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# LAND SUITABILITY AND POND REVITALIZATION ANALYSIS FOR THE CULTIVATION OF WHITE SHRIMP AND MILKFISH IN A TRADITIONAL POLYCULTURE AND INTENSIVE CULTIVATION OF WHITE SHRIMP (LITOPENAEUS VANNAMEI): A CASE STUDY AT LAND OF PT. ARUTMIN INDONESIA ASAM-ASAM MINE, TANAH LAUT REGENCY OF INDONESIA

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**ABSTRACT**
PT. Arutmin Indonesia Asam-Asam Mine, Tanah Laut Regency will try to carry out CSR development in the fisheries and marine sector in the form of making a demonstration plot (demonplot) in the form of ponds for Vanname shrimp cultivation at the location of former community shrimp ponds. The aim of this study was to analyze land suitability for Vanamme shrimp (Litopenaeus vannamei) cultivation in PT. Arutmin Indonesia Asam-Asam Mine, Tanah Laut Regency, South Kalimantan and pond revitalization for vanamme shrimp (Litopenaeus vannamei) cultivation on PT. Arutmin Indonesia Asam-Asam Mine, Tanah Laut Regency, South Kalimantan. Research in the area of former community ponds that have been freed by PT. Arutmin Indonesia Asam-asam Mine, Tanah Laut Regency, South Kalimantan Province. Data collection was carried out by observing the biophysical and social environmental conditions on PT. Arutmin Indonesia Asam-Asam Mine, Tanah Laut Regency, South Kalimantan). Data analysis technique to analyze the advantages of vannamei shrimp farming in traditional polyculture. Land suitability, the total value of the land suitability category to be used as a Vanname shrimp pond demonstration plot is 456 Ha with the Suitable category (S2) found at Station 1, Station 2 and Station 3 while the total value for the very suitable category is 364 Ha at Station 4. Average The average R/C ratio of vannamei shrimp farming is traditionally higher than the average R/C ratio of intensive vannamei shrimp farming in one production period. This happens because intensive cultivation costs a lot in investment costs compared to traditional methods which use little investment costs, but both traditional and intensive methods are very effective and economically profitable when viewed from short-term business performance indicators.

**KEY WORDS**
Vaname shrimp, land suitability, revitalization, PT. Arutmin, asam-asam.

PT. Arutmin Indonesia is one of the largest coal producing and exporting companies in Indonesia. Arutmin first signed a mining contract coal with the Government of Indonesia in 1981 and is the longest-running private coal producing company in Indonesia. Where among its missions is to improve the welfare of the community around the mine site and sustainable environmental preservation. PT. Arutmin Indonesia has several mining locations including the Asam-asam mine which is located in Asam-asam District, Tanah Laut Regency with a CSR program set by the Provincial Government of South Kalimantan, there are several priorities that have been developed for local communities around mining activities with the priority so far being education, health and the economy will even be developed in the fisheries and marine sectors.

One of the breakthrough programs of the Ministry of Maritime Affairs and Fisheries (KKP) is the development of export-based aquaculture with shrimp as one of the leading commodities. Shrimp is one of Indonesia's mainstay fishery commodities which has the potential to be exported. As one of the national leading commodities, shrimp has always been the choice to be involved in efforts to increase state revenues and reach the target of increasing production by up to 250% by 2024. Shrimp cultivation locations are currently spread across almost all parts of Indonesia, meanwhile according to the Head of the Maritime Affairs and Fisheries Office of Tanah Laut, South Kalimantan, Noor Hidayat said the potential for shrimp pond cultivation in Tanah Laut reaches 1,000 hectares which are located in four coastal districts namely, Kintap District, Jorong District, Takisung District and Kurau District, excluding Muara Asam-asam Village (*https://kalsel.antaranews.com*).

MMAF is targeting national shrimp production of 2 million tons per year by 2024. Area-based shrimp pond development is carried out using ecological and economic considerations. In this way, it is hoped that not only will there be an increase in community welfare and local revenue, but also that ecosystem sustainability can be maintained. In addition to the development of area-based shrimp ponds, there is also a breakthrough in revitalizing traditional shrimp ponds which cover an area of 5,000 hectares throughout Indonesia.Based on the description above, PT Arutmin Tambang Asam-Asam, Tanah Laut Regency will seek to carry out CSR development in the fisheries and marine sector in the form of making demonstration plots (demonplots) in the form of ponds for Vanname shrimp cultivation at the location of former community shrimp ponds which have been freed at the request of the community itself, so that later it is hoped that if the demonstration plot is successful it can revive the shrimp farming business that was previously carried out by the people of Muara Asam-Asam village, so that plans to reactivate additional ponds and revitalization increase production volume from 0.6 tonnes per hectare to 2 tonnes per hectares within an area of ± 100 hectares of former community ponds located on PT. Arutmin Indonesia Asam-asam mine is expected to provide increased community welfare and local revenue as well as sustainable ecosystem sustainability.

Before carrying out the construction of a demonstration plot for the cultivation of vanname shrimp, a suitability study should be carried out on the land and the carrying capacity of the waters for the cultivation of the vanname shrimp. The vannamei shrimp commodity was chosen because it is one of the leading commodities in supporting the industrialization of aquaculture, because it has high economic value, high market demand (high demand product), and this commodity has even been the prima donna of fisheries product exports. The aim of this study was to analyze land suitability for Vanamme shrimp (Litopenaeus vannamei) cultivation in PT. Arutmin Indonesia Asam-Asam Mine, Tanah Laut Regency, South Kalimantan and pond revitalization for vanamme shrimp (Litopenaeus vannamei) cultivation on PT. Arutmin Indonesia Asam-Asam Mine, Tanah Laut Regency, South Kalimantan.

## METHODS OF RESEARCH

Research in the area of former community ponds that have been freed by PT. Arutmin Indonesia Asam-asam Mine, Tanah Laut Regency, South Kalimantan Province. Data collection was carried out by observing the biophysical and social environmental conditions on PT. Arutmin Indonesia Asam-Asam Mine, Tanah Laut Regency, South Kalimantan).

Temperature measurements were carried out in the water column using a water quality checker. Dissolved oxygen measurements were carried out in the water column using a water quality checker. Water salinity measurements were carried out on the surface of the waters using a handrefractometer. Measurement of the pH of the waters is used using a pH kit.

Sampling and analysis of phosphate, nitrite, nitrate, TSS, BOD5 and organic matter taken at each predetermined observation station. Water samples that have been taken as much as 1 liter are then tagged and stored in a cool box, then the samples will be analyzed ex-situ at the Water Quality Laboratory of the ULM Faculty of Fisheries and Marine Affairs to determine the content values of Phosphate, Nitrite, Nitrate, TSS, BOD5 and organic matter.

Data analysis techniques to analyze the advantages of vannamei shrimp farming using traditional polyculture are used, namely:

$$\pi = TR - TC$$

Where:

π = Profit;
TR = Total Revenue;
TC = Total Cost.

Total revenue is all the results obtained from the sale of all production results. The formula is:

$$TR = P \times Q$$

Where:

P = Selling price/kg (Price);
Q = Total production and output (Quantity).

Total costs are all costs incurred in one production cycle, generally consisting of fixed costs and variable costs. The formula is:

$$TC = FC + VC$$

Where:

FC = Fixed Cost;
VC = Variabel Cost.

The market opportunity criteria are as follows:

- If TR < TC, then π decreases;
- If TR > TC, then π increases.

The method used for calculating weights and scoring is done with the following equation:

$$W = \frac{(n - Bx + 1)}{\sum(n - Bn + 1) + (n - Bn + 1) + \cdots..(n - Bn + 1)}$$

Where:

W = Weight;
N = Number of parameters to be scored;
Bx = Weight figure;
Bn = Weight figure to n.

Land suitability for aquaculture in this case is based on criteria adopted from the Fisheries Research Center (1992) and Poernomo (1992). Analysis of the suitability of pond areas is intended to determine the suitability of land and coastal waters (physical, chemical, and biological) for pond cultivation, carried out by measuring several environmental parameters which are ecological requirements for aquaculture development, namely substrate physics, water quality, and hydrooceanography (Fredinan 2008). The condition of the aquatic environment is a limiting factor for determining the suitability of cultivation land (Arifin et al. 2011)

Scoring aims to assess the limiting factors for each parameter. The Overlay process is carried out after all parameters are given weight and score. This process is carried out using ArcGIS 10.4 software and a pond area classification will be produced based on the parameters that are considered the most important in determining water suitability. The value of each class is based on calculations with the following formula:

$$N=\Sigma bi\ x \qquad (1)$$

Where:

N = Total value weight;
Bi = Weight on each criterion;
Si = Score on each criterion.
The total score of these parameters is calculated by the following equation:

$$\text{Total skor} = \sum_{i=1}^{n} N \qquad (2)$$

Determination of class intervals is done by the equal interval method. The equation can be written as follows:

$$\text{Class distance} = \Sigma(Bi \times Si)\ max - \Sigma(Bi \times Si)\ min \quad (3)$$

The carrying capacity of the waters is assessed from the water quality data that has been obtained from field measurements, and then analyzed spatially. Data analysis in this study consisted of the stages of contouring and spatial modeling by deriving physical, chemical and biological parameters based on a geo-statistical model, which refers to Hartoko (2000). The results of the interpolation of each water quality variable are then arranged in the form of thematic maps. The matrix or criteria used in this study consists of 10 parameters, namely Temperature, Salinity, pH, DO, Nitrite, Nitrate, Organic Matter, TSS, Phosphate, BOD5. Using the Surfer application in the form of a grid-based contouring and 3D surface plotting graphics program that runs on Windows, Windows 95, Windows NT operating systems. Surfer(R) works by interpolating random XYZ data into a regular grid, and placing the results of the gridding process in a *.GRD file. Files of this type will then be used to create 3D contour maps and surface maps, while the level of suitability is divided into 3 classes, namely class S1: Not suitable, class S2: suitable and class S3: very suitable.

## RESULTS AND DISCUSSION

The plan for making a Vaname shrimp pond demonstration plot is in the location of a former community shrimp pond that has been freed by PT. Arutmin Indonesia Asam-Asam Mine.

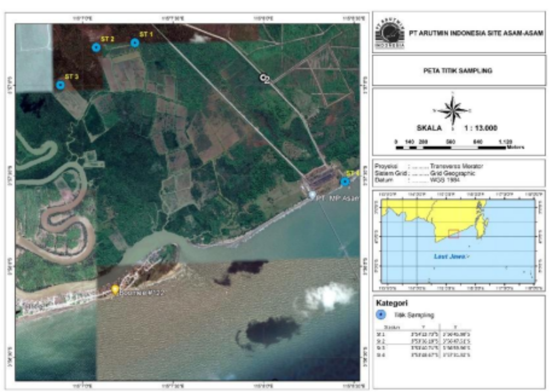


Figure 1 – Map of the location of the Water Quality Sampling Points at the location where the Vaname Shrimp Pond Demonstration Plot is planned to be made

Results of water quality measurements at 4 locations with coordinates at Station 1 or ST1: 115° 7'17.34"E, 3°56'45.98"S, ST2: 115° 7'4.54"E, 3°56'47.51"S, ST3: 115° 6'52.70"E, 3°56'59.96"S and ST4: 115° 8'27.03"E, 3°57'31.92"S, with 10 water quality parameters namely salinity, DO or Dissolved Oxygen ), temperature, pH, TTS (Total Suspended Solids), Nitrate, Nitrite, Phosphate, Organic matter and BOD 5 or Biochemical Oxygen Demand at 5 days.

Table 1 – Results of measurements of water quality parameters at 4 sampling points with 10 water quality parameters at the location where a vannamei shrimp pond demonstration plot is planned to be made

| Parameter | Cooridnate | 115° 7'17.34"E | 115° 7'4.54"E | 115° 6'52.70"E | 115° 8'27.03"E |
|---|---|---|---|---|---|
| | | 3°56'45.98"S | 3°56'47.51"S | 3°56'59.96"S | 3°57'31.92"S |
| | Quality Standards | ST1 | ST 2 | ST 3 | St 4 |
| Salinity (ppm) | | 2 | 7 | 10 | 30 |
| DO (mg/l) | > 5 | 2.7 | 4.7 | 6.3 | 6.2 |
| Temperature (C) | 28-32 | 32.4 | 32.8 | 34.6 | 31.2 |
| pH | 7-8,5 | 5.5 | 6.22 | 6.4 | 7.24 |
| TSS (mg/l) | < 80 mg/l | 11 | 6 | 6 | 15 |
| Nitrate (mg/l) | 0,008 mg/l | 0.01 | <0,01 | 0.01 | 0.01 |
| Nitrite (mg/l) | 0,06 mg/l | <0,01 | 0.02 | <0,01 | 0.01 |
| Phosphate (mg/l) | 0,015 mg/l | 0.02 | 0.03 | 0.02 | 0.2 |
| Organic Material | 40 mg/l | 2.3 | 1.7 | 4.8 | 4.9 |
| BOD 5 | 20 mg/l | 10,8 | 11,5 | 11,8 | 11,9 |

Table 2 – Parameter potential level values based on several references

| No | Parameter | Potential Level | | | Ideal | Reference |
|---|---|---|---|---|---|---|
| | | Not suitable (S1) | Suitable (S2) | Very suitable (S3) | | |
| 1 | Salinity | <10 atau > 35 | 25 – 35 | 15 – 25 | 15-35 | Aziz (2010), SNI 7772 (2013) |
| 2 | (ppm) | <2,0 | 2,0 - 3,5 | >3,5 | >2,0 | SNI 7772 (2013), Ferreira et al-2011 |
| 3 | DO | <18 atau >40 | 18-35 | 28-32 | 18-35 | WWF (2014), Nurjanah (2009), Ferreira et al (2011) |
| 4 | (mg/L) | <6,8 atau >8,6 | 6,8 – 7,6 | 7,6 – 8,6 | 6,8-8,6 | Nitya et al (2016) |
| 5 | Temperature | 250-300 | 200-250 | <200 | <250 | Arifin et al. (2007), KEPMEN LH NO. 51 2004, Utojo et al. (2010) |
| 6 | (C) | >1 | 0,6-1 | ≤0,5 | 0,05-1 | PERMEN KP Number 75 (2016),<br>Suwoyo & Tampangallo (2015), Goldman & Home (1994) |
| 7 | pH | >1 | 0,01 – 1 | <0,01 | 0,05-1 | PERMEN KP Number 75 (2016),<br>Suwoyo & Tampangallo (2015), Goldman & Home (1994) |
| 8 | TSS | >5,0 | >0,1-5,0 | ≥0,01-0,1 | ≥0,01-0,1 | PERMEN KP Number 75 (2016),<br>Suwoyo & Tampangallo (2015), Goldman & Home (1994) |
| 9 | (mg/l) | >95 | 91-95 | < 55-90 | <55-90 | PERMEN KP Number 75 (2016),<br>Suwoyo & Tampangallo (2015), Goldman & Home (1994) |
| 10 | Nitrate | <3->25 | 20-25 | 3-20 | 3-25 | Setyawan et al 2021 and SNI 01-7246-2006 |

Table 3 – Scoring weight table

| No | Parameter | Weight | Not suitable (S1) | | Suitable (S2) | | Very suitable (S3) | |
|---|---|---|---|---|---|---|---|---|
| | | | Score | Value | Score | Value | Score | Value |
| 1 | Salinity | 0.182 | 1 | 0.182 | 2 | 0.364 | 3 | 0.545 |
| 2 | Do | 0.164 | 1 | 0.164 | 2 | 0.327 | 3 | 0.491 |
| 3 | Temperature | 0.145 | 1 | 0.145 | 2 | 0.291 | 3 | 0.436 |
| 4 | Bod5 | 0.127 | 1 | 0.127 | 2 | 0.255 | 3 | 0.382 |
| 5 | pH | 0.109 | 1 | 0.109 | 2 | 0.218 | 3 | 0.327 |
| 6 | Nitrate | 0.091 | 1 | 0.091 | 2 | 0.182 | 3 | 0.273 |
| 7 | Nitrite | 0.073 | 1 | 0.073 | 2 | 0.145 | 3 | 0.218 |
| 8 | Phosphate | 0.055 | 1 | 0.055 | 2 | 0.109 | 3 | 0.164 |
| 9 | Organic Material | 0.036 | 1 | 0.036 | 2 | 0.073 | 3 | 0.109 |
| 10 | Tss | 0.018 | 1 | 0.018 | 2 | 0.036 | 3 | 0.055 |
| Total | | 1.000 | | 1 | | 2 | | 3 |

Salinity measurement results from Station 1 to Station 4 have different salinity content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S, the salinity value is 2 ppm, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S, the salinity value is obtained 7 ppm, ST3 with coordinates 115° 6'52.70"E, 3°56'59.96"S obtained a salinity value of 10 ppm and ST4 with coordinates 115° 8'27.03"E, 3°57'31.92"S obtained a salinity value 30 ppm. Generally, water salinity refers to the concentration of salt dissolved in water. Salinity is an important parameter in monitoring water quality, especially in aquatic environments such as the sea. Low salinity indicates the presence of fresh water, while high salinity indicates the presence of salt or sea water. Salinity can be affected by a number of factors, including evaporation, river flow, rainfall, and the interaction of seawater with land. In the marine environment, stable salinity contributes to the survival of marine organisms that are particularly adapted to these conditions. However, significant fluctuations in salinity can affect marine organisms, especially those that cannot tolerate rapid changes in salinity (Bange & Robinson, 2011).

Based on the results of water quality measurements for the salinity parameter at the location, the plan for making a Vaname shrimp mine demonstration plot based on scoring weighted data analysis and making a map using the surfer 17 application is only at ST 4 which is suitable for Vaname shrimp (litopenaeus vannamei) cultivation while at other stations it is not suitable. For vaname shrimp cultivation, the ideal salinity level is in the range of 15-25 ppt. In contrast to tiger prawns which require a salinity level of 20-25 ppt. Even though 25 ppt is the tolerance limit for vannamei shrimp salinity, it's still better not to be that big. This is due to the fluctuating salinity. If it's more than 25 ppt, then this water is definitely not good for vannamei shrimp.

The measurement results of DO or Dissolved Oxygen from Station 1 to Station 4 have different DO content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S DO value of 2.7 mg/l, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S is obtained DO value 4.7 mg/l, ST3 with coordinates 115° 6'52.70"E, 3°56'59.96"S obtained DO values 6.3 mg/l and ST4 with coordinates 115° 8'27.03"E, 3°57' 31.92"S obtained a DO value of 6.22 mg/l.

According to Alyandri (2019) the concentration of DO (Dissolved Oxygen) in water is below the specified quality standard, this may indicate a problem with the quality of the water. The presence of low DO can negatively impact aquatic organisms that require dissolved oxygen to survive. Low DO concentrations can indicate the presence of organic pollution or other contaminants in the water. The process of decomposing organic matter by microorganisms will consume oxygen, thus reducing its availability for other organisms and reducing the overall water quality. The concentration of DO (Dissolved Oxygen) in water is above the specified quality standard, this is generally considered a good thing for aquatic organisms. Adequate DO concentrations are important to support healthy aquatic life. The abundant presence of oxygen indicates an effective oxygenation process in the water, which means that the water is of good quality and free from significant organic pollution.

The content of dissolved oxygen or DO in the waters according to the quality standard is >5 mg/l. The results showed that ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S and ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S DO content was still below the quality standard. water, while ST3 with coordinates 115° 6'52.70"E, 3°56'59.96"S and ST4 with coordinates 115° 8'27.03"E, 3°57'31.92"S DO content exceeds water quality standards , whereas based on SNI 7772 (2013), Ferreira et al-2011, which became the reference in the suitability scoring weight, stated that the suitability of DO levels for all stations was very suitable except for ST1, which was appropriate.

The results of temperature measurements from Station 1 to Station 4 have different temperature contents. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S temperature values are 32.4 OC, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S obtained temperature values 32.8 OC, ST3 with coordinates 115° 6'52.70"E, 3°56'59.96"S obtained temperature values of 34.6 OC and ST4 with coordinates 115° 8'27.03"E, 3°57'31.92"S obtained temperature values 31.2 OC. The content of water temperature according to the quality standard is 28-32 OC. The water temperature measurements ST1, ST2 and ST4 are still within the water quality quality standards, while ST3 water temperature has exceeded the water quality quality standards. Temperature is one of the important factors in the waters. This is related to the nature of aquatic organisms which are cold-blooded animals, namely their body temperature is affected by environmental temperature. The environmental temperature is high, the body temperature of aquatic organisms is also high, so that the body metabolism of aquatic organisms is fast, and conversely, at low temperatures, the metabolism of aquatic organisms is also low. This affects the appetite of aquatic organisms which in turn will affect fish growth and ultimately affect production (Hastutiningrum et al, 2020).

Based on the results of the suitability analysis of temperature parameters it is very suitable except for station 3 which is suitable. This is in line with the measurement results that the water temperature at ST3 has exceeded the water quality quality standards, but is still appropriate based on weight scoring referring to WWF (2014), Nurjanah (2009), Ferreira et al (2011) for vannamei shrimp farming.

The water pH parameter is a measure used to determine the level of acidity or alkalinity of water. Water can be acidic, basic, or neutral depending on the concentration of hydrogen ions in the water. If the hydrogen ion concentration is high, then the water is acidic. If the hydrogen ion concentration is low, then water is alkaline. Water with a pH of 7 is considered neutral, which means that the concentrations of hydrogen and hydroxide ions are balanced (Rahadi et al, 2019).

The pH measurement from Station 1 to Station 4 has a different pH content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S pH value is 5.5, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S obtains a pH value of 6.22 , ST3 with coordinates 115° 6'52.70"E, 3°56'59.96"S obtained a pH value of 6.4 and ST4 with coordinates 115° 8'27.03"E, 3°57'31.92"S obtained a pH value of 7.24. The pH content of the waters according to the quality standard is 7-8.5. Water pH measurements ST1 to ST3 have a pH value that tends to lead to acid, while ST4 is included in the pH value of neutral water.

The results of TSS (Total Suspended Solids) measurements from Station 1 to Station 4 have different TSS content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S TSS value is 11 mg/l, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S is obtained TSS value of 6 mg/l, ST3 with coordinates of 115° 6'52.70"E, 3°56'59.96"S obtained TSS values of 6 mg/l and ST4 with coordinates of 115° 8'27.03"E, 3°57' 31.92"S obtained a TSS value of 15 mg/l.

The TSS content in waters that complies with the quality standard is <80 mg/l. so that based on the results of the suitability analysis for TSS (Total Suspended Solids) at the location the plan for the Vaname shrimp pond demonstration plot is very suitable. TSS is solid particles in the form of colloids, sediments, silt, dust, powders, or other organic or inorganic materials. TSS confinement from ST1 to ST4 is still within normal quality standards. Normal TSS values may vary depending on the water source and specific environmental conditions. However, in general, water that is considered to have normal TSS is water that has a low concentration of solid particles (Rahardi, et al, 2019).

The results of nitrate measurements from Station 1 to Station 4 have different nitrate content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S the nitrate value is 0.01mg/l, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S is obtained nitrate value <0.01 mg/l, ST3 with coordinates 115° 6'52.70"E, 3°56'59.96"S obtained nitrate values 0.01mg/ and ST4 with coordinates 115° 8'27.03"E, 3°57' 31.92"S, a nitrate value of 0.01 mg/l was obtained. The content of nitrate in the waters according to the quality standard is 0.008 mg/l. The water nitrate concentration from ST1 to ST4 exceeds the quality standard.

The condition of water nitrate is related to nitrite where the results of research on water nitrite from Station 1 to Station 4 have different nitrite content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S nitrite values are <0.01mg/l, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S obtained a nitrite value of 0.02 mg/l, ST3 with a coordinate point of 115° 6'52.70"E, 3°56'59.96"S obtained a nitrite value of <0.01mg/ and ST4 with a coordinate point of 115° 8'27.03"E, 3°57 '31.92"S obtained a nitrite value of 0.01 mg/l. The nitrite content of the waters according to the quality standard is 0.06 mg/l. The water nitrite concentration from ST1 to ST4 is still within the water quality standard limits, this is in line with the results of the suitability analysis, which is very suitable as shown in Figure 7.

Nitrate and nitrite are the two main forms of oxidized nitrogen compounds found in waters. Both have a close relationship in the nitrogen cycle and can change each other through biochemical processes.

Nitrate and nitrite are involved in the nitrification process, where ammonium ($NH_4^+$) is converted to nitrite by nitrite bacteria (Nitrosomonas), and then nitrite is oxidized to nitrate by nitrate bacteria (Nitrobacter). This process is an important part of the nitrogen cycle in aquatic ecosystems. One of the main causes of increased nitrate levels in waters is the presence of chemicals containing nitrogen (Rahman et al, 2021). So based on the analysis of the suitability of Nitrite at the study site it is suitable for ST 2 and ST 4, while for ST 1 and ST 3 it is Very Suitable.

The results of phosphate measurements from station 1 to station 4 have different phosphate content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S the phosphate value is 0.02mg/l, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S is obtained phosphate value 0.03 mg/l, ST3 with coordinates 115° 6'52.70"E, 3°56'59.96"S obtained phosphate values 0.02mg/ and ST4 with coordinates 115° 8'27.03"E, 3°57'31.92 "S obtained a phosphate value of 0.02 mg/l. The phosphate content of waters according to the quality standard is 0.015 mg/l. The water phosphate concentration from ST1 to ST4 is still within the phosphate quality standards. Phosphate in water (expressed as PO4-P) is a phosphate compound dissolved in the form of phosphate ion (PO4^3-).

Based on the results of the suitability analysis of the phosphate parameters, it is very suitable, except at station 4, which is suitable. Phosphate is one of the main forms of the nutrient phosphorus (P) in waters. Phosphates in water can come from a variety of sources, including human and natural activities. Phosphate in water can come from various sources, such as agricultural activities (use of phosphate fertilizers), domestic waste, industrial waste, soil erosion, and organic decomposition. Human activities, especially agriculture and domestic/industrial waste, are the main causes of increased phosphate concentrations in water (Sabli & Zahra, 2017).

The organic matter measurement results from Station 1 to Station 4 have different organic matter content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S the organic matter value is 2.3mg/l, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S Obtained organic matter value of 1.7mg/l, ST3 with coordinates of 115° 6'52.70"E, 3°56'59.96"S obtained organic matter values of 4.8mg/ and ST4 with coordinates of 115° 8'27.03"E, 3° 57'31.92"S obtained an organic matter value of 4.9mg/l. The content of organic matter in the waters that is still in accordance with the quality standard is 40 mg/l. Organic matter in waters can come from natural sources such as leaves that fall into the water, dead aquatic plants, and the remains of living organisms. In addition, human activities such as the disposal of organic waste from households, industry or agriculture can also be a source of organic matter in waters.

The impact of too high concentrations of organic matter in waters can cause environmental problems, such as a decrease in dissolved oxygen levels through a decomposition process that requires oxygen. Conditions with low dissolved oxygen levels (hypoxia) can cause stress for aquatic organisms and can disrupt the life of aquatic biota (Yudo, 2018), but at this research location the organic matter was very suitable in all observation stations.

The results of BOD 5 measurements from Station 1 to Station 4 have different BOD 5 content. Station 1 or ST1 with coordinates 115° 7'17.34"E, 3°56'45.98"S BOD 5 value is 10.8mg/l, ST2 with coordinates 115° 7'4.54"E, 3°56'47.51"S obtained BOD 5 11.5mg/l, ST3 with coordinates 115° 6'52.70"E, 3°56'59.96"S obtained BOD 5 11.8mg/ and ST4 with coordinates 115° 8'27.03"E, 3° 57'31.92"S obtained a BOD value of 11.9mg/l. The BOD content of 5 waters which is still in accordance with the quality standard is 20 mg/l. BOD5 (Biochemical Oxygen Demand) is a parameter used to measure the amount of oxygen consumed by microorganisms in the decomposition process of dissolved organic matter in water over a period of 5 days at water temperature. Control of BOD5 involves managing waste, using effective water treatment systems, and adopting sustainable agricultural practices. These steps aim to reduce the input of organic matter into the waters and prevent an excessive increase in BOD5 (Royani et al, 2021). Based on the results of the analysis of the suitability of the BOD5 parameter at the research location, it is very suitable for all water observation stations in the research location which will be used as a demonstration plot for Vaname shrimp farming.

The following is a thematic map of the matrix or criteria used in the study which consists of 10 important parameters, namely Temperature, Salinity, pH, DO, Nitrite, Nitrate, Organic Matter, TSS, Phosphate, BOD5 as shown in Figure 2:

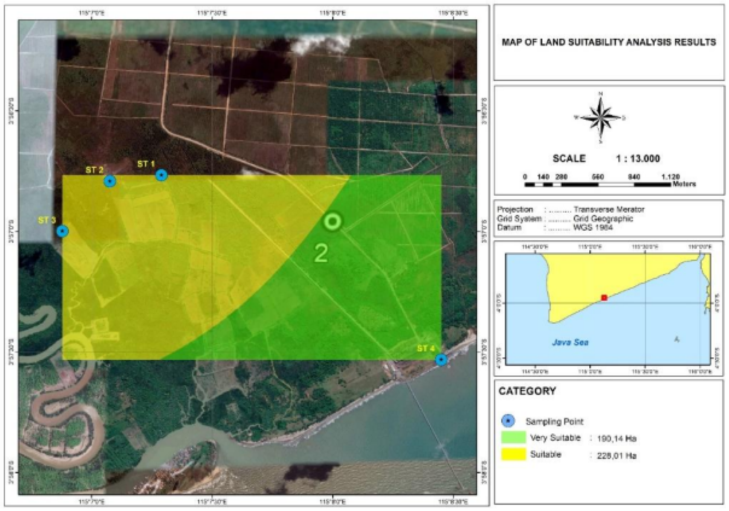


Figure 2 – Map of suitability of water quality parameters found at the planned location for the Vaname shrimp pond demonstration plot

The results of the weight scoring of all parameters from all stations contained parameters that were not suitable for the research location, namely the salinity found in ST 1, ST 2 and ST 3, but based on the results of the interpolation of all these parameters it can be concluded that the research locations planned to be used as demonstration plots for ponds Vaname shrimp stated that at station 1, station 2 and station 3 were declared suitable, while at station 4 it was very suitable with the respective carrying capacity of 456 ha suitable and 364 ha very suitable.

The plan for making this demonstration plot consists of 2 methods, namely traditional and intensive methods. The results of the analysis of the profit analysis of the traditional and intensive vannamei shrimp farming business at the Asam-Asam Mine are based on a profit analysis consisting of total costs, which are all costs incurred in one production cycle to profits in the production cycle. The investment costs for traditional vaname shrimp cultivation are in Table 4:

Table 4 – Investment Costs

| No | Investment Cost | Vol | Unit | Unit Price | Total | UE (Th) | Shrinkage |
|---|---|---|---|---|---|---|---|
| 1 | Land preparation | 2 | Ha | 2.500.000,- | 5.000.000,- | 10 | Rp 500.000,- |
| | Total | | | | | | Rp 500.000,- |

*Source: Primary data, 2023.*

Based on the investment costs obtained from the cost of depreciation and maintenance of cultivation facilities. The value of this investment cost is obtained from an average for vaname shrimp cultivation of Rp. 500,000.- From the depreciation cost data, it will be followed by calculating the fixed costs per year. These fixed costs consist of costs for depreciation and maintenance of cultivation facilities. The value of these fixed costs is obtained from the average cost incurred by cultivators of Rp. 500,000,- can be seen in Table 5 below:

Table 5 – Fixed Costs

| No. | Fixed cost | | One year |
|---|---|---|---|
| 1 | Shrinkage | | Rp 500.000,- |
| 2 | Facility maintenance | | Rp 300.000,- |
| Amount | | | Rp 800.000,- |

*Source: Primary data, 2023.*

Variable costs consist of seed prices, feed prices, and medicines/vitamins. These variable costs are presented in the following table:

Table 6 – Variable Costs

| No. | Variable Cost | Vol | Unit | Unit Price (Rp) | Production cost (Rp/Production) |
|---|---|---|---|---|---|
| 1 | Fertilizer | 4 | Sack | Rp 500.000,- | Rp 2.000.000,- |
| 2 | Shrimp Seeds | 20.000,- | ekor | Rp 250,- | Rp 5.000.000,- |
| 3 | Milkfish Seeds | 2.000,- | ekor | Rp 250,- | Rp 500.000,- |
| | Total | | | | Rp 7.500.000,- |

Based on the results of the research, it was obtained the results of a one-time variable cost of production, the average variable cost for traditional ponds incurred by cultivators was Rp. 7.500.000,- one time production. Based on the results of the analysis of fixed costs and variable costs of traditional vannamei shrimp farming, the income and profits of the cultivators are presented in the following table:

Table 7 – Total Operational Costs

| No. | Cost | Price (Rp) |
|---|---|---|
| 1 | Fixed cost | Rp 800.000,- |
| 2 | Variable Cost | Rp 7.500.000,- |
| | Total | Rp 8.300.000,- |

Table 8 – Acceptance

| Production | Vol (Kg) | Unit price (Rp) | Acceptance/year (Rp/year) |
|---|---|---|---|
| Vaname shrimp | 200 | 95.000,- | Rp 19.000.000,- |
| Milkfish | 500 | 15.000,- | Rp 7.500.000,- |
| Total | | | Rp 26.500.000,- |

Based on the results of the profit/profit analysis that has been obtained from the research, then it is averaged, so the net gain for vannamei shrimp farming in traditional ponds in Asam-asam is Rp. 18,200,000.00 per production. It is known that during the maintenance of vannamei shrimp there was around 75% death and milkfish died around 50%.

The profit analysis was then carried out in intensive vannamei shrimp ponds. The investment costs for intensive vannamei shrimp farming are in the following table:

Table 9 – Investment Costs

| No | Investment Cost | Vol | Unit | Unit price | Total | UE (Th) | Shrinkage |
|---|---|---|---|---|---|---|---|
| 1 | Land Preparation | 3 | Petak | 10.000.000,- | 30.000.000,- | 10 | Rp 3.000.000,- |
| 2 | Wheel 1 HP, 750 Watts | 12 | Buah | 5.500.000,- | 66.000.000,- | 10 | Rp 6.600.000,- |
| 3 | Electricity | 1 | Paket | 25.000.000,- | 25.000.000,- | 20 | Rp 1.250.000,- |
| 4 | Tarpaulin / HDPE 2.0mm | 3.000 | /m$^2$ | 50.000,- | 150.000.000,- | 3 | Rp 50.000.000,- |
| | Total | | | | | | Rp 60.850.000,- |

*Source: Primary data, 2023.*

Based on the investment costs obtained from the cost of depreciation and maintenance of cultivation facilities. The value of this investment cost is obtained from an average for vaname shrimp cultivation of Rp. 60,850,000, - from the depreciation cost data, it will be followed by calculating the fixed costs per year. These fixed costs consist of costs for depreciation and maintenance of cultivation facilities. The value of these fixed costs is obtained from the average costs incurred by vaname shrimp cultivators, which can be seen in the following table:

Table 10 – Fixed Costs

| No. | Fixed Costs | One Year |
|---|---|---|
| 1 | Shrinkage | Rp 60.850.000,- |
| 2 | Facility maintenance | Rp 1.000.000,- |
| | Total | Rp 61.850.000,- |

*Source: Primary data, 2023.*

Variable costs consist of seed prices, feed prices, and medicines/vitamins. These variable costs are presented in the following table:

Table 11 – Variable Cost

| No. | Variabe Cost | Vol | Unit | Unit Price (Rp) | Cost/Production (Rp/Production) |
|---|---|---|---|---|---|
| 1 | Fry PL 10-PL12 ( F1 Quaity) | 300.000 | Pcs | 80,- | Rp 24.000.000,- |
| 2 | Feed | 7.000 | kg | 20.000,- | Rp 140.000.000,- |
| 3 | Electricity Cost | 1 | 1 cycle | 30.000.000,- | Rp 30.000.000,- |
| 4 | Maintainer | 3 | month | 9.000.000,- | Rp 27.000.000,- |
| 5 | Probiotic, Probiotic Media, Disinfectans, etc | 1 | package | 15.000.000,- | Rp 15.000.000,- |
| 6 | Accommodation and consumption | 1 | package | 15.000.000,- | Rp 15.000.000,- |
| Ttal | | | | | Rp 251.000.000,- |

Based on the results of the research, it was obtained the results of a variable cost for one production, the average variable cost for intensive ponds issued by cultivators was Rp. 251.000.000,- one time production. Based on the results of the analysis of fixed costs and variable costs of intensive vaname shrimp cultivation, the income and profits of the cultivator are presented in the following table:

Table 12 – Total Operational Costs

| No. | Cost | Price (Rp) |
|---|---|---|
| 1 | Fixed Cost | Rp 61.850.000,- |
| 2 | Variable Cost | Rp251.000.000,- |
| | Total | Rp 312.850.000,- |

Table 13 – Income

| Production | Vol (Kg) | Unit Price (Rp) | Income/year (Rp/year) |
|---|---|---|---|
| Vaname shrimp | 6.000 | 75.000,- | Rp 450.000.000,- |
| | Total | | Rp 450.000.000,- |

Based on the results of the profit/profit analysis that has been obtained from the research, it is then averaged, so the net gain for vannamei shrimp farming in intensive ponds is Rp. 137,150,000, - production. It is known that vannamei shrimp during maintenance in intensive ponds experience 30% mortality. The benefits obtained between traditional and intensive vannamei shrimp ponds certainly have differences. Intensive vaname shrimp ponds have greater profits than traditional vannamei shrimp ponds. However, in general, the profits obtained by vannamei shrimp farmers in traditional and intensive ponds are still above the UMP of South Kalimantan Province, namely Rp. 3,755,761.- per month, so that the business results are still able to meet the needs of the cultivator's family. The cost efficiency of traditional and intensive vannamei shrimp farming is carried out through R/C ratio analysis. Where the R/C ratio is the comparison between the average total revenue and the average total cost. The greater the R/C ratio, the greater the profit the farmer will get. After analyzing the R/C ratio, an analysis is needed to find out the differences in the cost efficiency of traditional and intensive vannamei shrimp farmers. The results of the analysis of the R/C ratio are in the following table:

Table 14 – Average R/C ratio

| No | Description | Traditional | Intensive |
|---|---|---|---|
| 1 | Average Total Admissions | Rp. 26.500.000,- | Rp. 450.000.000,- |
| 2 | Average total cost | Rp. 8.300.000,- | Rp. 312.850,000,- |
| 3 | Average R/C ratio | 3.19 | 1.43 |

The average R/C ratio of vannamei shrimp farming is traditionally higher than the average R/C ratio of intensive vannamei shrimp farming, which is 1.43 in one production period, which means that the traditional vannamei shrimp farming is efficient. in the use of business costs, because every 1 currency unit (IDR 1) issued as the cost of the vannamei shrimp farming business will provide business revenue of 3.19 currency units (IDR 3.19). Meanwhile, the average ratio for intensive vannamei shrimp farming is 1.43, which means that intensive vannamei shrimp farming is efficient in the use of business costs, because every 1 currency unit (Rp. 1.43). This happens because intensive cultivation costs a lot of investment costs compared to traditional methods which use little investment costs.

According to Yuni., et al (2014) the average income of traditional vannamei shrimp farming is IDR 61,317,111.00/ha/cycle while the average income of intensive vannamei shrimp farmers is IDR 727,773,104.00/ha/cycle. This shows that vannamei shrimp farming in traditional ponds and intensive ponds is profitable and there is no significant difference between the average efficiency of vannamei shrimp cultivation in intensive ponds and traditional ponds in Situbondo Regency with a significance value of 0.916.

The investment requirements for traditional and intensive ponds are different. The most striking difference between traditional and intensive investment is the water wheel. Traditional pond business only requires land and equipment. Waterwheels are needed in intensive ponds because the stocking density in both types of ponds is quite dense. The biggest difference in operational costs in traditional and intensive ponds is the cost of feed and electricity costs. Traditional pond businesses rely on natural feed. In traditional ponds the need for electricity is only for lighting, while in intensive ponds the electricity demand for each is greater because of the water wheel. Thus, the total costs for traditional and intensive ponds certainly experience differences (Nainggolan et al., 2021). Policy recommendations for both traditional and intensive ponds are very profitable economically when viewed from short-term business performance indicators, such as revenue, profit, revenue/cost ratio, and pay back period.

## CONCLUSION

Based on land suitability calculations, the total value of the land suitability category for the Vaname shrimp pond demonstration plot is 456 Ha with the Suitable category (S2) at Station 1, Station 2 and Station 3 while the total value for the very suitable category is 364 Ha at Station 4.

The average R/C ratio of vannamei shrimp farming is traditionally higher than the average R/C ratio of intensive vannamei shrimp farming in one production period. This happens because intensive cultivation costs a lot in investment costs compared to traditional methods which use little investment costs, but both traditional and intensive methods are very effective and economically profitable when viewed from short-term business performance indicators.

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