AGROMIX, Volume 16 Number 1 (2026), Pages 25-34

AGROMIX
pISSN (Print): 2085-241X; eISSN (Online): 2599-3003
Website: https://jurnal.yudharta.ac.id/v2/index.php/agromix

The analysis potential of saline tilapia (*Oreochromis niloticus*) as a primary commodity candidate for silvofishery culture

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Original article

Article history
Received : March 7, 2024
Accepted : February 13, 2025
Published : March 30, 2025

Keyword
Brackish water;
Feasibility analysis;
Oreochromis niloticus;
Silvofishery;

ABSTRACT

Introduction: Silvofishery is an innovative environmentally friendly aquatic cultivation concept currently widely developed in coastal areas with various cultivation commodities. The purpose of this research is to analyze the feasibility of saline tilapia (*Oreochromis niloticus*) as a biological, ecological, and financial commodity for silvofishery cultivation. **Methods:** This research method utilized a causal ex-post facto design on four silvofishery ponds. The parameters studied include water quality, biological parameters of fish, plankton abundance, and financial feasibility parameters of the business. **Results:** The research results show that the weight of saline tilapia ranged from 3.01 to 21.24 gr/fish (13.37 ± 6.53) and biomass growth ranged from 3.010 to 19.116 kg (12.886 ± 7.79). Silvofishery water quality parameters resulted in pH data of 7.8-8.2 (8.0 ± 0.14), dissolved oxygen of 4.01-5.92 mg/L (4.90 ± 0.55), temperature of 31.00-32.75°C (31.80°C ± 0.60), salinity of 5-8 gr/L (6.3 ± 1.28), and organic matter of 54.32-73.87 mg/L (62.90 ± 6.33). Plankton abundance ranged from 10,000 to 90,000 cells/ml with the dominance of the genus *Chlorella* sp. The business feasibility analysis results showed a profit value of Rp. 8,840,000,-, R/C Ratio of 1.55, BEP unit of 297 kg, BEP sales of Rp. 4,428,000,-, profitability of 25%, Net Present Value of Rp. 101,528,000,-, IRR of 20.45%, and payback period of 2.7 years. This means that based on growth performance, pond water quality conditions, and business profit levels, the use of saline tilapia commodities in silvofishery pond cultivation is highly recommended. **Conclusion:** This research concludes that saline tilapia commodities are highly suitable when used as primary cultivation in integrated and comprehensive silvofishery activities.

Cite this article:
Ariadi, H., Soeprapto, H., & Sulistiana, A. (2025). The analysis potential of saline tilapia (*Oreochromis niloticus*) as a primary commodity candidate for silvofishery culture. *AGROMIX, 16*(1), 25–34. https://doi.org/10.35891/agx.v16i1.4944

INTRODUCTION

Aquaculture is a very important agribusiness activity that supports the world's food security system (Mardiana et al., 2024). The aquaculture sector contributes to 75% of the world's total animal protein needs (FAO, 2021). The need for animal protein from fish and shrimp biota is currently increasingly popular because of the low risk of disease produced (Linayati et al., 2024). In the first quarter of 2021, Indonesia's fish production in the global market reached 7,500 tons (FAO, 2021). This has great potential to be developed as a form of effort to improve the world's food security system from aquaculture results.

Saline tilapia (*Oreochromis niloticus*) is an adaptive and easily cultivated fish species (Ariadi *et al.*, 2020). The advantages of saline tilapia include high survival rates, rapid growth rates, and high feed conversion ratios, and its seeds are easily obtained (Ariadi *et al.*, 2022). Saline tilapia seeds are easily obtained due to their wild egg reproduction system, allowing for a high hatching process (Ariadi *et al.*, 2021). Tilapia is a fish species with a relatively high egg-hatching rate (Lukman *et al.*, 2021). Additionally, the selling price of saline tilapia in the market is relatively stable compared to other cultivated fish species (Ariadi *et al.*, 2021).

Silvofishery is an integration concept between aquaculture activities and mangrove restoration carried out in an integrated manner (Musa *et al.*, 2020). Silvofishery is widely developed as an adaptation form of environmentally friendly aquaculture models. Some advantages of silvofishery include a variety of cultivation productions (fish, crabs, shrimp) and cultivation models that do not pollute the surrounding environment (Lukman *et al.*, 2021). Silvofishery is also developed as an integrated mangrove restoration model (Leon-Herrera *et al.*, 2015).

Mangroves in silvofishery serve as a medium for absorbing organic waste from aquaculture activities to prevent environmental pollution (Rahman & Mahmud, 2018). Mangrove breathing roots also provide an ideal habitat for fish breeding and crab living media (Wijayanti & Pratomo, 2016). Silvofishery is widely developed due to the increasing unfriendliness of aquaculture activities in coastal areas. Some main commodities commonly used for silvofishery cultivation include milkfish and mullet (Musa *et al.*, 2020). Physiologically, milkfish and mullet have low growth rates when cultivated in brackish water (Linares-Cordova, 2024). Therefore, it is necessary to develop new commodities that are more profitable for silvofishery cultivation in brackish water.

Saline tilapia is a potential candidate that can be used as a commodity for silvofishery cultivation (Ariadi *et al.*, 2024). The physiological characteristics of saline tilapia which are easily adaptable to brackish water salinity conditions are very supportive to be used as a cultivated biota (Taufiqurrohman *et al.*, 2023). In addition, the silvofishery system that uses the agroforestry concept is also very suitable for brackish water fish commodities (Ariadi *et al.*, 2024). Therefore, there needs to be a study on the feasibility test of commodities for silvofishery cultivation using saline tilapia as the cultivated.

Based on the above gap analysis, the purpose of this research is to analyze the feasibility of saline tilapia (*Oreochromis niloticus*) as a biological, ecological, and financial commodity for silvofishery cultivation. This research hopes to provide a feasibility study for the development of silvofishery cultivation in brackish waters.

METHODS

This research was conducted using the concept of causal ex-post facto design or natural field observation. The study took place in the silvofishery ponds of Krapyak Village, Pekalongan City, for one cultivation cycle. There were four silvofishery ponds observed, utilizing saline tilapia as the cultivated commodity.

The variables observed during the study included water quality parameters (pH, dissolved oxygen, salinity, temperature, and organic matter), fish biological parameters (fish weight, fish biomass, and daily feed intake), plankton abundance, and the financial feasibility analysis of the business, which encompassed profit analysis, R/C Ratio, BEP unit, BEP sales, profitability, Net Present Value, Internal Rate of Return, and payback periods.

The method of financial feasibility analysis, including profit analysis, R/C Ratio, BEP unit, BEP sales, profitability, Net Present Value, Internal Rate of Return, and payback periods, was calculated based on equations developed by Primyastanto (2016) as follows:

Profit analysis

Business profit is the value of the difference between revenue (TR) and production costs (TC) calculated by the formula:

$$\pi = TR - TC$$

exp : π = profit results
TR = total revenue
TC = total cost

Where π represents profit, TR denotes total revenue, and TC refers to total cost. Profitability is a key indicator of business performance, reflecting the efficiency of resource utilization and cost management (Chiladze, 2018). For instance, in aquaculture enterprises, total revenue is generated from fish sales, while total costs include expenses for feed, labor, pond maintenance, and other operational expenditures (Arikan & Aral, 2019). A positive profit ($\pi > 0$) indicates financial sustainability, whereas a negative profit ($\pi < 0$) suggests a need for cost reduction or revenue enhancement strategies. Effective cost management and market-driven pricing strategies are essential to optimizing business profitability (Larka & Pavlenko, 2021). By analyzing these factors, aquaculture businesses can identify areas for improvement and implement targeted strategies to enhance their overall financial health and competitiveness in the market.

R/C ratio

The R/C ratio is the value of the division between revenue (TR) and production costs (TC) calculated by the formula:

$$R/C = TR / TC$$

exp : R/C = ratio between rent and cost from business
TR = total revenue
TC = total cost

Where R/C indicates the relationship between revenue and costs, TR represents total revenue, and TC refers to total costs. An R/C ratio greater than 1 ($R/C>1$) suggests that the business is profitable, as revenue exceeds production costs. Conversely, an R/C ratio below 1 ($R/C<1$) indicates financial inefficiency, implying that the business is operating at a loss (Chen *et al.*, 2011)and may need to reevaluate its pricing strategy, reduce expenses, or improve operational efficiency to enhance profitability. In the context of aquaculture, the R/C ratio is commonly used to evaluate the economic feasibility of fish farming systems. For example, a study by Musa *et al.* (2020) on silvofishery ponds found that businesses with an R/C ratio of 1.5 or higher were considered financially viable, demonstrating that every $1 spent on production generated at least $1.50 in revenue (Musa *et al.*, 2020). Factors influencing the R/C ratio include feed efficiency, stocking density, water quality management, and market price fluctuations (Bethke, 2019). By monitoring and optimizing the R/C ratio, business owners can make informed decisions to enhance profitability and long-term sustainability.

Rentability

Rantability is the percentage of profit (L) divided by working capital (M) during the business operation:

Rentability = x 100%

exp : Rentability = comparison between profit and capital that generates profit
L = profit
M = working capital

Where L represents profit, and M denotes the working capital used during business operations. A higher rentability percentage indicates a more efficient use of capital, signifying that the business generates substantial profit relative to its investment (Bardash *et al.*, 2019). In aquaculture, rentability is an essential indicator for evaluating the financial performance of different production systems. For example, a study by Braga *et al.* (2016) on intensive and semi-intensive shrimp farming found that businesses with rentability above 30% were considered financially attractive, while lower values indicated a need for better cost management or increased revenue (Braga *et al.*, 2016). Several factors influence rentability, including feed conversion efficiency, operational cost control, and market price stability (Anuar & Wahab, 2022). By analyzing rentability, business owners can assess the viability of their investment and implement strategies to improve financial sustainability.

Net present value

Net Present Value is the difference between gross revenue and total expenditure divided by the discount factor in business investment:

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

exp : NPV = Net Present Value from business activity
n = business duration
i = constanta for-i
Bt = gross revenue
Ct = total expenditure
t = business time

In aquaculture investment, NPV is commonly used to determine the long-term profitability of fish farming systems. For example, a study by Engle *et al.* (2017) found that shrimp farms with an NPV exceeding $10,000 over five years were considered financially sustainable, while farms with negative NPV values required adjustments in operational costs and revenue generation strategies. Factors such as fluctuating feed prices, market demand, and environmental conditions can impact NPV calculations. By analyzing NPV, investors can make informed decisions about the feasibility and sustainability of their business ventures.

Internal rate of return

Internal Rate of Return is the internal return rate based on the Net Present Value and the bank interest rate calculated using the following formula:

IRR = i’ + (i” – i’)

exp : IRR = Internal Rate Return
NPV = Net Present Value
i = bank interest rate

In aquaculture investments, IRR is a crucial indicator for assessing financial feasibility. A study by Mukta *et al.* (2019) on tilapia farming found that an IRR exceeding the prevailing bank interest rate indicated a profitable business, whereas a lower IRR suggested potential financial risks. Generally, an IRR higher than the market interest rate is desirable, as it implies that the investment yields better returns compared to other financial instruments, such as savings or bonds (AlZoubi, 2022). However, IRR calculations must also consider external factors such as feed costs, market fluctuations, and operational efficiency, which can influence long-term profitability (Siagian & Hakim, 2023).

By analyzing IRR, investors can make informed decisions about capital allocation and business expansion strategies. Understanding the various components that affect IRR can help stakeholders optimize their farming practices and enhance overall financial performance.

Payback periods

The payback period is the analysis of investment return, whether constant or not, during the business operation:

PP = x 1 years

exp : PP = Payback Periods
Invest = invest cost for business activity
Deposit/year = investment cost for business years

In aquaculture, the payback period is essential for evaluating the feasibility of different fish farming systems. For instance, a study by Marin-Riffo *et al.* (2021) on shrimp farming revealed that businesses with a payback period of fewer than three years were considered financially viable (Marín-Riffo *et al.*, 2021). However, factors such as fluctuating market prices, feed costs, and environmental conditions can impact the actual payback duration (Vu Thi *et al.*, 2018). By analyzing the payback period, business owners can assess investment risks and make informed decisions about scaling operations or optimizing cost structures.

RESULTS AND DISCUSSIONS

Saline tilapia growth rate

The growth rate of saline tilapia in silvofishery ponds is described as showing good progress (continuously increasing) and progressive biomass growth (Figure 1.). Biomass growth appears to decline in week 11 due to mortality. The weight of saline tilapia raised for 19 weeks ranged from 3.01-21.24 gr/fish (13.37 ± 6.53), and fish biomass growth in the pond ranged from 3.010-19.116 kg (12.886 ± 7.79) (Figure 1). Ideal environmental conditions and proper maintenance processes greatly influence the performance of fish cultured in ponds (Leon-Herrera *et al.*, 2015).

Saline tilapia is an omnivorous fish species, so its growth rate tends to continue increasing (Xing *et al.*, 2022). Omnivorous fish not only consume artificial feed but also plankton and leaf detritus (Wu *et al.*, 2021). This synthesis correlates with the silvofishery pond model located in mangrove forest areas. Mangrove leaves contain many antioxidant and bioactive compounds that support fish growth rate (Lang *et al.*, 2024). The progressive growth rate of fish correlates with the increasing biomass of fish in the silvofishery pond.

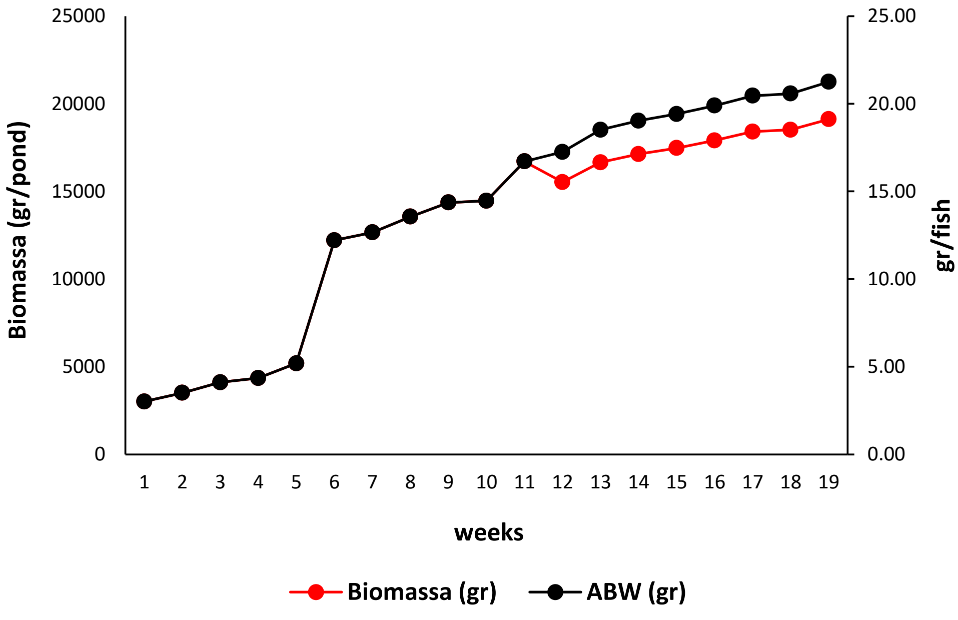

Figure 1. Fish growth rate (abw) and biomass increase in silvofishery ponds

Water quality in silvofishery ponds

The condition of water quality parameters can be seen in Figure 2. In general, pH, dissolved oxygen, temperature, and salinity parameters tend to fluctuate dynamically. The pH value ranges from 7.8 to 8.2 (8.0 ± 0.14), which falls within the optimal range for saline tilapia culture, supporting fish growth and survival. According to [relevant reference], this pH range is suitable for maintaining physiological balance and metabolic processes in tilapia. Dissolved oxygen ranges from 4.01 to 5.92 mg/L (4.90 ± 0.55), temperature from 31.00 to 32.75°C (31.80°C ± 0.60), and salinity from 5 to 8 gr/L (6.3 ± 1.28). The average salinity value in silvofishery ponds tends to be low due to the predominance of freshwater in the silvofishery aquaculture ecosystem.

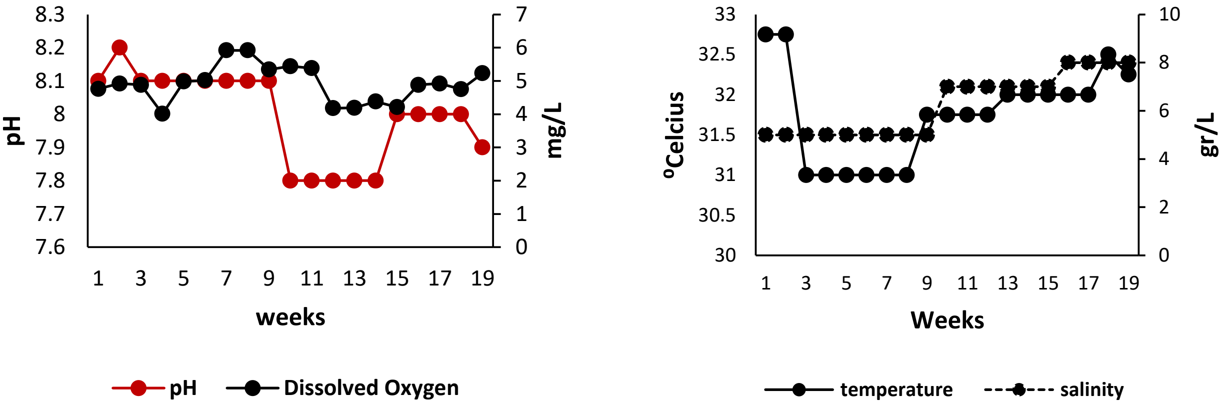

Figure 2. Fluktuasi parameter pH, dissolved oxygen, temperature, and salinity

The organic matter content in silvofishery ponds can be seen in Figure 3. The organic matter content is depicted as continuously increasing, but still within the standard threshold value for water quality. The organic matter content ranges from 54.32 to 73.87 mg/L (62.90 ± 6.33). The low concentration of organic matter indicates that in silvofishery ponds, there is an intense absorption process of organic materials by mangrove roots (Ariadi *et al.*, 2023).

Mangroves play a crucial role in regulating water quality by trapping and breaking down organic matter, which helps maintain a balanced aquatic ecosystem. Their extensive root systems not only stabilize sediments but also promote microbial activity that aids in organic matter decomposition (Rajendran *et al.*, 2016). Additionally, the presence of mangroves can reduce the risk of excessive organic accumulation, which could otherwise lead to oxygen depletion and deteriorate pond conditions (Zheng *et al.*, 2022). These findings highlight the ecological benefits of integrating mangroves into aquaculture systems, reinforcing their importance in maintaining water quality and supporting sustainable silvofishery practices.

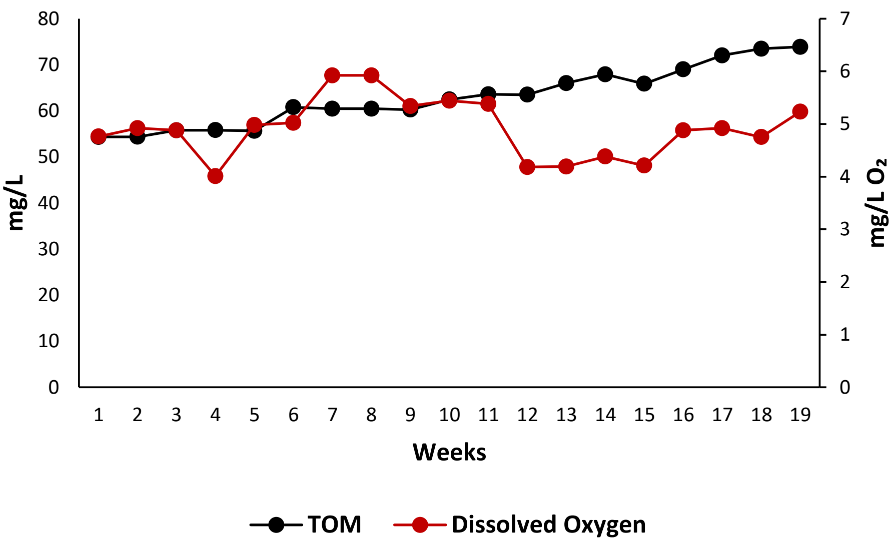

Figure 3. Organic matter abundance and oxygen solubility rate in silvofishery ponds

From the display of several water quality data, it can be explained that the presence of mangrove habitat significantly affects the stability of water quality in silvofishery ponds. Mangrove roots have the function of absorbing organic matter and suspended particles (Jiang *et al.*, 2024). Additionally, the wide stomata and physical characteristics of mangrove leaves also influence the stability of water temperature levels (Sagala *et al.*, 2024). Stable temperature correlates with the level of oxygen solubility facultatively (Mardiana *et al.*, 2023). As temperature increases, the solubility of oxygen in water decreases due to the increased kinetic energy of water molecules, leading to a reduced capacity to hold dissolved gases (Chapra *et al.*, 2021). This inverse relationship highlights the importance of maintaining stable temperature levels to ensure adequate oxygen availability for saline tilapia, as sufficient dissolved oxygen is crucial for their metabolic processes, growth, and overall survival.

The pH value of the water also tends to be dynamic and controlled. This indicates that the conditions of the silvofishery waters are quite stable and dynamic. The stability of water pH conditions is also influenced by the salinity level in the aquatic ecosystem (Ariadi *et al.*, 2023). Stable and controlled waters are very ideal for use as fish farming media (Musa *et al.*, 2020).

Plankton abundance

The abundance of plankton in silvofishery ponds tends to be diverse. From the four ponds studied, four classes and ten genera of plankton were found, with an abundance range of 10,000–90,000 cells/ml (Table 1). The most dominant plankton class is Chlorophyceae, and the most dominant plankton genus is Chlorella sp. Chlorella sp. is a plankton genus that lives colonially and grows abundantly in fertile waters (Soeprapto *et al.*, 2023). The dominance of Chlorella sp., green algae rich in protein and essential fatty acids, suggests a readily available food source for saline tilapia larvae and juveniles (Tikue & Workagegn, 2022). This nutritional contribution can enhance fish growth, immunity, and overall survival rates in silvofishery systems.

The presence of nutrients becomes a limiting factor for the growth of the Chlorella sp. genus in fish ponds (Appoo *et al.*, 2024). The stable water quality conditions and the presence of mangroves as nutrient absorbers significantly influence the abundance of plankton in silvofishery ponds (Damastuti *et al.*, 2023). Saline tilapia raised in silvofishery ponds are quite ideal when encountering Chlorella sp. Chlorella sp. is one of the plankton genera recommended to be used as natural fish feed (Soeprapto *et al.*, 2023). The protein and chlorophyll content in Chlorophyceae are highly needed for fish fry growth (Samal *et al.*, 2023).

Table 1. Plankton abundance in silvofishery pond

No	Class	Plankton abundance in silvofishery pond (cell/ml)			
		A	B	C	D
	Bacillariophyceae				
1	*Skeletonema sp.*	10,000		10,000	
2	*Coscinodiscus sp.*			40,000	30,000
3	*Amphora sp.*				10,000
4	*Amphipora sp.*			10,000	
	Chlorophyceae				
1	*Chlorella sp.*	80,000	20,000	90,000	
2	*Gleocystis sp.*	10,000		30,000	70,000
3	*Chlamydomonas sp.*	10,000		20,000	20,000
	Cyanophyceae				
1	*Oscillatoria sp.*	20,000	10,000	50,000	
2	*Microcystis sp.*	20,000		30,000	60,000
3	*Anabaena sp.*		10,000	40,000	
Genera		6	3	9	5
Total (cell/ml)		150,000	40,000	320,000	190,000

The level of plankton diversity, which tends to be moderate, is also good for the pond ecosystem's balance. This indicates that the moderate plankton conditions indicate no dominance of specific genera (Ariadi *et al.*, 2022). Plankton in fish pond ecosystems generally is dynamic, following the dynamics of fluctuating nutrient abundance (N:P) (Magyar *et al.*, 2024). This condition is a concern in determining the type of fish farming pattern to be used.

Financial feasibility analysis

A financial feasibility analysis is conducted to predict whether silvofishery cultivation activities using saline tilapia have promising profit projections. This analysis is essential in determining the potential return on investment and sustainability of the business in the long term. Data for financial feasibility projections are obtained from the total post-harvest selling price, which reflects the market value of the produced commodity. Financial feasibility analysis is used as a form of investment feasibility assessment in a productive business (Ariadi *et al*., 2019), helping stakeholders make informed decisions before committing resources. To analyze the level of financial feasibility of the business, it is necessary to first determine the fixed capital and working capital values of silvofishery cultivation activities, which form the foundation for further cost-benefit calculations (Muqsith *et al.*, 2023). The cost of business capital for silvofishery cultivation using saline tilapia is presented in Table 2, serving as the initial step in evaluating the overall financial performance of the enterprise.

Table 2. Silvofishery pond business capital

Capital Venture	Unit (Pcs)	Price (Rp.)	Technique Age (years)	Total (Rp.)
Fix Cost				
Pond basket	8	375,000	5	3,000,000
Bamboo	85	15,000	5	1,275,000
Pond net mesh 0.1 mm	2	125,000	2	250,000
Acclimatization pond	2	2,750,000	5	5,500,000
	Total			10,025,000
Operational Cost				
Fry	3,600	1,000	1	3,600,000
Feed	225	13,000	1	2,925,000
Bacteria starter	10	35,000	1	350,000
	Total			6,875,000
	GRAND TOTAL			16,900,000

The results of the financial feasibility analysis are presented in Table 3. Generally, saline tilapia raised in silvofishery ponds exhibit profitable business profitability and projections. The level of business profitability can be seen from the harvest profit value of Rp. 8,840,000,-, R/C Ratio of 1.55, BEP unit of 297 kg, and BEP sales of Rp. 4,428,000,-. Furthermore, the business feasibility value can be observed from the profitability rate of 25%, Net Present Value of Rp. 101,528,000,-, IRR of 20.45%, and payback period of 2.7 years.

Table 3. Silvofishery business feasibility analysis

No.	Analysis	Results	Standard Assessment	Criteria
1	Profitability (Rp.)	8,840,000	TR>TC	Profitable
2	R/C Ratio	1.55	R/C>1	Profitable
3	BEP Unit (Kg)	297	BEPu < Q	Profitable
4	BEP Sales (Rp)	4,428,000	BEPs < TR	Profitable
5	Rentability (%)	25	R > i	Feasibility
6	Net Present Value (Rp)	101,528,000	NPV > 0	Feasibility
7	IRR (%)	20.45	IRR > discount factor	Feasibility
8	Payback Period (tahun)	2.7	PP < technique age	Feasibility

In one cycle of silvofishery cultivation (4 months) using saline tilapia as the commodity in a 480 m2 pond, a profit of Rp. 8,840,000,- was obtained. This value has a revenue and sales ratio of 1.55, which is deemed feasible as it is greater than 1. The cultivation activity also yields a profitability rate of 25%, exceeding the average investment bank interest rate of 15-20% (Kholodilin, 2024). The R/C ratio and profitability values will determine the estimation of cultivation cycle improvement in the next cycle (Wafi *et al.*, 2021).

The Net Present Value is also sufficiently high (>0), indicating that this business is highly feasible for development. The Net Present Value is a business projection value that can serve as a reference for future business development (Lampert, 2024). The IRR value is also higher than the bank interest rate of 15-20%, signifying that this business is highly suitable for investment (Ariadi *et al.*, 2021). The cultivation of saline tilapia using the silvofishery concept is predicted to yield a payback period of 2.7 years. This means that the business will fully recoup its investment within 2.7 years. The payback period value is a primary consideration for an investor in determining investment decisions in active businesses (Muqsith *et al.*, 2023).

Overall, based on the data presentation from the research results, it can be concluded that saline tilapia can be a strong candidate commodity for silvofishery cultivation. This statement is based on the biological growth performance, pond water quality conditions, and good post-harvest financial performance. Saline tilapia is a popular consumption fish in the Southeast Asian region (Dong *et al.*, 2019). Saline tilapia is also easy to breed and has a high survival rate (Ariadi *et al.*, 2021). Therefore, it is highly suitable for this fish to be used as a primary commodity in silvofishery cultivation.

Silvofishery cultivation, which offers a variety of harvest commodities, would be highly suitable if it has high-value cultivation commodities. Saline tilapia is a type of fish demanded by the market and has a relatively stable selling price

(Dong *et al.*, 2019). Other advantages of saline tilapia in silvofishery cultivation include its adaptability to brackish water conditions (Musa *et al.*, 2020). This is crucial because the majority of silvofishery cultivation activities are carried out in brackish water areas (Leon-Herrera *et al.*, 2015).

CONCLUSION

In conclusion, saline tilapia is highly suitable as a primary cultivation commodity in silvofishery activities. This can be observed from the performance of biological growth rate, correlation impacts on pond ecological factors (water quality and plankton abundance), and the results of profitable financial feasibility estimation.

ACKNOWLEDGEMENT

This research was supported by a research grant from a young lecturer at Pekalongan University under contract No. 23/LPPM/2024. We extend our sincere gratitude to the Research and Community Service Institute (LPPM) of Pekalongan University for their financial assistance and continuous support throughout this study. We also appreciate the valuable contributions of our colleagues and research team members, whose insights and dedication have greatly enriched this work. Special thanks are extended to the local fish farmers and field assistants for their cooperation during data collection, as well as to the laboratory staff for their technical assistance in sample analysis. Lastly, we acknowledge the constructive feedback from peer reviewers, which has helped improve the quality of this research. This study would not have been possible without the collective efforts of all parties involved.

REFERENCES

Al-Zoubi, M. S. (2022). Stock market performance: Reaction to interest rates and inflation rates. *Banks and Bank Systems*, *17* (2), 200-214. https://doi.org/10.21511/bbs.17 (2).2022.16

Anuar, S. K. A., & Wahab, M. A. (2022). Factors that influence the preferences of tenants. *Malaysian Journal of Sustainable Environment*, *9* (1), 1-14. https://doi.org/10.24191/myse.v9i1.17296

Appoo, J., Bunbury, N., Jaquemet, S., & Graham, N. A. J. (2024). Seabird nutrient subsidies enrich mangrove ecosystems and are exported to nearby coastal habitats. *iScience*, *4*, 109404.

Ariadi, H., Fadjar, M., & Mahmudi, M. (2019). Financial feasibility analysis of shrimp vannamei (*Litopenaeus vannamei*) culture in intensive aquaculture system with low salinity. *ECSOFiM (Economic and Social of Fisheries and Marine Journal)*, *7* (1), 95–108.

Ariadi, H., Fahrurrozi, A., & Al Ramadhani, F. M. (2024). *Outlook silvofishery*. Penerbit ADAB.

Ariadi, H., Khristanto, A., Soeprapto, H., Kumalasari, D., & Sihombing, J. L. (2022). Plankton and its potential utilization for climate resilient fish culture. *AACL Bioflux*, *15* (4), 2041–2051.

Ariadi, H., Linayati, & Mujtahidah, T. (2023). Oxygen transfer rate efficiency of paddle wheel aerators in intensive shrimp ponds. *BIO Web of Conferences*, *74*, 01012.

Ariadi, H., Pandaingan, I. A. H., Soeprijanto, A., Maemunah, Y., & Wafi, A. (2020). Effectiveness of using pakcoy (*Brassica rapa* L.) and kailan (*Brassica oleracea*) plants as vegetable media for aquaponic culture of tilapia (*Oreochromis* sp.). *Journal of Aquaculture Development and Environment*, *3* (2), 156–162.

Ariadi, H., Soeprapto, H., & Sulistiana, A. (2024). Performa budidaya ikan nila saline (*Oreochromis niloticus Salina*) pada kolam silvofishery. *Samakia: Jurnal Ilmu Perikanan*, *15* (1), 97–104.

Ariadi, H., Syakirin, M. B., Mardiana, T. Y., Soeprapto, H., Linayati, & Madusari, B. D. (2023). Kelimpahan plankton *Prorocentrum* sp. pada tambak intensif udang vaname (*Litopenaeus vannamei*). *AGROMIX*, *14* (2), 215–220.

Ariadi, H., Wijaya, M. C., Elyah, F., & Mardiana, T. Y. (2021). Financial analysis of tilapia (*O. niloticus*) fry business activity at the Klemunan Fish Fry Center, Blitar District. *Journal of Aquaculture Development and Environment*, *4* (1), 227–232.

Arikan, M. S., & Aral, Y. (2019). Economic analysis of aquaculture enterprises and determination of factors affecting sustainability of the sector in Turkey. *Ankara Universitesi Veteriner Fakultesi Dergisi*. https://doi.org/10.1501/VETFAK_0000002888

Bardash, S., Petruk, A., & Osadcha, T. (2019). Identification of financial rent: From the theory of rent to its accounting. https://doi.org/10.32070/EC.V1I41.19

Bethke, E. (2019). The missing theoretical part—Influence of the stock efficiency in yield maximization, using bluefin tuna as an example. Social Science Research Network. https://doi.org/10.2139/SSRN.3341429

Braga, A., Magalhães, V., Hanson, T., Morris, T. C., & Samocha, T. (2016). The effects of feeding commercial feed formulated for semi-intensive systems on *Litopenaeus vannamei* production and its profitability in a hyper-intensive bio floc-dominated system. *Aquaculture Reports*. https://doi.org/10.1016/J.AQREP.2016.03.002

Chapra, S. C., Camacho, L. A., & McBride, G. B. (2021). Impact of global warming on dissolved oxygen and BOD assimilative capacity of the world's rivers: Modeling analysis. *Water*, *13* (17), 2408. https://doi.org/10.3390/W13172408

Chen, K.-H., Chen, C.-W., & Chen, W. (2011). A study on the C/R ratio of direct-operation multi-touch interface. In *Advanced Materials Research* (pp. 383–386). Trans Tech Publications Inc. https://doi.org/10.4028/www.scientific.net/AMR.228-229.383

Chiladze, I. (2018). Theoretical and practical aspects of profitability factorial analysis. https://doi.org/10.15544/SSAF.2018.02

Damastuti, E., de Groot, R., Debrot, A. O., & Silvius, M. J. (2023). Effectiveness of community-based mangrove management for coastal protection: A case study from Central Java, Indonesia. *Ocean & Coastal Management*, *238*, 106498.

Dong, H. T., Senapin, S., Jeamkunakorn, C., Nguyen, V. V., Nguyen, N. T., Rodkhum, C., Khunre, P., & Rattanarojpong, T. (2019). Natural occurrence of Edwardsiellosis caused by *Edwardsiella ictaluri* in farmed hybrid red tilapia (*Oreochromis* sp.) in Southeast Asia. *Aquaculture*, *499*, 17–23.

Engle, C. R., McNevin, A. A., Racine, P., Boyd, C. E., Paungkaew, D., Viriyatum, R., Tinh, H. Q., & Minh, H. N. (2017). Economics of sustainable intensification of aquaculture: Evidence from shrimp farms in Vietnam and Thailand. *Journal of The World Aquaculture Society*, *48* (6), 980-993. https://doi.org/10.1111/JWAS.12423

Food Agriculture Organization (FAO). (2021). *World fisheries production in 2021*. Food Agriculture Organization.

Jiang, Z., Sanders, C. J., Xin, K., Wang, F., Sheng, N., & Xiong, Y. (2024). Increasing carbon and nutrient burial rates in mangroves coincided with coastal aquaculture development and water eutrophication in NE Hainan, China. *Marine Pollution Bulletin*, *199*, 115934.

Kholodilin, K. A. (2024). Rent control effects through the lens of empirical research: An almost complete review of the literature. *Journal of Housing Economics*, *63*, 101983.

Lampert, A. (2024). Global non-sustainable harvest of renewable resources reduces their present price but increases their net present value. *Resource and Energy Economics*, *76*, 101409.

Lang, T., Ke, X., Wei, J., Hussain, M., Li, M., Gao, C., Jiang, M., Wang, Y., Fu, Y., Wu, K., Zhang, W., Tam, N. F., & Zhou, H. (2024). Dynamics of tannin variations in mangrove leaf litter decomposition and their effects on environmental nitrogen and microbial activity. *Science of The Total Environment*, *908*, 168150.

Larka, L. S., & Pavlenko, V. V. (2021). Cinoutvorennya v systemi ekonomichnogo upravlinnya biznesom.[Pricing in the system of economic business management] Pryazovskyj ekonomichnyj visnyk. *Priazovsky Economic Bulletin, 2*(25), 104-107. https://doi.org/10.32840/2522-4263/2021-2-19

Leon-Herrera, R. D., Flores-Verdugo, F., de Santiago, F. F., & Gonzalez-Farias, F. (2015). Nutrient removal in a closed silvofishery system using three mangrove species (*Avicennia germinans*, *Laguncularia racemosa*, and *Rhizophora mangle*). *Marine Pollution Bulletin*, *91*, 243–248.

Linares-Cordova, J. F., Rey-Planellas, S., Boglino, A., Jimenez-Rivera, J. A., Duncan, N. J., de Oca, G. A. R. M., & Ibarra-Zatarain, Z. (2024). Flathead grey mullet (*Mugil cephalus*) juveniles exhibit consistent proactive and reactive stress coping styles. *Aquaculture*, *578*, 740012.

Linayati, Nhi, N. H. Y., Ariadi, H., Mardiana, T. Y., Fahrurrozi, A., & Syakirin, M. B. (2024). Relationship between abundance of *Chlamydomonas* spp and *Chlorella* spp on clinical performance of red tilapia (*Oreochromis niloticus*) in silvofishery ponds. *Croatian Journal of Fisheries*, *82* (1), 33–42.

Lukman, K. M., Uchiyama, Y., & Kohsaka, R. (2021). Sustainable aquaculture to ensure coexistence: Perceptions of aquaculture farmers in East Kalimantan, Indonesia. *Ocean & Coastal Management*, *213*, 105839.

Magyar, T., Nemeth, B., Tamas, J., & Nagy, P. T. (2024). Improvement of N and P ratio for enhanced biomass productivity and sustainable cultivation of *Chlorella vulgaris* microalgae. *Heliyon*, *10*, e23238.

Mardiana, T. Y., Ariadi, H., Linayati, Wijianto, Fahrurrozi, A., & Maghfiroh. (2023). Estimation of water carrying capacity for floating net cage cultivation activities in Pekalongan coastal waters. *Jurnal Perikanan Universitas Gadjah Mada*, *25* (1), 19–24.

Mardiana, T. Y., Ariadi, H., Rattanavichai, W., Soedibya, P. H. T., & Linayati. (2024). Feasibility study area and dissolved oxygen-carrying capacity of silvofishery pond on the coastal area. *ILMU KELAUTAN: Indonesian Journal of Marine Sciences*, *29* (2), 1-10.

Marín-Riffo, M. C., Raadsma, H. W., Jerry, D. R., Coman, G. J., & Khatkar, M. S. (2021). Bioeconomic modeling of hatchery, grow-out, and combined business of Australian black tiger shrimp *Penaeus monodon* farming. *Reviews in Aquaculture*, *14* (2), 458-478. https://doi.org/10.1111/RAQ.12541

Mukta, M. A., Khan, M. A., Mian, R. U., & Juice, R. A. (2019). Is tilapia farming financially profitable and efficient? Policy options for sustainable farming. *Journal of The Bangladesh Agricultural University*, *17* (1), 135-142. https://doi.org/10.3329/JBAU.V17I1.40669

Muqsith, A., Ariadi, H., & Wafi, A. (2023). Financial feasibility analysis and business sensitivity level on intensive aquaculture of name shrimp (*Litopenaeus vannamei*). *ECSOFiM (Economic and Social of Fisheries and Marine Journal)*, *8* (2), 268–279.

Musa, M., Mahmudi, M., Arsad, S., & Buwono, N. R. (2020). Feasibility study and potential of the pond as silvofishery in a coastal area: Local case study in Situbondo Indonesia. *Regional Studies in Marine Science*, *33*, 100971.

Primyastanto, M. (2016). *EVAPRO (evaluasi proyek) teori dan aplikasi pada usaha pembesaran ikan sidat (Anguilla sp.)*. Universitas Brawijaya Press.

Rahman, M. M., & Mahmud, M. A. (2018). Economic feasibility of mangrove restoration in the Southeastern Coast of Bangladesh. *Ocean & Coastal Management*, *161*, 211–221.

Rajendran, N., Saravanakumar, K., & Kathiresan, K. (2016). *Mangroves: A potent source of polysaccharides*. https://doi.org/10.1201/9781315371399-42

Sagala, P. M., Bhomia, R. K., & Murdiyarso, D. (2024). Assessment of coastal vulnerability to support mangrove restoration in the northern coast of Java, Indonesia. *Regional Studies in Marine Science*, *70*, 103383.

Samal, P., Srivastava, J., Charles, B., & Singarasubramanian, S. R. (2023). Species distribution models to predict the potential niche shift and priority conservation areas for mangroves (*Rhizophora apiculata*, *R. mucronata*) in response to climate and sea level fluctuations along coastal India. *Ecological Indicators*, *154*, 110631.

Siagian, P., & Hakim, L. N. (2023). The influencing of internal and external factors on share return (case study on banking going public in Indonesia). *Penanomics Journal*, *2* (2), 112-124. https://doi.org/10.56107/penanomics.v2i2.120

Soeprapto, H., Ariadi, H., & Badrudin, U. (2023). The dynamics of *Chlorella* spp. Abundance and its relationship with water quality parameters in intensive shrimp ponds. *Biodiversitas Journal of Biological Diversity*, *24* (5), 2919–2926.

Taufiqurrohaman, A. H. A., Wibowo, D. E., & Ariadi, H. (2023). Study of fisheries law for the development of the aquaculture sector in land-based areas. *DE LEGA LATA: Jurnal Ilmu Hukum*, *8* (2), 253–259.

Tikue, T. G., & Workagegn, K. B. (2022). Plankton composition and abundance in semi-intensive aquaculture pond and their preference by Nile tilapia. *Aquaculture Studies*, *22* (4), 297-307. https://doi.org/10.4194/aquast1032

Vu Thi, K. A., Khanh, V. H., Thuy, V. H. T., & Thuy, D. V. (2018). Factors influencing the cost-based pricing method: The empirical study of Vietnamese feed mills. *Economics. Ecology. Environment*, *(1-05), 134–149.* https://doi.org/10.21003/EA.V171-05

Wafi, A., Ariadi, H., Muqsith, A., & Madusari, B. D. (2021). Business feasibility of intensive vaname shrimp (*Litopenaeus vannamei*) with a non-partial system. *ECSOFiM (Economic and Social of Fisheries and Marine Journal)*, *8* (2), 226–238.

Wijayanti, W. P., & Pratomo, R. A. (2016). Adaptation of social-economic livelihoods in the coastal community: The case of Mangunharjo Sub-District, Semarang City. *Procedia - Social and Behavioral Sciences*, *227*, 477–484.

Wu, L., Liang, H., Hamunjo, C. M. K., Ge, X., Ji, K., Yu, H., Huang, D., Xu, H., & Ren, M. (2021). Culture salinity alters dietary protein requirement, whole body composition, and nutrient metabolism-related gene expression in juvenile Genetically Improved Farmed Tilapia (GIFT) (*Oreochromis niloticus*). *Aquaculture*, *531*, 735961. https://doi.org/10.1016/j.aquaculture.2020.735961

Xing, S., Li, P., He, S., Cao, Z., Wang, X., Cao, X., Liu, B., Chen, C., You, H., & Li, Z. H. (2022). Physiological responses in Nile tilapia (*Oreochromis niloticus*) induced by the combined stress of environmental salinity and triphenyltin. *Marine Environmental Research*, *180*, 105736. https://doi.org/10.1016/j.marenvres.2022.105736

Yang, Z. (2022, January 1). Modified NPV model as a new evaluation approach to investment decisions. *Management Science and Industrial Engineering Digest*, 53–59. https://doi.org/10.23977/msied2022.053

Zheng, H., Ni, S., Tan, X., & Wang, C. (2022). In situ purification experiment of a mangrove–aquaculture coupling system: A case study of a crab pond in Wanning, Hainan Province. *Journal of The World Aquaculture Society*, *53* (6), 1422–1435. https://doi.org/10.1111/jwas.12868