MANAGEMENT MODEL ECOSYSTEM MANGROVE BASED ON BUSINESS FEASIBILITY

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ABSTRACT

The aim of this research is: 1) To analyze the results of the main cultivation production of the silvofishery pond; 2) To analyze the result of silvofishery pond cultivation; and 3) To analyze the feasibility of the main cultivation business in the silvofishery pond. The method used for analyzing mangrove ecosystem with focus are: 1) To identify the type of organism that makes mangrove ecosystem as habitat; 2) To interview with farmer and fisherman; and 3) Business feasibility analysis with the Benefit Cost Ratio analysis approach. The results of this study as follows: 1) The main cultivation of IDR. 17,000,000 for 0.40 ha th^{-1} or IDR 42,500,000, ha^{-1} the^{-1}; 2) The cultivation yield of IDR.12,000,000 for 0.40 ha th^{-1} or equivalent IDR 30,750,000, ha^{-1} the^{-1}; 3) The results of the analysis of the feasibility of the main cultivation of the main cultivation show feasible, because the analysis results show BCR>1, so it is concluded that the ratio of 40% ponds economically feasible cultivated. Suggestion from this research for cultivation activity in silvofishery pond that is: 1) Besides applying main cultivation, also sideline cultivation still recommended as additional income; 2) Drainage of embankment should be done routinely once in a year so that accumulation of organic material from mangrove form litter of leaves, flowers, fruits, stalks, twigs and other undergoing process discomposing.

Keywords: Model, Mangrove, Management, Economic, Feasibility.

INTRODUCTION

Background

Indonesia is one of the second largest archipelagic countries in the world, has the second longest coastline in the world after Canada is about 81,000 km and has a large island and a small island of approximately 17,508 pieces (Dahuri et al., 1996) In addition, according to Supriharyono (2005) has the fifth highest biodiversity in the world, Indonesia is geographically located on the equator between 6°N and 11°S, 95°W to 141°E. The elevation of Indonesia has the highest mountain less than 5000 m above sea level and has a marine trough of approximately 5000 m below sea level.

Along the coastline, there are mangrove ecosystems that have high biodiversity both flora and fauna that have economic value either directly or indirectly. However, these mangrove ecosystems have been damaged both in quantity in the form of extent and quality in the form of biodiversity decline. Converting mangrove forests into ponds is economically profitable, but there are huge ecological losses. The results of the study indicate that the production of ponds from mangrove forest conversion to ponds is only IDR. 20,607,000, ha^{-1} th^{-1}, but there is an average ecological loss of IDR. 31,142,002 ha^{-1} th^{-1} (Asbar, 2007).

The ecological function of the mangrove ecosystem mentioned above is still a fraction of other ecological functions compared to previous research results such as (Yulianda et al., 2010) reaching 7.8 billion ha^{-1} th^{-1}, then (Sambu, 2018) reaching IDR. 6,075,892,844, ha^{-1} th^{-1}. The results of a study conducted in the Tongke-Tongke mangrove ecosystem in the same year only analyzed the ecological function of the mangrove ecosystem from the ecological function of the physical as a tornado, as a deterrent to the salt water interaction to the mainland, and as the abrasion deterrent of the ocean wave not including the physical function for building materials and firewood.

According to Sofyan (2001), mangrove forest area in Indonesia in 1982 reached 5,209,543 and in 1999 remained 2,346,414. The result of the analysis indicated that 17 years there was a decrease of 2,863,120 ha or 54%. Even the current area of 2,346,423 ha or 46% is mostly in critical condition in the quality of biodiversity decrease, because the reforestation done so far tends to be dominated by one type of rhizophora reaching 86.83%, while the remaining 13.17% divided into bruguira, avicennia and senneratia (Sambu, 2013).

One model of mangrove ecosystem management is silvofishery as a solution to prevent damage to mangrove ecosystems both in Indonesia and other countries for sustainable mangrove ecosystem function that is economically profitable for generations still present and sustainable for generations to come. Indicators of a business are said to be economically profitable if the results of the analysis of Benefit-Cost Ratio or BCR>1, and said to be sustainable if the results of environmental capacity analysis of the availability of resources greater than the needs of organisms to live and develop naturally or S>D.

The ratio of mangrove area and fish pond to the management of silvofishery has been done several studies both institutionally and individually including:

1. Perhutani (1998) suggested 80% mangrove and 20% ponds, but the result of this study is considered too give the portion of mangrove ratio too big.
2. The results of Zuna (1998) study suggested a ratio of 54% of mangroves and 46 ponds.
3. Nur (2002) suggested a 50% mangrove ratio and 50% pond.

Some previous studies concluded that the proportion of mangrove area is greater than the proportion of pond area in silvofishery ponds, which is between 50% to 80%, while the proportion of ponds is between 20% to 50%. By looking at the varying proportions of the area, there is a need for further research that can find the proportion ratio between mangrove and ponds that are optimally and sustainably. The research will use the concept of supply-demand and the cost ratio concept.

The results will be achieved in this study are how to utilize natural resources optimally, economically, which can guarantee the sustainability of human life at this time, and ecologically without destroying natural resources for the sustainability of future generations so that this research embodies a model of mangrove ecosystem management that based on environmental carrying capacity and business feasibility.

The Objective of the Research

The objectives of this research are:

1. To analyze the results of the main cultivation of silvofishery pond.
2. To analyze the result of silvofishery pond cultivation.

3. To analyze the feasibility of the main cultivation business in the silvofishery pond.

RESEARCH METHODOLOGY

Time and Location

This research was conducted for six months starting from May until October 2018, while the research location of Samataring Village, East Sinjai District of Sinjai Regency, South Sulawesi Indonesia as presented in Figure 1.

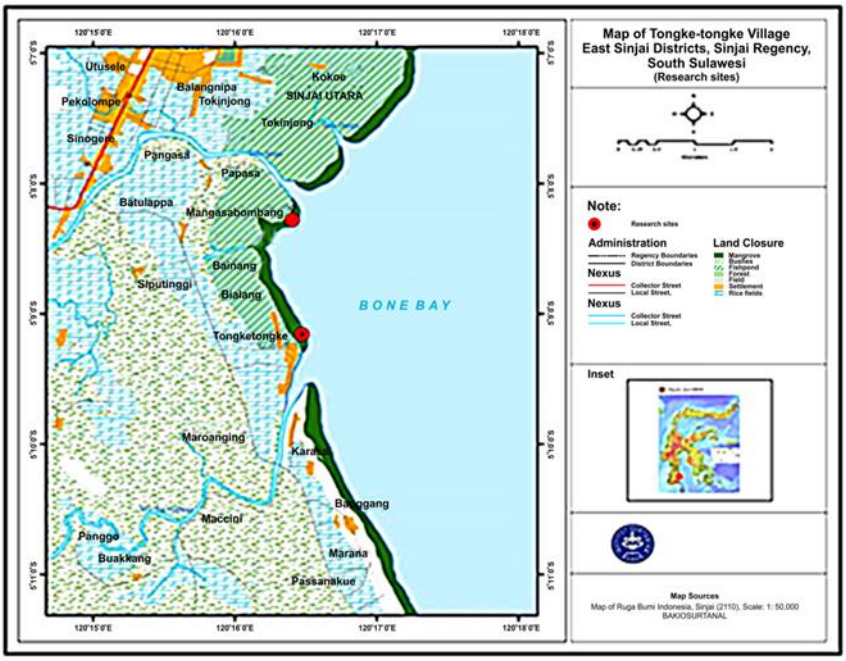

FIGURE 1
MAP OF RESEARCH SITES OF TONGKE-TONGKE VILLAGE, EAST SINJAI DISTRICT, SINJAI REGENCY

Tools and Materials

Tools and materials used in this research include stationery writing, engineering books management of mangrove ecosystem as a foundation. Tape recorder or tool recorder used during interviews with farmers ponds, fishermen, farmers groups and all stakeholders in the management of mangrove ecosystems optimally and sustainably.

Procedure of the Research

Prior to conducting this research, there are several stages:

1. Survey of research sites.
2. Assisting farmers and jointly conducting cultivation activities at the location of the research.
3. Determining respondents from farmers and fishermen groups, and stakeholders determined proportional based on the relevance of the research object.

4. Collecting literature related to the research object in the form of previous research report, village potential book and BPS Sinjai regency, journals related to the research object.

Research Design

To determine the optimal ratio of silvifishery pond management, the study conducted on three maps or research sites:

1. Location or plot of mangrove 100%.
2. Map representing two objects, 60% mangrove and 40% pond.
3. Plots representing a 100% pond.

This three mapping will be observed and analyzed by ecological aspect and economic aspect, for ecological aspect, include litter quality, pond quality, and water quality, while for economic aspect include: the economic value of mangrove, main cultivation production, and cultivation production.

Analysis of Data

Business feasibility in the management of silvofhisery ponds to be analyzed includes:

1. Main cultivation production consisting of tiger shrimp and milkfish.
2. Simultaneous cultivation production consisting of wild shrimp and wild fish.
3. Benefit value of mangrove ecosystem.

To find out this feasible business did business feasibility analysis per ratio silvofishery pond using the equation as follows:

$$R/C=TR/TC \quad (1)$$

Where,
TR=Total business receipts (IDR ha^{-1} th^{-1})
TC=Total business cost (IDR ha^{-1} th^{-1})

The criteria used are if $R/C \geq 1$, then the business is feasible to cultivate, whereas if $\pi<0$ and $R/C<1$, then the business is not feasible cultivated.

Analysis of the difference between the present value of the benefit and the present value of the cost of using the Net Present Value (NPV). If NPV>0 means worthy effort, whereas if NPV=0 then returns exactly the opportunity cost of capital, and if NPV<0 then effort is not feasible. The value of NPV is obtained by the equation:

$$NVP = \sum_{t}^{n} = 1 \frac{B_t - C_t}{(1+r)^t} \quad (2)$$

Where,
B_t: Business benefit in year t.
N: Economic age.
t: 0, 1, 2, 3, ... the nth year.
C_t: Business cost in year t.
r: Discount rate.

Then measured Net Benefit cost ratio (Net B/C). Net B/C is a comparison of the present value of the business profits with the investment cost at the beginning of the business. To calculate the net value of B/C we use the following equation:

$$NET\ B/C = \frac{\sum_{t=o}^{n} \frac{B_t - C_t}{(1+r)^t}}{\sum_{t=o}^{n} \frac{B_t - C_t}{(1+r)^t}(B_t - C_t)} \quad (3)$$

RESULTS AND DISCUSSION

General Overview of Research Sites

Samataring urban village has a coastline of approximately 2.5 km, and along the line, there is a potential pond area of 101.50 ha or 14.16% of the total pond area in Sinjai Regency is 716.50 ha. In addition, there is a mangrove ecosystem of 280.50 ha or 20.74% of the total area of the mangrove ecosystem in Sinjai district. Percentage of the area between mangrove ecosystem and pond in Samataring sub-district is mangrove ecosystem 73.43% and pond 26.57%. Samataring village of coastline length of approximately 2.5 km has a green belt (green belt), an average of 112 m wide of the coastline (zero datum).

According to Ukkas (2011), historically the existence of ponds in Samataring Village is of 101.50 ha area. Until 2011, about 90% is the result of land conversion from mangrove ecosystem to pond. Continue Ukkas that Samataring village have different characteristics from other regions in Indonesia, if other areas in Indonesia increasingly convert mangrove ecosystems into ponds, mangrove ecosystems become more diminished, otherwise in Samataring Village when converting mangrove ecosystem into ponds with a certain area will increase, because has become an agreement for the community that anyone who wants to convert mangrove ecosystem into a pond with a certain area, it is required to plant mangrove at least double of the mangrove ecosystem that will be conserved into ponds.

Economic Aspects

The cultivation system applied to the silvofishery pond is the polyculture of tiger shrimp and milkfish as the main cultivation. While seaweed is not cultivated on the grounds of limited sunlight entering the pond waters, but the surrounding ponds average polyculture of tiger shrimps, milkfish, and seaweed as the main cultivation because it is considered to have several advantages including:

1. Ecology.
2. Economy.
3. Social.

The cultivation of a polyculture system or diversification in an ecologically sustainable silvofishery pond aims to allow organic matter derived from mangrove litter either in the form of detritus through decomposition process of that has been decomposed in other forms such as nitrogen, phosphorus, potassium, and so on. All nutrients can be utilized by various biota that is

cultivated so that the potential of soil quality decline and water quality can be minimized. Polycultivation of tiger shrimp, milkfish and seaweed form a mutualism symbiosis mutual profitable.

While cultivation polyculture tiger shrimps, milkfish, and seaweed in ponds, economically aims to make efficient use of all resources, in the form of land use, operational costs, labour and so forth. The cultivation of a polyculture system is said to be land efficiency because it can maintain several types of organisms on the same land simultaneously, the cost of inputs such as fertilizer, lime, and medicines can be minimized as well as labour issues as a manager.

Furthermore, the cultivation of polyculture systems in silvofishery ponds, aimed at maintaining biodiversity, the higher the biodiversity of an ecosystem, the higher the ecological, economic and social functions. In addition, the cultivation of a polyculture system may involve some seasonal labour at harvest time, as harvesters, carriers, and sellers, meaning that the more diverse types of commodities cultivated in a pond increasingly require labour to reach the last consumer.

In addition to the main aquaculture organisms namely tiger shrimps, milkfish, and seaweed, simultaneously there are also some odd-looking organisms of various species of wild fish, wild shrimp, and so are also of high economic value. The result of analysis of the total production of silvofishery ponds per maintenance cycle shows that the results of cultivation is very helpful to the production of main cultivation, besides there is direct benefit value of mangrove ecosystems such as mangrove crab, corals, never, and fry. The occurrence of a negative correlation between mangrove ratio with main cultivation production directly and indirectly influence.

1. The greater the ratio of mangrove than ponds to the management of silvofishery, the narrower the land for the main cultivation.
2. Indirectly the greater the ratio of mangrove than ponds, the higher litter production potentially affecting soil and water quality.

Main cultivation: The results of the main cultivation analysis on silvofishery pond which includes tiger shrimp and milkfish are ecologically unconditional for seaweed farming because silvofishery ponds are slightly disturbed by sunlight, this is because part of the plot area is the area of mangrove vegetation. Another area of cultivation 100% is a pond so as to get penetration perfect sunlight throughout the day, therefore to design silvofishery ponds in addition to the ratio between mangrove and ponds are also considered the layout of the mangrove area should be on the north or south of the pond so that the pond area is not disturbed penetration morning and afternoon sunlight. The results of the main cultivation analysis as presented in Table 1.

The result of analysis of main cultivation production on silvofishery pond with ratio of 60% mangrove and 40% pond as presented in table above shows that marginal value which is very significant with main cultivation result with cultivation area which 100% pond reaches Rp. 43,000,000. However, the differences that can be matched with the results of the cultivation of squid in the form of wild shrimp, wild fish both from age mangrove and from the pond area as presented in Table 1. Squid cultivation in the form of wild shrimp and wild fish enough to provide benefits on the management of silvofishery ponds, there is expenditure for the cost of production facilities in the form of seeds.

Sideline cultivation: The results of the analysis of sidestreams on silvofishery ponds that include wild shrimp, and wild fish, ecologically eco-friendly, for maintaining several types of organisms on the land and at the same time as different traits are herbivores or plant-eaters, there are carnivores or meat-eaters, even omnivores or eater of all. Thus, all types of food contained in the waters utilized so that the potential accumulation of organic materials that potentially pollution can be avoided (Poernomo, 1992). In addition, economical cultivation can increase the production of a land with low expenditure costs, because the procurement of seeds occurs naturally. The results of the production of odour cultivation in the form of wild shrimp and wild fish are presented in Table 1.

The results of the analysis of cultivation production of silvofishery ponds with 60% mangrove and 40% pond as presented in the above table shows that the marginal value between silvofishery and the ratio of 60% mangrove and 40% of the pond to the 100% land is smaller because the main cultivation value of the mangrove area is IDR. 18,450,000 th^{-1} in the form of wild shrimp and wild fish plus the production of the pond area which is also in the form of wild shrimp and wild fish is IDR. 12,300,000 th^{-1}, so the total production of sideline cultivation reached IDR. 30,750,000, While the production of sideline cultivation in the form of wild shrimp and wild fish is only IDR. 7,687,500.

The analysis result between main cultivation and sideline cultivation of the main cultivation production and the sideline cultivation in the pond area is 100% that is IDR. 67,687,500, while the main cultivation and sideline production in silvofishery pond that is IDR. 47,750,000 increasingly shows the marginal value is smaller is IDR. 19,937,500 th^{-1}. The analysis result of fish pond production 100% with silvofishery pond shows that economically bigger the ratio of the pond, it can be more profitable, otherwise in ecologically the greater the mangrove ratio the greater the ecological benefit value of a mangrove ecosystem.

Direct benefit value: In beside to analyzed the value of silvofishery pond production with a ratio of 60% of mangroves and 40% ponds are also analyzed pond production that is 100%, then analyzed the value of direct benefits of ecological value of the mangrove ecosystem as a place of spawning, as a place to eat and as a shelter as presented in Table 1. The objectives are analyzed from these three ecosystems to compare how much margin between the three observation sites.

Table 1
RESULTS OF CULTIVATION PRODUCTION ANALYSIS AND ECOSYSTEM BENEFIT VALUE MANGROVES, SILVOFISHERY ECOSYSTEMS, AND ECOSYSTEMS (HA^{-1} THE^{-1})

Parameter Ekonomi	Mangrove (100%)	Silvofishery (%)		Fishpond (100%)
		Mangrove (60)	Fishpond (40)	
1. Main Cultivation				
Shrimp Windu	-	-	9,000,000	22,500,000
Milkfish	-	-	8,000,000	20,000,000
Seaweed	-	-		18,000,000
Sub Amount (IDR)	-	-	17,000,000	60,000,000
2. Aquaculture				
Wild Shrimp	-	9,450,000	6,300,000	3,937,500
The Wild Fish	-	9,000,000	6,000,000	3,750,000
Sub Amount (IDR)		18,450,000	12,300,000	7,687,500

3. Direct Benefit Value				
Wild Shrimp	15,750,000	9,450,000	-	-
Wild Fish	15,000,000	9,000,000	-	-
Crabs	17,500,000	10,500,000	-	-
Corals	12,000,000	7,200,000	-	-
Fry	11,250,000	7,350,000	-	-
Nener	17,000,000	10,000,000	-	-
Sub Amount (IDR)	88,500,000	53,500,000	-	-
output (IDR)	88,500,000	100,750,000		67,687,500

Source: Analysis results (2018).

The result of the analysis shows that the highest value is the result of cultivation production and the value of direct benefit from the mangrove ecosystem occupies the highest is IDR.100,750,000 following the value of direct benefits from the mangrove ecosystem is IDR.88,500,000 and the value of the cultivation of pond that is to IDR.67,687,500. Thus the silvofishery model is an optimal and sustainable management of mangrove ecosystems, economically the silvofishery model produces Rp. 29,300,000 or 29.01% and ecologically in the form of direct benefit value is IDR.71,450,000 or equal to 71.99%. The results of this analysis indicate the results of several previous studies, namely Naamin (1990) and Niartiningsih (1996) that the addition of mangrove area is correlated with increasing coastal waters fishery production.

CONCLUSION AND SUGGESTION

Conclusion

Based on the results of the analysis, the research concludes as follows:

1. The results of the analysis indicate that the greater the ratio of mangrove silvofishery ponds the smaller the results of main cultivation.
2. On the contrary with analysis results show that the greater the ratio of mangrove the greater the results of the production of sideline cultivation.
3. The result of Benefit-Cost Ratio analysis or BCR of main cultivation is 1.5, it shows that silvofishery pond ratio of 60% mangrove and 40% pond is economically feasible to cultivate, not including sideline cultivation in the form of wild shrimp and wild fish.

The ratio between mangroves and ponds in the crescent-shaped silvofishery pond is mutually backward, it means ecological aspects emphasize conservation, while the economic aspects emphasize utilization.

Suggestions

The results of this study as follows:

1. To produce silvofishery pond production should the preparation be done perfectly with drying, pest eradication, and limiting.
2. Cultivation system is better done as polyculture to create symbiosis mutualism aimed so that pond bottom condition did not happen to accumulation of organic materials that potentially reduce soil quality and water quality.

3. Design of silvofishery ponds as mangrove areas as conservation areas on the north or south of the expanse, so that sunlight does not interfere with pond expanse as cultivation area.

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