Feasibility study of grouper (Epinephelus sp) culture in Manyak Payed, Aceh Tamiang region, Indonesia

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Abstract. The study aims to analyze the suitability of grouper culture in the waters of Meurandeh village by taking physical, chemical, and biological aspects. This research was conducted in Meurandeh village, Manyak Payed Aceh Tamiang sub-district from December to January 2019, using a scoring method on 3 observation stations, with direct measurement methods (in situ). Water quality parameters measured were as bathymetry, current velocity, water transparency, temperature, salinity, pH, dissolved oxygen, and nitrate. The level suitability was divided into three (3) suitability criteria very suitable, suitable, and not suitable. The results showed that the locations of stations I, II and III were included as very suitable classes for grouper cultivation with a total score of 73%, 77%, and 77% respectively. It can be concluded that the waters of Meurandeh village could support the grouper culture activity.

1. Introduction
As a coastal area, Indonesia, especially Aceh Tamiang Regency has a 77.7 km coastline which includes abundant marine and fisheries resources and many potentials can be developed and can increase income and community welfare [1, 2, 3]. From the data obtained, the quite important potential is in the field of aquaculture, where the potential of ponds is an area of 5190 Ha spread in four coastal sub-districts of Aceh Tamiang Regency covering Manyak Payed ± 2246 Ha, Banda Mulya ± 1236 Ha, Bendahara ± 254 Ha and Seruway ± 1454 ha. Looking at the potential of the cultivation area in coastal areas, it can be a source of livelihood for fish cultivating communities that have economic prospects and at the same time provide a large contribution to the region. But in fact, the existing potential has not been maximally empowered, because there is still a lack of community knowledge in the cultivation process [4].

Grouper belongs to the subfamily category of Epinephalinae, which is from the family Serranidae. In the world, there is around 115 number of grouper species from 30 genera that have been known so far. Groupers are known to be widespread from tropical to subtropical waters [5]. In nature, groupers live on the bottom of the water, mostly in the waters of the reef but some live in the estuary waters and some in the sandy habitat. Grouper is a carnivorous saltwater fish that has a high tolerance to salinity, so it is easily found in estuarine and marine environments [6]. Groupers are solitary fishes and generally live for long periods in the fabric. During spawning, spawning aggregation and very vulnerable to fishing operations [7].

The location selection is generally based on the species you want to culture and the technology used, but in some instances, the sequence can be reversed. The existence of restrictions on one of these factors, the characteristics of the corresponding waters will limit the selection of other factors. Some considerations that need to be considered in determining the location are technical conditions consisting of physical, chemical and biological and non-technical parameters in the form of market, security and human resources [8]. One of the mistakes in developing cultivation is an unsuitable aquatic environment. For
culture to develop properly, it is necessary to have appropriate water conditions, and good water quality for the growth of groupers. Water quality is very important factor for the success of the business of cultivating groupers. Analysis of the suitability of aquatic parameters in the form of fish farming commodities needs to be done so that we get a level of conformity for the commodities that we want to cultivate [9].

2. Materials and Methods
The research was conducted in December - January 2019 in brackish water, Meurandeh Village, Manyak Payed District, Aceh Tamiang. Data collection was carried out at three research stations. And then carried out an analysis at the Marine Biology Laboratory, Faculty of Marine and Fisheries, Syiah Kuala University, Banda Aceh. The map of research location can be seen in Figure 2.1 below.

This research was conducted by determining 3 different station points. At each station, 3 plots aimed to represent the condition of the waters at each of the 3 station points determined by the village of Meurandeh. The research method used was a direct measurement of water quality from physical, chemical, and biological parameters. Data on water quality collected originated from predetermined station points which can represent each observation location. Measurements were made in situ such as temperature using a thermometer, dissolved oxygen using DO meter, salinity using a refractometer, brightness using a secchi disk, current speed using floating great and pH using a pH meter. As for the nitrate content, samples were taken, then analyzed at the BPAP Ujung Batee laboratory.

![Research Maps](image_url)
Sampling to be tested was carried out at 08.00 a.m until 16.00 p.m. Samples were tested directly (in situ) such as DO, salinity, brightness. Depth, current speed, temperature, and pH, whereas in nitrate samples analyzed in BPAP Ujung Batee Laboratory.

**Scoring system**

| Variable       | Range      | Rating Points (A) | Weight (B) | Score (A x B) |
|----------------|------------|-------------------|------------|--------------|
| Depth (m)      | 15-25      | 5                 |            |              |
|                | 6-15 or 26-35 | 3               | 3          | 9            |
|                | <5 or >35  | 1                 | 3          | 3            |
| Current speed (m/s) | 0.2-0.4  | 5                 |            |              |
|                | 0.05-<0.2  | 3                 | 3          | 9            |
|                | <0.05 or >0.5 | 1            | 3          | 3            |
| Brightness (m) | >5         | 5                 |            |              |
|                | 3-5        | 3                 | 3          | 9            |
|                | <3         | 1                 | 3          | 3            |
| Temperature (°C) | 25-27 or 31-32 | 3             | 2          | 6            |
|                | <25 or >32 | 1                 | 2          | 2            |
| Salinitas (ppt) | 30-35      | 5                 |            |              |
|                | 20-29      | 3                 | 2          | 6            |
|                | <20 or >35 | 1                 | 2          | 2            |
| pH             | 6.5-8.5    | 5                 |            |              |
|                | 4-6.4 or 8.5-9 | 3             | 2          | 6            |
|                | <4 or >9.5 | 1                 | 2          | 2            |
| DO (ppm)       | >5         | 5                 |            |              |
|                | 4-4.9      | 3                 | 3          | 9            |
|                | <3.9       | 1                 | 3          | 3            |
| Nitrate        | 0.9-3.2    | 5                 |            |              |
|                | 0.7-0.8 or 3.3-3.4 | 3         | 1          | 3            |
|                | <0.67 or >3.4 | 1            | 1          | 1            |
| **Total score**|            |                   |            | 95           |

Source: Modified [10].

Scoring was given with a value of 1, 3 and 5 according to the specified criteria and limits. If the results of measurements of a physical-chemical parameter in the water are in optimum condition, the score given is high, which is 5. But on the contrary, if the measurement results are at the less optimum limit, the given score will be lower, namely 1 or 3.

The evaluation results of the conformity assessment system for grouper culture locations can be seen in Table 3.2 Calculation of suitability values for grouper culture activities using the following equation [11].

\[
IKK = \sum_{i=1}^{N} \frac{N_i}{N_{\text{max}}} \times 100 \% 
\]
Table 2. Evaluation of Aquatic Suitability Assessment for Grouper Culture Locations

| No | Value range (score) | Level of Conformity | Evaluation       |
|----|---------------------|---------------------|------------------|
| 1  | 85 – 100 %          | S1                  | Very Suitable    |
| 2  | 75 – 84 %           | S2                  | Suitable         |
| 3  | 65 – 74 %           | S3                  | Conditional      |
| 4  | < 65 %              | N                   | Not suitable     |

Source: [12]

3. Results and Discussions

Physical and chemical parameters of the water

From the results of observations in the field, it showed that the range of physical and chemical parameters was in a good range for grouper life. This was because the parameters observed were not in the tolerance limit for grouper growth and development. The results of measurements of physical and chemical parameters can be seen in table 3 below:

Table 3. Parameter of Physical and Chemical

| No | Parameter              | Unit | Station I | Station II | Station III |
|----|------------------------|------|-----------|------------|-------------|
| 1  | Depth                  | Meter| 7.4       | 7.3        | 7.8         |
| 2  | Current speed          | m/s  | 0.2       | 0.3        | 0.3         |
| 3  | Brightness             | Cm   | 117.5     | 132.5      | 162.5       |
| 4  | Temperature            | °C   | 29        | 30         | 30          |
| 5  | Salinity               | Ppt  | 16        | 20         | 22          |
| 6  | pH                     |      | 7.3       | 7.3        | 7.4         |
| 7  | Dissolved oxygen (DO)  | Ppm  | 5.3       | 5.7        | 5.1         |
| 8  | Nitrate                | Ppm  | 3.2       | 2.9        | 2.8         |

Scoring of the suitability of the location of grouper culture

Water suitability is the suitability (adaptability) of a waters for specific use purposes, through the determination of the value (class) of waters as well as the pattern of water use that is connected with the potential of the region, so that the use of more directed waters and efforts to preserve its preservation [13]. Waters suitability assessment is carried out by classifying them into categories based on similarity in nature or quality that affect the suitability of waters for certain users. So that the waters can be assessed by seeing whether they are suitable for the use of the culture. The scoring results of the suitability of meurandeh village grouper culture can be seen in Table 4 below.
Table 4. Scoring suitability for grouper culture

| Station | Value range (score) | Level of Conformity | Evaluation       |
|---------|---------------------|---------------------|------------------|
| I       | 73%                 | S3                  | Conditional      |
| II      | 77%                 | S2                  | Suitable         |
| III     | 77%                 | S2                  | Suitable         |

Water brightness is one of the indicators used to determine the location for fish farming in floating net (karamba). The brightness of the water shows the ability of light to penetrate the water layer at a certain depth. The high brightness level indicates that the waters are clear enough and suitable for the culture location. Conversely, waters with low brightness levels indicate high brightness materials influenced by the content of mud, plankton and other dissolved materials. The brightness of the waters in the meurandeh village of Aceh Tamiang ranges from 1.1 m to 1.6 m with an average of 1.3 m. The highest brightness distribution is at station III. While at station I shows the lowest brightness value. The difference in brightness in the waters of the village of Meurandeh at each location in the nine samples is thought to be related to the depth of location and time of observation [14].

The results of measurements of water depth at the sampling point in the waters of the village of Meurandeh Aceh Tamiang ranged from 7.3 m to 7.8 m, with an average value of 7.5 m. The highest depth value is at station III which is 7.8, while the lowest is at station I which is 7.3. The difference in water depth at each sampling location is not too much different or sloping. Proper depth of water can avoid damage to the net due to the attack of puffer fish (*Diodon sp*) as pests, as well as the remaining accumulated food left in the bottom of the sea waters and cause a decrease in the quality of fish life [15]. According to [16], the optimum depth value for grouper cultivation is 6-28 m, the depth value in these waters reaches a class that was suitable for grouper culture.

The measurement results for the current velocity in the waters of the village of Meurandeh varied from 0.2 m/s to 0.3 m/s. The lowest current velocity occurred at station point I, while the highest value was found at station point II and III. The difference in current velocity was thought to be caused by the location. Every process of tide or low tide activity caused currents. For permanent flows, factually cannot be known. This was due to research carried out in a short period and only once. So it was concluded that the current that occurred was a local flow due to tides [17]. The measurement results of the flow velocity in the waters of the village of Meurandeh were included in the appropriate category for the grouper culture activity.

Water temperature was one of the physical parameters that play a role in the life and growth of aquatic biota. Temperature directly affects aquatic organisms, especially in the photosynthesis of aquatic plants, metabolic processes, and reproductive cycles. The water temperature measured at each observation location ranged from 29-30 °C. Data on the distribution of sea surface temperature obtained from Station I was 29°C, station II was 30°C, and station was III 30°C, showed sea surface temperatures in the waters of the village of Meurandeh, Aceh Tamiang in 2019 ranged from 29-30°C. These results were very good for supporting grouper culture. This was by the opinion of [18], which is 25-32°C, with daily fluctuations of less than 1 °C which can be declared stable and feasible for culture.

Seawater has a relatively stable pH value and generally ranges from 7.5 to 8.4. The pH value can be influenced by photosynthetic activity, temperature and industrial and household wastes. Acidic waters (pH below 5) or alkaline (pH above 11), can cause death and no reproduction in fish. For reef fish, it is known to have very good growth in the pH range of 7.0-8.5 [19]. The pH value of the field survey data ranges from 7.3 to 7.4.
Dissolved oxygen (DO) is the most critical chemical parameter in fish farming. Oxygen in water comes mainly from the air (through diffusion) and results from the photosynthesis of aquatic plants, especially phytoplankton. The solubility of oxygen in water is influenced by water temperature, location height, salinity, and air pressure. Addition of air pressure and an increase in water temperature and salinity cause low oxygen solubility and vice versa. The concentration and availability of dissolved oxygen are one of the limiting factors for cultivated fish. The concentration of oxygen in water can affect growth, feed conversion, and reduce the carrying capacity of the waters. Water flow conditions must be considered because it will affect the availability of dissolved oxygen which is important for the prevention of diseases that often attack groupers [20]. Dissolved oxygen content in each observation location ranged from 5.1 to 5.7 ppm, indicating that the waters in the study location were feasible for grouper culture. Fish will live well on oxygen content ratio is 4-8 ppm [21].

Marine fish have a high tolerance for salinity. However, salinity is also one of the determining factors for growth and survival. Most juveniles are more sensitive to changes in salinity when compared to adult fish. Increasing salinity in addition to influencing the conductivity of electricity can also increase osmotic pressure which in turn affects metabolism, especially in the osmoregulation process. The fish will acclimatize when changes in extreme salinity occur. During the acclimatization process, the fish are easily stressed and weak. The results of salinity measurements at the study sites were in the range of 16-22 ppt, included in the normal salinity category of groupers. According to [22], high salinity can trigger stress, reduce feed intake and result in poor growth for groupers because it is urgent to balance osmoregulation and ionic.

The measurement results for the variable nitrate show values that vary from 2.8 ppm to 3.2 ppm with an average value of 3.0 ppm. The lowest nitrate is at station III which is 2.8 ppm, while the highest value is at station I which is 3.2 ppm. The difference in nitrate content in some locations is thought to be caused by the high nitrate in the bottom of the water. Deep water allows decomposition of sinking particles into organic nitrogen. [23] The nitrate concentrations will increase with increasing depth. Nitrate and phosphate are elements that together affect the growth of phytoplankton. Besides that, there is a process of disposal of pond waste at station 3, allowing the entry of nitrates into the waters. [24] Argues that nitrate levels in waters are much influenced by anthropogenic pollution that comes from human activities and animal feces. In accordance with the instructions at the location of station, it shows the average range of nitrate content in the village of Meurandeh Aceh Tamiang, still supporting grouper culture activities.

The scoring value of the suitability of the results of the research obtained from this study is that at station I the total score is 73%, at station II is 77%, and at station III is 77%. If seen in the total score obtained at each station included in the S2 category, it is suitable. This is by the statement [25], that the range of scores of 75-84% has a degree of conformity (S2) or suitable which means that these waters are very good for grouper culture without limiting factors that affect productivity during culture. Besides that, the environmental factors in the waters of the village of Meurandeh are still well preserved. Other factors that cause suitable level of conformity, namely the number of plankton found in the location of this study fall into the fertile category [26]. If seen from these results it is said that in the waters of the village of Meurandeh this is included in the category that is suitable for determining the appropriate land suitability in the process of grouper culture.
Conclusion
The waters of the village of Meurandeh Aceh Tamiang were included in the scoring values suitable for the process of grouper species breeding. The best locations were obtained at stations II and III with a total score of 77%.

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