Feasibility Study of Mangrove Area *Silvofishery* Development in Lantebung

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Abstract- *Silvofishery* is a traditional technology aquaculture system that combines fishery business with mangrove planting. This study aims to: (1) analyze the feasibility of mangrove land for *silvofishery* activities in terms of biology, physics, and chemistry; (2) analyzing the applicable and appropriate *silvofishery* models/forms in the Lantebung Mangrove Area; (3) analyzing community interest in *silvofishery* development in the Lantebung Mangrove Area. In this study, environmental parameters were obtained by direct measurement, while public interest was obtained by distributing questionnaires using purposive sampling technique. The data analysis used is vegetation data analysis, suitability data analysis, and descriptive analysis. The results showed that Station 1 and Station 3 were in the quite appropriate category, while Station 2 was in a very suitable category to support the activity of developing *silvofishery* for crab cultivation using the step-by-step confinement model. Supported by the high interest of the community to develop *silvofishery* for crab cultivation in the Lantebung Mangrove Area with a percentage of 57.78%. Thus, the Mangrove Area in Lantebung is feasible to develop *silvofishery* a crab culture.

Index Terms- *Silvofishery*, feasibility, public interest, Lantebung

I. Introduction

Mangrove forest is a general term that describes tropical coastal communities (Parmadi et al., 2016). Mangroves are one of the typical coastal ecosystems because they have an integrated role between physical and biological aspects, or also known as ecological functions, while their use will be meaningful in the economic aspect for ecosystem users, namely humans. There are no less than 75 species of mangroves in Indonesia. Mangroves also have an important role in balancing environmental quality and neutralizing pollutants. Mangroves grow in tidal areas which have the ability to grow in salty waters and have a very real role as a barrier to abrasion. In addition to its location in a tidal area with supportive fertility, this mangrove has the potential to be developed into aquaculture areas.

The increasing use of coastal areas, in addition to having a positive impact through increasing living standards and employment or business opportunities, also has a negative impact if its use is not controlled (Rustam et al., 2020). The mangrove ecosystem is a forest area in the coastal area. This mangrove ecosystem is a type of fragile that is very sensitive to environmental changes, even though the ecosystem is open access so that increased exploitation of mangrove resources by humans will reduce the quality and quantity (Rustam et al., 2020). This condition provides a lesson that with the limited availability of natural resources, the flow of goods and services produced from natural resources cannot be carried out continuously so that efforts are needed to reduce dependence or at least give nature time to recover. Optimal utilization efforts, which are also mangrove forest conservation measures, can be carried out through the mina forest/*silvofishery* (Rustam et al., 2020).

The existence of mangroves in Makassar City, especially in Bira Village, is a strategic asset to be developed on the basis of economic activity for the purpose of the prosperity of coastal communities and increasing local revenue. The people of Bira Village are dominant as fishermen, farmers, and fish farmers with a population of 11,926 people (BPS Makassar City, 2018). The potential of natural resources in Ex. Bira is a 58.53 ha mangrove forest (Bando et al., 2017). The types of mangroves found growing in the area were *Avicennia sp*, *Bruguiera sp*, and *Rhizhopora sp* which has enormous functions and benefits, both in terms of physical, chemical, biological, economic, and even ecotourism.

The potential for *silvofishery* in Lantebung can be an alternative in preserving mangroves which ecologically play a role in protecting coastal habitats and producing fishery products of important economic value while empowering local communities. Empowerment of local communities is very much needed in the development of *silvofishery* in the Lantebung Mangrove Area, because it is the local community themselves who will build, own and manage directly, so that they can directly receive economic benefits, protect social and cultural values and maintain sustainability and security. surrounding environment (Ummung and Massiseng, 2019).

Silvofishery is a traditional technology aquaculture system that combines fishery business with mangrove planting, which is followed by the concept of introducing a management system by minimizing inputs and reducing the impact on the environment (Paruntu et al., 2016). The term *silvofishery* or wanamina has recently been widely discussed and practiced as an environmentally friendly model of mangrove ecosystem management, one of which is the research conducted by Sambu (2013) in Sinjai Regency by combining fisheries activities with mangrove ecosystem conservation so as to increase pond productivity. *Silvofishery* has a dual purpose, namely on the ecological aspect of preserving the mangrove ecosystem and on the economic aspect of optimizing the pond (Sambu, 2013).

Based on the results of initial observations, the community only makes the area an attraction for local and foreign tourists to increase their income. However, since the COVID-19 pandemic hit, the income of the people in the area has decreased drastically, coupled with the erratic weather conditions making it difficult for fishermen to go to sea. Therefore, the method needed to improve the economic condition of the community in the area is *silvofishery*, considering that the existence of mangroves in the area is a natural habitat. Based on some of the descriptions above, the researcher is interested in conducting a study entitled "Feasibility Study of *Silvofishery* in Mangrove Areas in Lantebung". The formulation of the problem in this study are: (1) how is the feasibility of mangrove land in implementing *silvofishery* terms of the biological, physical, and chemical aspects of the area Lantebung mangroves?; (2) how the *silvofishery* can be applied in the region Lantebung mangroves?; (3) how is the community's interest in *silvofishery* in the Lantebung Mangrove Area?. The aims of this study were: (1) to analyze the feasibility of mangrove land for *silvofishery* terms of biology, physics, and chemistry; (2) to analyze the *silvofishery* applicable (3) to analyze community interest in *silvofishery* in the Lantebung Mangrove Area.

II. RESEARCH METHODOLOGY

Research site and time

This research was conducted from January to February 2022 in the mangrove area of Lantebung, Makassar City, South Sulawesi Province (Figure 1).

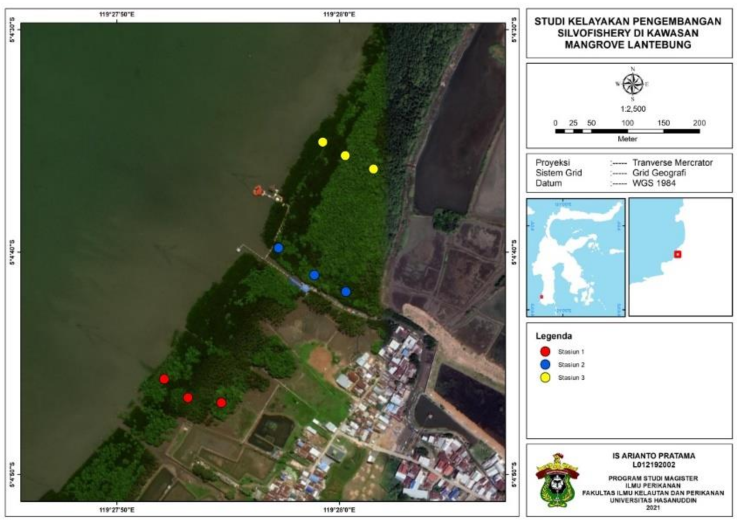

Figure 1: Map of research site and sampling area

Data types and sources

The data taken in this study are primary data and secondary data. Primary data consists of environmental parameters and data on community interests obtained by distributing questionnaires to the public. Environmental parameters include temperature, salinity, water pH, soil pH, soil texture, DO, tides, types of mangrove vegetation, and mangrove density. Secondary data consists of documents and other data obtained from literature studies.

Population and sample

The population in this study amounted to 379 respondents. The sampling technique in this research is purposive sampling. To determine the number of samples can use the formula with a purposive sampling method (Zainuddin, 2002). Based on the calculation results, the minimum number of respondents is 45 people.

Research procedure

1. Environmental parameter data

a. Physical parameter data (temperature and tides). Temperature data retrieval according to Fataha et al., (2019), can use a digital thermometer. Tidal data collection was carried out at the Paotere Maritime Meteorological Station (BMKG) office. The data obtained for 15 days then saw the highest tide and lowest low tide. Inundation height is an environmental character that affects the type of vegetation that grows in the mangrove ecosystem.

b. Chemical parameter data (salinity, water pH, soil pH, soil texture, and DO). Salinity data retrieval according to Oktafiansyah (2015), the tool used is a digital refractometer by activating the refractometer. Sampling of soil pH and soil texture at the research site was carried out with 9 samples for soil pH, 3 stations each, 3 replicates, while the soil texture used was a composite soil sample, soil samples were taken from 3 times for one point, then mixed evenly, so that one result is obtained that can describe the average condition of each sample point. The determination of the sample point follows the water sampling point. Soil samples were taken from layers 0 – 5 cm and layers 5 – 10 cm (August 2008). Samples were taken using a tool in the form of a shovel. Then the soil samples were analyzed for texture. Dissolved oxygen (DO) measurement can be done by titration (titrimetry). The method of measurement is the standard Winkler method.

c. Biological parameter data: types of mangrove vegetation and mangrove density. The measurement of the condition of vegetation types and mangrove density is carried out by measuring trees so that species density data is collected which aims to obtain mangrove data of both species and density and mangrove conditions so that it becomes one of the basic mangrove management that supports the management of natural resources on the coast. The method used to determine the station in this study is the purposive sampling method (Parmadi et al., 2016). The number of stations determined is 3 stations and each station consists of 3 sub stations.

2. Questionnaire

This questionnaire was conducted to measure public interest, by submitting a questionnaire sheet containing a list of questions to respondents using a purposive sampling approach. Determination of respondents with this method follows several considerations, such as farmers, fishermen whose concentration of residence and work activities are around the Lantebung Mangrove Area, institutions that are directly involved in accessing environmental resources and mangrove/coastal ecosystems. In answering the respondent's question, it is only justified by choosing one of the alternative answers that have been provided. This study uses the Likert scale as the measurement scale and indicators from Zulfanedhi (2016), which include: feelings of pleasure, attention to activities, concentration on activities, awareness in activities, willingness in activities, and involvement in activities.

3. Documentation

This technique is carried out through the technique of recording the required data from both respondents and at the time of field data collection. This technique is useful for strengthening the data that has been taken using the previous data retrieval technique. In this research, it is done by taking pictures or documentation about the profile of the station location.

Data analysis

1. Vegetation Data Analysis

Mangrove vegetation data was analyzed by calculating the Species Density (K). The formula used to calculate the species density can be seen below:

$$Di = \frac{ni}{A}$$

Description:

Di = Species density (ind/m2)

ni = Total number of species stands i

A = Total area of sampling area

2. Data Analysis Conformity Feasibility

The feasibility study was carried out to determine the suitability of the area as a cultivation area for mud crab *(Scylla sp.)* with *a silvofishery* pattern. This is based on the ability of the land to support activities that can be carried out in the area. The calculation in the feasibility suitability analysis is based on several parameters which are supporting factors for the activities carried out in the provided area. Each of these parameters has an assessment weight based on its level of importance to support the activities that can be carried out, while the assessment score is a classification obtained from observations of conditions in the field. The value of each parameter is the result of multiplying the weights and scores, then adding up the values of all the parameters. The determination of the suitability of the area is seen based on the percentage of conformity, which is obtained from the comparison between the total values of all parameters according to observations in the field with the maximum possible value.

The preparation of the suitability matrix is the basis of spatial analysis through scoring and weighting factors. Evaluation is carried out on scoring and weighting to get a suitability class that describes the level of suitability of a field for a particular use. The level of suitability is divided into four classes (Bakosurtanal, 1996), namely:

a. Class S1: Highly Suitable This area does not have serious restrictions to apply the treatment given or only has meaningless or no significant barriers to its use and does not increase the input or level of treatment given.

b. Class S2: Moderately Suitable This area has limitations that are serious enough to maintain the level of treatment that must be applied. This barrier will increase the input or level of treatment required.

c. Class S3: Marginally Suitable This area has serious limitations to maintain the level of treatment that must be applied. The barrier will further increase the input or level of treatment required.

d. Class N: Not Suitable (Not Suitable) This area has a permanent boundary, thus preventing any possible treatment in the area.

The suitability matrix was prepared by means of a literature review and expert discussion, so that it was known that the conditional variables were used as a reference in assigning weights. Therefore, the variables that are considered important and dominant become the basis for consideration of giving greater weight and the less dominant variables are given a smaller weight.

With the distribution of optimal quality data for the *silvofishery* pattern crab culture, a suitability matrix was compiled to determine the scoring results for each parameter with the scoring system as shown in Table 1 below:

Table 1: Eligibility criteria for Crab cultivation with *silvofishery* pattern

Variable	Weight	Good (score 5)	Moderate (score 3)	Pour (score 1)	Reference

Temperature (^{O}C)	2	25-35	20-25	<20 & >35	Setiawan and Triyanto (2012)
Salinity (ppt)	2	15-25	>25-30	<15 & >30	Setiawan and Triyanto (2012)
Water pH	1	7,5-9	6,5-7,5	<6,5 & >9	Setiawan and Triyanto (2012)
DO (mg/L)	2	>4	3-4	<3	Setiawan and Triyanto (2012)
Soil Ph	2	6,5 – 8,5	5 – 6,4	<5	Setiawan and Triyanto (2012)
Vegetation Type	2	*Rhizophora mucronata*	*Rhizophora stylosa*	*Avicennia alba*	Setiawan and Triyanto (2012)
Vegetation Density	3	Dense (>15)	Moderate (>10-15)	Damaged (<10)	Setiawan and Triyanto (2012)
Soil Texture	2	Mud – Clay (Fine)	Clay, Mud, Sandy Mud (Medium)	Sand (Coarse)	William (2003)
Tidal (cm)	3	1 – 3	0,5 – 1 or 3,3 – 3,5	<0,5 or >3,5	Muslim (2014)

Source: Agus (2008) and Hanjani (2019) with some modifications

Description:
1) Rating score based on Bakorsultanal's (1996) instructions, namely
5: Good 3: Moderate 1: Pour
2) Based on consideration of the influence of the dominant variable.
3) The score is $\sum_{i=1}^{n} = A \text{ X } B$

The total value of the product of the variable values and their weights is used to determine the feasibility class of the supporting variables (parameters), with the following calculation:

$$Y = \sum ai \,.\, Xn$$

Description:
Y = Final value
ai = Weighting factor
Xn = Value of the level of support for variables (parameters)

Based on the equation, the maximum and minimum values are obtained in the class determining the suitability value, with this equation the data is obtained as shown in Table 2 below this:

Table 2: Values and weights of suitability for *Silvofishery* of Mangrove Crab

No.	Parameter	Min Value	Max Value	Weight	Total Min Value	Total Max Value
1.	Temperature (°C)	1	5	2	2	10
2.	Salinity (ppt)	1	5	2	2	10
3.	Water pH	1	5	1	1	5
4.	Soil pH	1	5	2	2	10
5.	DO (mg/L)	1	5	2	2	10
6.	Vegetation Type	1	5	2	2	10
7.	Density	1	5	3	3	15
8.	Soil Texture	1	5	2	2	10
9.	Tidal	1	5	3	3	15
Total					19	95

Source: Processed data (2022)

The feasibility class interval is obtained based on the Equal interval method, in order to divide the range of attribute values into sub-ranges of the same size. The calculation is as follows:

$$I = \frac{(\Sigma ai \,.\, Xn)\,max - (\Sigma ai \,.\, Xn)\,min}{k}$$

Description:
I = Eligibility class interval
k = Number of determined eligibility classes
ai = Weighting factor
Xn = Support level value variables (parameters)

Based on the formula for the equal interval method above, the water quality feasibility class interval for the development of mud crab *silvofishery* is as follows:

$$I = \frac{95 - 19}{4} = 19$$

Based on the above calculation, it is known that the interval between each class is 19, from a minimum value of 19 and a maximum of 95. So that the results of the evaluation of the land suitability assessment system for the cultivation of mud crab (Scylla sp.) *silvofishery* patterns can be shown in Table 3 below:

Table 3: Evaluation of the Suitability Assessment of *Silvofishery* Development for Crab Cultivation

Classification of Land Suitability	Value (%)
Very suitable (S1)	76 – 95
Quite suitable (S2)	57 – 75,9
Conditionally suitable (S3)	38 – 56,9
Not suitable (N)	19 – 37,9

Then to determine the area suitability index then the calculation is carried out by looking for the value of N first, the value of N is the value of 1 percentage of the weighting results obtained, so that the percentage assessment interval is in the range of 0 to 100%. to find the value of N can be known by using the following equation:

$$N = \frac{(\Sigma ai\ .\ Xn)\,max - (\Sigma ai\ .\ Xn)\,min}{100}$$

Description:
N = Percentage in 1 interval of weighting value
ai = Weighting factor
Xn = Value level of support variables (parameters)

Based on the equation method above, it is obtained the percentage value in 1 interval of suitability for the feasibility of crab cultivation (Scylla sp.) with a *silvofishery* pattern and it is found that the N value is 0.76 so that by knowing the N value it can be used to determine the index value. Regional Suitability (IKW) using the following equation.

$$IKW = \frac{(\Sigma ai\ .\ Xn)\,min}{N}$$

Description:
IKW = Area suitability index
ai = Weighting factor
Xn = Value of variable support level (parameter)
Min = Lowest value
N = Percentage in 1 interval weighted value (0.76)
Nb = Value weighting results

3. Data analysis on public interest

The analysis to be carried out is descriptive analysis. Descriptive analysis is the activity of statistically analyzing the data that has been collected and describing the data without intending to make conclusions that generalize the results of the study (Sugiyono, 2012). Descriptive analysis is used to see the trend of the variable frequency distribution by determining the level of achievement of respondents on the variable. Statistical analysis used includes: calculating descriptive statistical values, making criteria for categorization, making descriptions and calculating community interest variables based on indicators. The following are categorization criteria calculated based on the normal distribution approach:

Table 4: Criteria for Category

Skoring Range	**Category**
X ≥ Mi + Sdi	High
Mi – SDi ≤ X < Mi + Sdi	Medium
X < Mi – Sdi	Low

Source: Syam (2021)

III. RESULT AND DISCUSSION

A. Biological Parameters

Biological parameters carried out in this study were determining the type of vegetation and vegetation density. The density value of mangrove vegetation in the Lantebung mangrove forest area is presented in Table 5.

Table 5: Mangrove Type and Density

Station	Plot	Species	Number of Trees (Ni)	Area (m)	Density (Tree/100 m²)
1	1	*Rhizhopora mucronate*	45	100	45
	2	*Rhizhopora mucronate*	28	100	28
		Avicennia alba	26	100	26
	3	*Rhizhopora mucronate*	32	100	32
		Avicennia alba	22	100	22
Total			153	100	153
Average					30,6
2	1	*Rhizhopora mucronate*	42	100	42
		Avicennia marina	1	100	1
	2	*Rhizhopora mucronate*	45	100	45
		Avicennia alba	1	100	1
		Avicennia marina	2	100	2
	3	*Rhizhopora mucronate*	20	100	20
		Avicennia alba	3	100	3
		Avicennia marina	14	100	14
Total				100	128
Average					16
3	1	*Avicennia marina*	15	100	15
	2	*Avicennia alba*	7	100	7
		Avicennia marina	13	100	13
	3	*Rhizhopora mucronate*	58	100	58
Total				100	93
Average					23,25

Source: Processed data (2022)

From the results of measurements of the density value of mangrove species in each replicate, it shows that *Rhizophora mucronata* has the highest density value when compared to other species such as *Avicennia alba* and *Avicennia marina*. Based on the average density value for each station, station 1 has a density value of 30.6 trees/m2, station 2 has a density value of 16 trees/m2, and station 3 has a density value of 23.25 trees/m2. The station that has a higher density value than the other stations is station 1. The high value of mangrove density indicates the number of trees in this station.

Rizky et al. (2013) in his research revealed that of the many types of mangroves in Indonesia, the type of mangrove *(Rhizophora sp)* is the main mangrove plant that is most commonly found. This type of mangrove is a mangrove group that captures, holds sediment and stabilizes the soil. This is in line with research conducted by Sunarto et al. (2015) which states that the mangrove species *Rhizhopora sp* is very supportive of the life of mud crabs because of the availability of food and the condition of water quality in the river is better.

Based on the results of the study, the density of mangrove species obtained at each research location showed varying values. The density value for each station can be seen in table 4 which shows that a higher density value is obtained at station 1 with a density value of 30.6 trees/m2 and the lowest density value is found at station 2 with a total species density of 16 trees/m2. The high density of mangroves indicates the number of trees in this station. This shows that the development of crab culture *silvofishery* at this location can be done because the higher the density of mangroves, the crabs can also live with the abundance of food available at that location. This is in line with research conducted by Kusmayadi (2017) that mangrove density with crab density has a very strong positive correlation. The waters around the mangrove forest are very suitable for the life of mangrove crabs because their food sources such as benthos and litter are quite available. The availability of natural food in the form of litter is strongly influenced by the density of mangroves (Soviana, 2004).

B. Physical Parameters

There are 2 physical parameter data observed, namely temperature and tides.

1. Temperature

The results obtained at the time of temperature data collection can be seen in table 5 below:

Table 6: Temperature obtained at each station

Station	Temperature (°C)			Average
	Deuteronomy 1	Deuteronomy 2	Deuteronomy 3	
1	30,8	28,1	28,3	29,1
2	33,8	33,5	33,3	33,5
3	32,3	29,3	28,6	30,1

Source: Processed data (2022)

Temperature plays an important role for the life and development of biota. The temperature at the study site ranged from 29 – 34 0C. The temperature obtained at station 1 with an average of 29.1 °C, the temperature at station 2 obtained 33.5 0C, and the temperature at station 3 obtained an average of 30.1 0C. This shows that the temperature at these three stations can be a place for crabs to live. This is in line with what was stated by FAO (2011) that land is suitable for the life of mud crabs with temperatures between 25-35 °C. The same thing was also stated by Fujaya (2010) in his research that temperature is one of the important abiotic factors that affect the survival, growth, and molting activities of crustaceans, the optimum temperature for crabs is 25 - 35°C. Research conducted by Suprayogi (2013) shows that the temperature of the mangrove ecosystem is between 24.4 – 27.9 °C. Mangrove crabs can live in mangroves with temperatures around 23 - 32 °C, while for optimal growth a temperature of 26 - 32 °C is needed. It can be concluded that the temperature in the mangrove area in Lantebung is within tolerance limits for the development of *silvofishery* for crab culture and crab breeding.

2. Tidal

Tidal measurements are carried out by collecting secondary data at the Paotere Maritime Meteorological Station (BMKG) for 15 days and for 24 hours. The tide chart is presented in Figure 2 below.

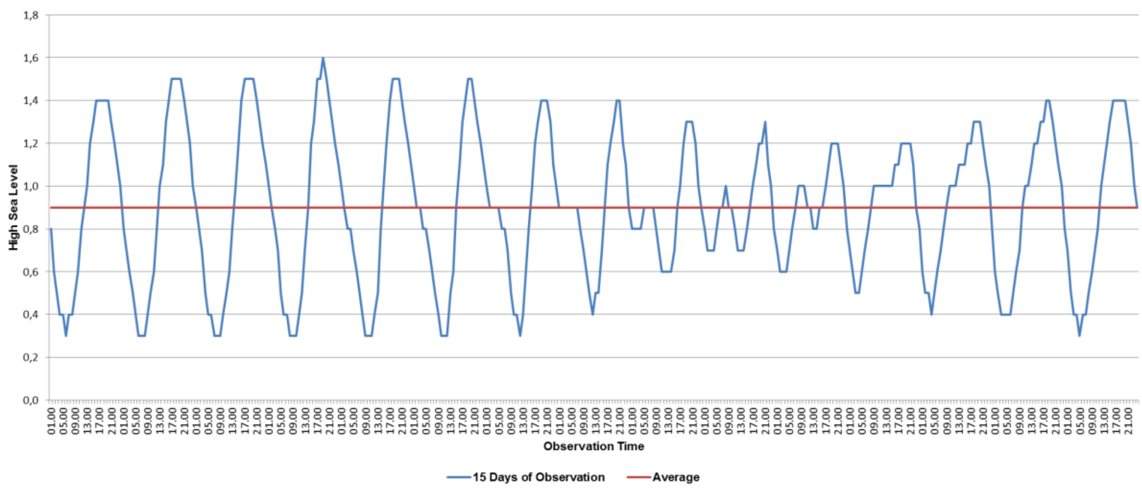

Figure 2: Tidal Patterns in the Lantebung Mangrove Area

The tides obtained were 1.6 m and the lowest value was 0.3 m, while the average tide for 15 days was 0.9 m. The period of time it takes from the starting point back to that point for a period of 24 hours. The time it takes from the lowest low tide to the highest tide (10 – 11 hours) is much faster than the time it takes from the highest tide to the lowest tide (11 – 12). Therefore, there is a time difference of 1 hour from the highest tide to the lowest low tide and from the lowest low tide to the highest tide. Crabs tend to be more active when high tides occur, so that the tidal level has a strong relationship with selection and assessment to determine the suitability of the area for crab *(Scylla sp.)* cultivation. These waters experience one ebb and flow and one ebb or diurnal tide. This tidal type, based on the results of Agus (2008) research, is a good tidal type for mud crab cultivation.

There are 4 chemical parameter data observed, namely salinity, water pH, soil pH and DO.

C. Chemical Parameters

1. Salinity

The results obtained at the three stations during salinity data collection in the field are presented in table 7 below:

Table 7: Salinity data

Station	Salinity (ppt)			Average (ppt)
	Deuteronomy 1	Deuteronomy 2	Deuteronomy 3	
1	26	25	26	25,7
2	20	21	22	21,0
3	27	31	27	28,3

Source: Processed data (2022)

Salinity at the site ranged from 21 – 28 ppt. Salinity is very influential on the life of mud crabs. Mangrove crabs can withstand salinity up to 38 ppt (Agus, 2008). Therefore, the research location is quite suitable to be used for the development of crab culture *silvofishery*. This is adjusted with Gunarto's (2005) research which states that the lower the salinity, the greater the growth. The salinity in this research location is in the low category so that it is suitable for the development of crab culture *silvofishery*. This is also supported by KEPMENLH No. 51 of 2004 the value of the quality standard is up to 34 ppt, which means that changes are allowed up to < 5 ppt of seasonal average salinity.

2. Water pH

The results obtained at the research location with 3 stations and 3 replications can be seen in table 8 below:

Table 8: The pH value of the water at the research location

Station	Water pH			**Average**
	Deuteronomy 1	Deuteronomy 2	Deuteronomy 3	
1	7,11	7,09	7,07	7,09
2	7,08	7,07	7,05	7,07
3	7,09	7,05	7,09	7,08

Source: Processed data (2022)

Development of maximum crab culture *silvofishery* should be carried out at pH 7.0 – 8.0 (Herlinah et al., 2016). This statement is in accordance with the results of the study between 7.07 – 7.09. This is in line with KEPMENLH No. 51 of 2004 which has a water quality standard value for marine biota of 7 – 8.5 pH units and is allowed to change to < 0.2 pH units. A similar study was conducted by Ario et al. (2019) in their article if the value of this range is suitable for cultivation purposes, especially crabs.

3. Soil pH

The results of soil pH measurements are presented in table 9 below:

Table 9: Results of Observation of Soil

Station	**Soil pH**			**Average**
	Deuteronomy 1	**Deuteronomy 2**	**Deuteronomy 3**	
1	7,4	7,6	7,5	7,5
2	7,9	8,1	7,7	7,9
3	7,1	6,8	6,9	6,9

Source: Processed data (2022)

The results of measurements in the laboratory showed that the soil pH values at 3 stations ranged from 6.9 to 7.9, This value range is said to be very good for crab culture. William AW (2003) in his research stated that the criteria that must be met in the cultivation of mud crabs in a location for soil pH are 5.5 - 7.5.

4. Soil Texture

Based on laboratory analysis of soil texture, it can be seen in table 10.

Table 10: Results of Soil Texture Analysis at Station Soil

Station	**Soil Texture (%)**			**Texture Class**
	Clay	**Mud**	**Sand**	
1	26	45	29	Mud Sandy
2	42	34	24	Mud Clay
3	28	31	41	Sand

Source: Processed data (2022)

Table 10 shows the difference in substrate at each station, this affects the different types and density of mangroves. The results of the soil texture analysis at station 1 are classified as sandy mud. This is because sand no longer dominates the composition of the substrate. This station has a muddy substrate as is usually found in Mangroves. The waters are a bit cloudy due to the presence of easily agitated particles. The type of substrate at station 3 is sandy, this is because in replicates 1 and 2, *Avicennia spp.* where this species is only found on sandy substrates. This is also supported by the opinion of Nybakken (1988), who said that *Avicennia spp*. cannot grow normally on shady or thick muddy substrate conditions which are usually found in forests. The type of substrate at station 2 is smooth (muddy clay), this is due to the type of mangrove *Rhizhopra spp.* which has distinctive roots, thereby reducing water movement. This situation causes fine bottom substrate particles to settle around the mangrove roots, thus forming a collection of soft sediment layers that are very difficult to drain. Mangrove crabs have a habit of digging holes and burying themselves in mud for cover.

5. Dissolved Oxygen (DO)

The results of data collection carried out in the field can be presented in table 11 below:

Table 11: Dissolved Oxygen (DO) Dissolved Oxygen (DO)

Station	Dissolved Oxygen (DO)			Average
	Deuteronomy 1	Deuteronomy 2	Deuteronomy 3	
1	2,744	2,548	2,842	2,71
2	5,390	5,194	4,998	5,19
3	1,960	1,960	1,078	1,67

Source: Processed data (2022)

Dissolved oxygen obtained at the study site is in the range of 1.67 – 5.19 mg/L. Dissolved oxygen which has a high value is found at station 2 so that at station 2 it is classified as good as a location for developing crab culture *silvofishery*. The optimal dissolved oxygen for cultivation according to Wijaya (2007) ranges from 5-8 mg/L. So stations 1 and 3 cannot be used as locations for *silvofishery* development because the dissolved oxygen yield is below 5 mg/L. This is in accordance with KEPMENLH No. 51 of 2004 which shows that DO waters are good for marine biota is > 5 ppm. Because the research location that has a good dissolved oxygen level for *silvofishery* development land is located at station 2.

D. Feasibility Analysis of Crab Cultivation with *Silvofishery* Pattern

Based on the results of the research conducted, it can be seen that the following categories are suitable for station 11 which are presented in table 12 below:

Table 12: Feasibility Conformity Level at Station 1

No.	Parameter	Weight	Research Result	Score	Weight x Score
1.	Temperature (°C)	2	29,1	5	10
2.	Salinity (ppt)	2	25,7	3	6
3.	Water pH	1	7,09	3	3
4.	Soil pH	2	7,5	5	10
5.	DO (mg/L)	2	2,71	1	2
6.	Vegetation Type	2	*Rhizhopora mucronata*	5	10
7.	Density (tree/100m^2)	3	30,1	5	15
8.	Soil Texture	2	Medium	3	6
9.	Tidal (m)	3	0,9	3	9
Total					71

Source: Processed data (2022)

From the calculation of the suitability level category of feasibility at Station I obtained values for each parameter. The temperature parameter was obtained with 29.1 0C. The salinity parameter was found to be 25.7 ppt. For water pH parameters obtained 7.09 and 7.5 soil pH. For dissolved oxygen obtained 2.71 mg/L. The mangrove density parameter was found to be 30.1 trees/100m2 and was the highest density of the three stations. For parameters of mangrove species obtained 2 types, namely *Rhizophora mucronata* and *Avicennia alba*. The soil texture is categorized as medium and the tidal water level is 0.9 m.

Based on the results of the study, it can be seen that the category of feasibility level for station 2 is presented in table 13 below:

Table 13: Level of Feasibility Conformity at Station 2

No.	Parameter	Weight	Research Result	Score	Weight x Score
1.	Temperature (°C)	2	33,5	5	10
2.	Salinity (ppt)	2	21,0	5	10
3.	Water pH	1	7,07	3	3
4.	Soil pH	2	7,9	5	10
5.	DO (mg/L)	2	5,19	5	10
6.	Vegetation Type	2	*Rhizhopora mucronate*	5	10
7.	Density (tree/100m^2)	3	16	5	15
8.	Soil Texture	2	Fine	5	10
9.	Tidal (m)	3	0,9	3	9

Total	87

Source: Processed data (2022)

From the calculation of the suitability level category of feasibility at Station 2 obtained values for each parameter. For the temperature parameter, the measurement results are 33.5 0C. For the salinity parameter obtained 21.0 ppt. The parameters for water pH and soil pH were 7.07 and 7.9, respectively. For the dissolved oxygen parameter, it was obtained 5.19 mg/L which is the best dissolved oxygen among the three stations. Types of mangroves from field measurements found 3 types, namely *Rhizophora mucronata*, *Avicennia alba* and *Avicennia marina*. Mangrove density is 16 trees/100m2. For the texture of the soil is categorized as smooth and for the tides it is 0.9 m.

Based on the results of the research conducted, it can be seen that the category of feasibility level for station 3 is presented in table 14 below:

Table 14: Level of Feasibility Conformity at Station 3

No.	Parameter	Weight	Research Result	Score	Weight x Score
1.	Temperature (°C)	2	30,1	5	10
2.	Salinity (ppt)	2	28,3	3	6
3.	Water pH	1	7,08	3	3
4.	Soil pH	2	6,9	5	10
5.	DO (mg/L)	2	1,67	1	2
6.	Vegetation Type	2	*Rhizhopora mucronata*	5	10
7.	Density (tree/100 m²)	3	23,25	5	15
8.	Soil Texture	2	Coarse	1	2
9.	Tidal (m)	3	0,9	3	9
Total					67

Source: Processed data (2022)

From the calculation of the suitability level category of feasibility at Station 3 obtained values for each parameter. For the temperature parameter, the measurement results are 30.1 0C. For the salinity parameter, 28.3 ppt was obtained. For the parameters of water pH and soil pH, respectively 7.08 and 7.5 were obtained for soil pH. For the dissolved oxygen parameter, it was obtained 1.67 mg/L. Types of mangroves from field measurements found 3 types, namely *Rhizophora mucronata*, *Avicennia alba* and *Avicennia marina*. Mangrove density obtained results of 23.25 trees/100m2. For the soil texture is categorized as rough and for the tidal level it is 0.9 m.

Table 15: Results of Feasibility Assessment for Crab Cultivation with *Silvofishery* Pattern

Parameter	Weight	Station					
		1		2		3	
		Score	Value	Score	Value	Score	Value
Temperature (°C)	2	5	10	5	10	5	10
Salinity (ppt)	2	3	6	5	10	3	6
Water pH	1	3	3	3	3	3	3
Soil pH	2	5	10	5	10	5	10
DO (mg/L)	2	1	2	5	10	1	2
Vegetation Type	2	5	10	5	10	5	10
Density (tree/100 m²)	3	5	15	5	15	5	15
Soil Texture	2	3	6	5	10	1	2
Tidal (m)	3	3	9	3	9	3	9
Total			71		87		67
Suitability Value (%)			68,42		89,47		63,16
Suitability Category			S2		S1		S2

Source: Processed data (2022)

Based on the evaluation results of the matrix analysis, the suitability score for the feasibility of crab cultivation with the *silvofishery* pattern is in the range of 67 (63.16%) – 87 (89.47%). There are two categories of results based on the suitability matrix, namely very suitable (S1) and quite suitable (S2). Station 2 is in the very appropriate category (S1), while Station 1 and Station 3 are in the quite appropriate category (S2). Based on the results of the analysis of the 3 observed stations, Station 2 is in the very appropriate category (S1) to support *silvofishery* development activities for mud crab cultivation. Over all the research location is in the quite appropriate category (S2) with a weighted value of 73.68%, which means this area has serious enough constraints to maintain the level of treatment that must be applied. This barrier will increase the input or treatment level required for the development of crab culture *silvofishery (Scylla spp.)*. Thus, the *silvofishery* pattern crab cultivation is feasible to be developed in the Lantebung Mangrove Area, precisely at Station 2.

The *silvofishery* pattern cultivation activity that can be used at the research location is carried out using the step-by-step confinement method. This method is a common technique for cultivating crabs without cutting/damaging mangroves, which are made of bamboo with length, width, and height of 1.0 X 1.0 X 1.0 m respectively. The cage is placed in a mangrove area. The outside of the cage is lined with waring which aims to protect the cage from garbage and dirt carried by the current. In order to keep the water circulation in the cage running well, the bamboo halves are spaced about 1 cm apart from each other. In addition, it is necessary to have a cover that can be opened and closed to allow feeding treatment and the penetration of incoming light.

E. Description of Research Respondents

1. Age of Responden

Based on the research conducted, the characteristics of the Lantebung community who became respondents based on age are presented in Table 16 below:

Table 16: Age of Respondents in Lantebung

Age (Years)	Frequency	Percentage (%)
≤ 25	4	8,9
26 – 45	12	26,7
46 – 65	24	53,3
≥ 66	5	11,1
Total	45	100

Source: Processed data (2022)

From the table above, it can be seen that 8.9% of respondents aged ≤ 25 years, 26.7% of respondents aged 26 – 45 years, 53.3% of respondents aged 46 – 65 years, and 11.1% of respondents aged ≥ 66 years.

2. Education of Respondents

The data regarding the education level of the Lantebung community who became respondents are presented in Table 17 below:

Table 17: Education Level of Respondents in Lantebung

Education	Frequency	Percentage (%)
SD Equivalent	7	15,6
SLTP Equivalent	11	24,4
SLTA Equivalent	21	46,7
D3/ S1	6	13,3
Total	45	100

Source: Processed data (2022)

In general, the education of the Lantebung community is not good enough. The highest level of public education is senior high school (SLTA) with a percentage of 46.7%, while the level of undergraduate education is only 13.3%.

3. Gender of Respondents

The gender percentage of the Lantebung community can be seen in Table 18 below:

Table 18: Gender of Respondents in Lantebung

Gender	Frequency	Percentage (%)
Male	38	84,4
Female	7	15,6
Total	45	100

Source: Processed data (2022)

Based on the respondent's data obtained, the most dominant gender is male with a percentage of 84.4%, while female is 15.6%.

Based on the research that has been done, the characteristics of the people who become respondents are based on age, education, and gender. It is known that the highest percentage of age is at the age of 46-65 with a percentage of 53.5%. Male is the most dominant with a percentage of 84% at the research site. In education, the highest percentage is at the senior high school (SLTA) level with a percentage of 46.7%. This shows that the age, education, and gender of these respondents are good enough to support the development of *silvofishery* with crab cultivation. According to Feronika (2011), age, education, and gender are a way to improve the skills and knowledge of the community in treating the environment such as in management, utilization, development and protection.

F. Public Interest

A statistical descriptive table for the variable of public interest can be presented below:

Table 19: Descriptive Statistics

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Public Interest	45	14	36	50	45.33	.44608	2.99	8.96
Valid N (listwise)	45							

Source: Processed data (2022)

Based on table 19, the results of descriptive analysis for the community interest variable are as follows: minimum value of 36, maximum value of 50, the mean is 45.3, and the standard deviation is 2.99. The number of statements on the variable of public interest is 14 statements with scores of 4, 3, 2, and 1. The categorization of the variable of public interest is presented based on the mean score (M) and standard deviation (SD) which are described in the following table.

Table 20: Categorization of community interest variables

Category	Score Range	Frequency	Percentage %
High	$X \geq 45{,}33$	26	57,78
Medium	$40{,}67 \leq X < 45{,}33$	15	33,33
Low	$X < 40{,}67$	4	8,89
Total		45	100

Source: Processed data (2022)

Public interest is in the high category by 57.78%, public interest in the medium category is 33.33%, and public interest in the low category is 8.89%. Community interest is in the high category, it is shown that people in the Lantebung Mangrove Area are interested when mangroves can be used to increase income apart from the tourism sector.

The community supports the use of mangroves that have never been applied to the area. The form of mangrove utilization that can be developed is *silvofishery*. Residents who live want the area to be checked to find out whether or not *silvofishery* is feasible to develop, so that the community's economy can increase. In its development, the role of the community is very important so that the results obtained are maximized, therefore the community is willing to be directly involved in the development of *silvofishery*. Based on the existing mangrove land in the area, some people think that the suitable model for *silvofishery* development is the step-by-step confinement model. It can be concluded that the community's interest in developing *silvofishery* for crab cultivation in the Lantebung Mangrove Area is in the high category, namely 57.78%.

IV. CONCLUSION

The conclusions obtained from this study are as follows:

1. Based on the results of the evaluation of the matrix analysis, the suitability score for the feasibility of crab cultivation with the *silvofishery* was in the range of 67 (63.16%) – 87 (89.47%). It was found that Station 2 was in the very appropriate category (S1), while Station 1 and Station 3 were in the quite appropriate category (S2). Over all the research location is in the quite appropriate category (S2) with a weighted value of 73.68% which means this area has serious enough constraints to maintain the level of treatment that must be applied. This barrier will increase the input or level of treatment required for the development of crab culture (*Scylla spp.*). Based on the results of the analysis of the 3 observed stations, Station 2 is in the very appropriate category (S1) to support *silvofishery* crab cultivation. Thus, *silvofishery* is feasible to be developed in the Lantebung Mangrove Area, precisely at Station 2.
2. Based on the results of the analysis, it was found that public interest was in the high category by 57.78%, public interest in the medium category was 33.33%, and public interest in the low category was 8.89%. Thus, public interest in developing *silvofishery* for crab cultivation in the Lantebung Mangrove Area is in the high category, namely 57.78%.

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