:
- R/C Ratio > 1, profitable business
- R/C Ratio = 1, the business is in a breakeven state where TR = TC
- R/C Ratio < 1, Loss Effort

Benefit/Cost Ratio (B/C Ratio)

$$\text{B/C Ratio} = \frac{\text{PVB}}{\text{PVC}}$$

Description:
PVB = present value benefit (Rs)
PVC = present value cost (Rs)

Business eligibility criteria:
- B/C Ratio > 1, profitable business
- B/C Ratio = 1, business at break-even
- B/C Ratio < 1, Loss Effort

Return of Investment (ROI)

$$\text{ROI} = \frac{\text{TR} - \text{TC}}{\text{TC}} \text{ x } 100$$

Description:
ROI = Return of investment
TR = total revenue (Rs)
TC = total cost (Rs)

Business eligibility criteria:
- ROI > current bank interest rates, business is feasible
- ROI < current bank interest rates, business not feasible

Net Present Value (NPV)

$$\text{NPV} = \sum_{t=1}^{n} \frac{\text{Bt} - \text{Ct}}{(1+\text{i})^t}$$

Description:
NPV = Net present value (Rs)
Bt = annual benefit (Rs)
Ct = annual cost (Rs)
$(1+\text{i})^t$ = Discount factor (df)
i = Interest rate
t = Economical lifespan

Business eligibility criteria:
- NPV > 0, business is feasible
- NPV = 0, business in breakeven point where TR = TC
- NPV < 0, business not feasible

Net Benefit Cost (NBC)

$$\text{NBC} = \frac{\sum_{t-0}^{n} \frac{\text{Bt} - \text{Ct}}{(1+\text{i})^t}}{\sum_{t-0}^{n} \frac{\text{Ct} - \text{Bt}}{(1+\text{i})^t}}$$

Description:
NBC = Net benefit cost (Rs)
Bt = annual benefit (Rs)
Ct = annual cost (Rs)
$\frac{1}{(1+\text{i})^t}$ = Discount factor (df)
i = Interest rate
t = Economical lifespan

Business eligibility criteria:
- NBC > 0, business is feasible
- NBC = 0, business in breakeven point where TR = TC
- NBC < 0, business not feasible

Payback Period (PP)

$$\text{PP} = \frac{\text{I}}{\text{NI}} \text{ x 1 Tahun}$$

Description:
PP = Payback period
I = investment (Rs)
THE = net income (Rs)

Business eligibility criteria:
- PP < 5 years investment age, business is feasible
- PP > 5 years of investment age, business not feasible

Please explain any limitation of research like environmental issue, seed of seawed, kind of ooyster, etc

RESULT AND DISCUSSION

Result

The financial feasibility of the seaweed and pearl oyster cultivation business is categorized as feasible. The use of components and cost structures in cash flow is efficient to generate profits. The total amount of income is greater than the capital invested, so that the business is categorized as monetarily profitable and has been able to cover the

operational expenses of the business unit in producing post-harvest products.

Furthermore, based on the results of the business feasibility analysis, it was found that the cultivation business of the two commodities is feasible to be developed. This is shown from the eligibility criteria based on the comparison of costs and benefits, the percentage of profits, the level of return on assets, the difference and comparison between expenses and receipts, and the time of return of capital (Table 1 and Table 2).

Table 1. Financial Feasibility Criteria for Seaweed Mariculture Activities in the Dampier Strait Conservation Area.

Eligibility Criteria	Value	Remarks
Revenue/Cost Ratio (R/C)	1,28	R/C *Ratio* >1, profitable business
Benefit/Cost Ratio (B/C)	1,28	B/C *Ratio* >1, profitable business
Gross Profit Margin	> 10%,	High-profit revenue retention
Return of Investment (ROI)	28%	ROI > current interest rates, a viable venture
Net Present Value (NPV)	IDR 171,665,731	NPV > 1, worth the effort
Net Benefit Cost (NBC)	9,83	NBC > 1, worth the effort
Payback Period (PP)	1 year 2 months	PP < 5 years

Information/source: Research Data Analysis

Table 1. Financial Feasibility Criteria for Pearl Oyster Mariculture Activities in the Dampier Strait Conservation Area.

Eligibility Criteria	Value	Remarks
Revenue/Cost Ratio (R/C)	1,37	R/C *Ratio* >1, profitable business
Benefit/Cost Ratio (B/C)	1,24	B/C *Ratio* >1, profitable business
Gross Profit Margin	> 10%,	High-profit revenue retention
Return of Investment (ROI)	44%	ROI > current interest rates, a viable venture
Net Present Value (NPV)	IDR 86,230,315	NPV > 1, worth the effort
Net Benefit Cost (NBC)	1,98	NBC > 1, worth the effort
Payback Period (PP)	3 years 2 months	PP < 5 years

Information/source: Research Data Analysis

The ratio between income and profit to capital is included in the profitable category (R/C Ratio > 1 and B/C Ratio > 1) with high profit retention (GPM > 10%). The Return on Investment ratio exceeded Bank Indonesia's interest rate in 2022 by 5.75%. The accumulated Net Present Value (NPV) over five years has a value above one (NPV > 1) with a comparative value between the number of positive and negative NPVs of more than one (NBC > 1). The asset recovery period is below the planned business investment life.

Discussion

The results of the analysis showed that the seaweed and pearl oyster cultivation business was included in the financially viable category. This feasibility is shown by the total income that is larger than the invested capital, so that the business can generate profits while covering operational costs during the production process until post-harvest. Financial viability in aquaculture enterprises is fundamentally determined by the ability of revenue streams to consistently exceed total expenditures across a defined investment horizon, encompassing both fixed and variable costs (Shang 1990). The components and cost structures applied in cash flow are also considered efficient in supporting business continuity and generating optimal economic value. The efficiency of cost components reflects sound resource allocation practices, which are critical for sustaining production cycles and maintaining competitive margins in volatile commodity markets. Thus, both types of cultivation businesses have good prospects to be developed as mariculture-based economic activities.

Furthermore, based on the results of the business feasibility analysis, it was found that the cultivation business of the two commodities is feasible to be developed. This is shown from the eligibility criteria based on the comparison of costs and benefits, the percentage of profits, the level of return on assets, the difference and comparison between expenses and receipts, and the time of return of capital. The Revenue Cost Ratio (R/C Ratio) and Benefit Cost Ratio (B/C Ratio) values are above one, which shows that the business provides economic profits. R/C Ratio exceeding one is the standard threshold in project evaluation indicating that total discounted benefits surpass total discounted costs, thereby affirming economic viability from an investor's perspective (Kadariah 2001). In addition, the Gross Profit Margin (GPM) value is more than 10%, so the profit retention rate is relatively high and reflects the business's ability to generate net profit effectively. GPM above 10% is generally considered satisfactory in smallholder aquaculture contexts, as it signals an adequate buffer against input cost fluctuations and market price variability — both of which are characteristic features of seaweed and shellfish commodity systems (Kasmir and Jakfar, 2013).

The results of the analysis also show that the value of Return on Investment (ROI) exceeds Bank Indonesia's interest rate in 2022 by 5.75%, so investment in seaweed and pearl oyster cultivation is considered more profitable than capital storage in the banking sector. When ROI surpasses the prevailing risk-free rate, the opportunity cost of capital is satisfied, meaning that business

investment yields a return superior to what could be obtained through passive financial instruments; a fundamental criterion for rational investment decision-making (Brigham and Houston, 2019). Accumulated Net Present Value (NPV) over five years shows a positive value with a Net Benefit Cost Ratio (NBC) greater than one. A positive NPV confirms that the present value of future cash inflows exceeds the initial capital outlay when discounted at the appropriate rate, reflecting a net wealth gain for the investor over the project's lifespan (Gitman *et al*. 2011). This condition indicates that the economic benefits obtained are greater than the investment costs incurred. In addition, the payback period is below the planned investment life, so the level of business risk is relatively low and allows for a faster return on capital. A payback period shorter than the asset's economic life reduces exposure to long-term uncertainties, including regulatory changes, environmental variability, and commodity price shifts that are particularly relevant in coastal aquaculture systems (Little *et al*. 2016).

In general, the results of the study show that the Dampier Strait Conservation Area has economic characteristics that can support the development of sustainable mariculture activities. This potential is reflected in financial feasibility indicators that show that seaweed and pearl oyster cultivation businesses can provide economic added value and increase opportunities for the welfare of coastal communities. With the support of good environmental conditions and market prospects, these two commodities have the potential to become leading sectors in the development of a cultivation-based marine economy.

The results obtained show that the Dampier Strait Conservation Area has economic characteristics that are able to support the sustainable implementation of mariculture activities and bring monetary added value to improve people's living standards. This is seen from the criteria of financial feasibility and business development capacity of the two commodities. The coexistence of conservation mandates and economic utilization within marine protected areas reflects the growing recognition that sustainable aquaculture can align with biodiversity objectives when governed through adaptive co-management frameworks that balance ecological integrity with livelihood imperatives (Ahmed and Thompson, 2019). The components and cost structure used in the business planning scheme are able to support the sustainability of seaweed and pearl oyster cultivation business effectively. This can be seen from its determination which has considered financial aspects based on fluctuating market conditions. This situation requires an accurate projection because the characteristics of production capital are dynamic so that sometimes it can cause instability in the fabrication process in producing post-harvest products. Sensitivity analysis and scenario-based forecasting are therefore recommended as complementary tools to static feasibility indicators, enabling business actors to anticipate adverse conditions and adjust operational strategies accordingly (Umar 2009). Through this, a business actor can estimate the value of benefits in the long term.

The description indicates that the results of the financial feasibility analysis can estimate the amount of costs incurred and benefits received by an investor when he wants to run a seaweed and pearl oyster farming business. According to Gibbs (2007), details of capital, revenue, and projected profits in cash flow can be the basis of a work plan system for business actors in making decisions to develop their business measurably and efficiently. This perspective is reinforced by the recognition that structured financial planning tools, including pro forma cash flows, break-even analysis, and investment appraisal metrics collectively enhance the strategic capacity of both smallholder and commercial operators to navigate the inherent uncertainties of aquaculture production (FAO 2022). It also stated that the level of fiscal feasibility can be the basis for determining the standard threshold for industrial expansion that can facilitate the taking of preventive measures, if in the course of activities with economic value occur force majeure which has the potential to cause conflict (Little *et al*. 2013). Establishing clear feasibility benchmarks serves not only as a financial safeguard but also as a governance instrument, enabling regulatory authorities and community stakeholders to define acceptable risk thresholds and ensure that mariculture expansion occurs within ecologically and socially sustainable boundaries.

CONCLUSION

The financial feasibility analysis demonstrates that seaweed and pearl oyster mariculture in the Dampier Strait Conservation Area is economically feasible and has strong potential for sustainable business development. Both commodities satisfy all investment feasibility criteria, including Revenue-Cost Ratio (R/C), Benefit-Cost Ratio

(B/C), Gross Profit Margin (GPM), Return on Investment (ROI), Net Present Value (NPV), Net Benefit-Cost Ratio (Net B/C), and Payback Period (PP), indicating that expected revenues exceed investment and operational costs while providing attractive returns within a relatively short capital recovery period. These findings confirm that the existing cost structure and cash flow management efficiently support profitable and financially sustainable mariculture enterprises.

The positive financial performance also suggests that seaweed and pearl oyster cultivation can serve as viable livelihood options for coastal communities while supporting economic development within a marine conservation area. When implemented under appropriate environmental management and governance frameworks, these mariculture activities can contribute to balancing conservation objectives with local economic benefits. Therefore, the financial feasibility results provide a practical basis for investors, local communities, and policymakers in planning sustainable mariculture development in the Dampier Strait Conservation Area. Future studies should integrate financial feasibility with ecological carrying capacity, market dynamics, and sensitivity analyses to support long-term sustainable investment and adaptive management.

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