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Analysis of Ecobiological Aspects of Coastal Waters for The Development of Fish Cultivation Businesses in Floating Net Cages

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ABSTRACT: The aim of this study; To find out the ecobiological aspects of waters for Tilapia cultivation activities in floating net cages. The method used in this research is the water observation method such as physical, chemical and biological parameters of waters. Determining the carrying capacity of waters is an approach based on the availability of dissolved oxygen. The results of the observations showed that oxygen levels in the waters were observed for 24 hours with an interval of 3 hours. The average oxygen level was 6.5 ppm, while the minimum level desired by cultivated organisms was 3.6 ppm. This means that oxygen availability is 2.9 ppm. It is known that the volume of water available for aquaculture activities is 1,946,280 m3, so the available oxygen capacity is 263.75 kg O2. Thus, the capacity of the waters to accommodate organic waste is 1,318.75 kg. If the percentage of feed provided is an average of 5% per day, then the carrying capacity of the aquatic environment for cultivation = 26.375 kg or 26.38 tons of Tilapia. The production level for cages measuring 2 x 2 x 2 m3 = 0.25 tons/cage, then the maximum number of cages that can be operated under carrying capacity conditions = 105 cages

Keywords: Floating net cages, Cultivation, Tilapia, and water carrying capacity

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1. INTRODUCTION

Tanjung Merdeka, Makassar City, is located in the coastal waters of Makassar City and is one of the areas where many Tilapia fish cultivation businesses have been developed in floating net cages (KJA). However, it is known that the Tanjung Merdeka water area of Makassar City has limits to the capacity (carrying capacity) of the water environment and the level of business feasibility to accommodate fish farming activities in floating net cages in a sustainable manner. A prominent characteristic of tilapia cultivation in floating net cages (KJA) is that the food required for fish to live and grow relies on artificial feed as the main food source. Not all of the artificial feed given is utilized by pet fish and will become leftover food. The remaining unused feed has a potential impact on the quality of the aquatic environment as a cultivation medium. Leftover feed in the form of organic material to the physical, chemical and biological conditions of the aquatic environment will to a certain extent increase the productivity of aquatic organisms, but if the input exceeds the ability of aquatic organisms to utilize it, problems will arise. Problems that arise include the level of water turbidity becoming high so that the penetration of sunlight into the waters decreases (Rustam, 2009), the photosynthesis process is only limited to the surface, an increase in toxic chemical elements and a decrease in the levels of chemical elements needed by organisms such as dissolved oxygen and pH, as well as the occurrence of organism succession and increased biological activity,

namely the decomposition process by bacteria. The occurrence of changes in the physical, chemical and biological conditions of the coastal waters environment will also affect the feasibility of cultivating fish in floating net cages which will provide maximum profits in a sustainable business.

Based on this, the problems studied are (1) What is the ability waters to support tilapia fish cultivation activities in floating net cages (2) the capacity of the aquatic environment in this case the carrying capacity of waters to accommodate fish cultivation activities in floating net cages so that they can be carried out sustainably, The specific objectives of this research are; (1) to determine the ecobiology of the coastal waters of Tanjung Merdeka, Makassar City for tilapia cultivation activities in floating net cages, (2) to determine the carrying capacity of coastal waters to accommodate fish cultivation activities in floating net cages, (3) To control the business large-scale fish cultivation in an area for sustainable fish cultivation activities.

The urgency of this research is expected; (1) there is a balance between potential recipients (supply) and potential utilization (demand) of the Tanjung Merdeka water resources, Makassar City. The potential recipient (supply) in question is the ecological capacity (carrying capacity) to accommodate tilapia cultivation activities in floating net cages (KJA) which are characterized by the biophysical and chemical characteristics of the waters. The potential demand in question is the size of the fish farming business or activity that can be carried out, which is characterized by the amount of production and the amount of waste produced from the fish farming activity.

2. RESEARCH METHODS

Research Area and Time

This research will be carried out in Tanjung Merdeka Waters, Makassar City, South Sulawesi. This research was carried out in 2020.

Research Implementation Methods

Biophysical and chemical characterization of coastal waters for cultivating tilapia in floating net cages (KJA).

This activity of observing biophysical and chemical parameters of waters aims to determine the present status of water conditions related to water quality for fish life. This observation was carried out by determining the observation location at 4 observation points which were determined using tools GPS (Global Positioning System). Observation and sampling methods at each observation location and analysis methods are presented in table 1 which refers to the American Public Health Association (APHA) (l992).

Table 1. Water quality parameters observed in the study

No	Parameters	Tools used	Laboratory analysis
Physics			
1	Temperature	Thermometer	Insitu
2	Turbidity	Turbiditymeter	Laboratory
3	Brightness	Secchidick	Insitu
4	TSS	Sample bottles and ice box	Laboratory
5	Tidal	Scale board	Insitu
6	Current	Currentmeter	Insitu
chemistry			
7	pH	pHmeter	Insitu
8	Salinity	Handrefractometer	Insitu
9	Oxygen	DOmeter	Insitu
10	Ammonia	sample bottles, presevative	Laboratory
11	Nitrate	sample bottles, presevative	Laboratory

12	orthophosphate	sample bottles, presevative	Laboratory
13	BOD_5	sample bottles, presevative	Laboratory

Aquatic Biology

Plankton

To obtain phytoplankton samples, water samples were taken by filtering 100 liters of water with plankton net No. 25 to 30 ml and preserved with 10 ppm formalin. Type identification is carried out in the laboratory using a microscope and identification book. Plankton counts were carried out using a Sedgwick Rafter Counting Cell under a microscope. Formulas for calculating abundance, uniformity and diversity;

Abundance (K)

$K = Vs/VaxNx10^4$

where;

K = Plankton abundance (cells/l),

Vs = Water volume Filtered Va (ml),

Va = Volume of filtered water (l),

N = Number of plankton observed,

10^4=Conversion of the volume of water examined in the haemocytometer

Assessment of Physical, Chemical and Biological Parameters of Water

To determine the effect of tilapia cultivation activities in floating net cages (KJA) on the quality of the aquatic environment, data from monitoring in the field and laboratory on the physical and chemical parameters of waters are compared to the values of water quality parameters suitable for cultivation in floating net cages (KJA) based on (MENKLH, 1988; Beverdge, 2006).

Estimation of Waste Loads from Cultivation Activities

Observation of aquaculture waste that is thrown into the surrounding water environment is carried out by calculating the amount of feed given and the amount of feed that is not eaten. Estimates of total organic matter from fish farming activities were calculated based on the method proposed by Iwama (1991 in Barg, 1992) with reference to the total uneaten feed and faeces.

Determination of Water Carrying Capacity for Deep Fish Cultivation Floating Net Cages (KJA).

The approach used in determining the carrying capacity of the Tanjung Merdeka water environment in Makassar City is the carrying capacity approach based on (1) analysis of the relationship between the availability of dissolved oxygen and the load of organic waste, (2) the rate of oxygen demand (Rustam, 2005)

(1) Carrying capacity of waters based on the availability of dissolved oxygen:

This analysis refers to that proposed by Willoughby (1968 in Meade, 1989) and Boyd (1999). Water changes due to tides will provide or supply dissolved oxygen in water bodies. Determining the availability of dissolved oxygen in water bodies is the difference between the dissolved O_2 concentration (g/m3) in the water body (O water) and the desired minimum dissolved O_2 concentration (g/m3) from cultivated organisms (Oikan). If the volume of water entering the waters (Qo m3/minute) is known, then the oxygen carrying capacity available in the waters (O_2) for 24 hours (1440 minutes/day) is;

= Qo m3/min x 1,440 min /day x (O water – Ofish O_2 / m3

= X g O_2 /day /1000

= X Kg O_2/day

Where ;
Qo = water volume (m3),
Owater = dissolved oxygen content in the water body (mg/l),
O fish = minimum oxygen level required by fish (mg/l),
1440 = number of minutes in one day, the amount of oxygen needed to decompose 1 kg of organic material according to Werdemeyer (1996) is 0.2 kg O_2 = Y kg O_2/ kg organic waste.

3. RESULTS AND DISCUSSION

Physico-Chemical Characteristics of Water

Water quality in a broad sense includes various physical and chemical properties of waters. Thus, water quality refers to various types of water quality variables that indicate the characteristics of a water's purpose. To determine whether or not the water quality is appropriate for aquaculture activities, it is compared with the sea water quality standard guidelines for biota (fish farming) according to the MENKLH (1988). The complete results of measurements of the physical-chemical parameters of waters at all observation stations are presented as follows.

(a). Temperature

The observation results show that the average observed temperature value does not show very striking variations, namely in the average range of 28.5 - 1.50^{o}C. Large water temperature fluctuations are undesirable for the purposes of a fish farming business. Because water temperature can affect the biochemical processes that occur in an organism's body. If the temperature increases by 10^{o}C, the metabolic processes in the organism become twice as fast (Boyd, 1999). So organisms will consume more oxygen at higher temperatures, while at the same time the solubility of oxygen will decrease with increasing water temperature.

(b)Depth.

The depth of the water at the floating net cage location and its surroundings as measured at each observation station ranged from 1.0 – 6.20 meters with an average depth at each station of 3.60 meters. The average depth at the research location for the development of fish cultivation in a floating net cage system meets the requirements. that the water depth suitable for fish cultivation using a floating net cage system must have a water depth ranging between 3 - 5 meters.

(c) Flow Speed

The average current speed at the time of research for each station was 0.038 0.002 m/s. Based on the results of observations, the current in each observation is relatively small. This is in accordance with the opinion of Sulaediono (Rustam, 2005) who states that current speeds below 1.0 m/s are considered low. The low current speed in Tanjung Merdeka is because the waters are classified as protected waters, and will affect the distribution of pollutants such as organic waste from leftover feed resulting from floating net cage activities.

(d) Degree of Acidity (pH)

The results of measuring the degree of acidity (pH) in the average observation were 6.97 - 0.47. The pH value at each station when referring to water quality standards for aquatic biota (MENKLH, 1988) is still in the desired range of degrees of acidity (pH), namely 6.5 – 8.5. This shows that the observed pH value shows fluctuation values between each station. is in a narrow range. The high pH value obtained in this area is thought to be related to the presence of chlorine discharge from washing PDAM water, which is also a source of PDAM water which can increase the pH.

(e) Brightness and Turbidity

The average brightness value obtained at each station ranged from 6.0 to 3.5. This brightness value is still considered acceptable when compared with the quality standard for water brightness based on the MENKLH (l988), which is greater than 3 m. The average turbidity value obtained at each station ranged from 1.35 to 1.38. When compared with the water quality standard value for biota based on the MENKLH (1988), the value

obtained has exceeded the desired value, namely greater than 5 NTU. This shows that the level of turbidity in the waters of the study area is not good for aquatic biota.

(f) Dissolved Oxygen (DO)

The average value of dissolved oxygen content at each station is 7.45 - 2.00 ppm. The oxygen content range value is in the range above the minimum amount required for living organisms according to the Sea Water Quality Standards for Biota (MENKLH, 1988). Meanwhile, the range of dissolved oxygen content was observed for 24 hours with an interval of 3 hours. Based on the results of these observations, oxygen levels were lowest at night before morning and highest during the day. According to Widigdo (2000) for cultivation purposes, the minimum oxygen level is 3 ppm, a concentration lower than that will cause slow fish growth.

(g) BOD

Based on the measurement results, the average BOD5 value at each station found a range of 5.62 - 0.54 ppm. This BOD5 value range, when compared with sea water quality standards for marine biota based on the MENKLH (1988), is still below the desired threshold, namely < 25 ppm.

(h) Ammonia, Nitrate and Nitrite

The average range values for ammonia, nitrate and nitrite content measured at each station were ammonia 0.051 - 0.02 ppm, nitrate 0.002 - 0.001 and niitrite 0.002 - 0.001. The highest average values of ammonia, nitrite and nitrate were obtained at stations located in floating net cages. Meanwhile, the lowest values were obtained in the area around the floating net cages. This shows that fish farming activities using a floating net cage system contribute ammonia, nitrate and nitrite to the floating net cage area.

(i) Total Phosphate

The average phosphate value in each study ranged between 0.22 - 0.18 ppm. The total phosphate levels obtained were classified as waters that had fertility at the oligotrophic and eutrophic levels. This is in line with what was obtained by Rustam (2009) that waters containing less than 0.1 ppm of phosphate have fertility at the oligotrophic level, while phosphate content of more than 0.1 ppm has fertility at the eutrophication level. If it is based on quality standards for marine biota (MENKLH, 1988, and Widigdo (2000), then the average value of total phosphate content at each station has not exceeded the threshold.

(j) Plankton

Based on the results of observations at all stations, in general the number of individuals and types of phytoplankton with varying abundances was obtained at each station. The results of identification of phytoplankton types obtained at all stations were 3 classes each of diatoms or Bacillariophyceae (81.98%), Cyanophyceae (11.71%) and Dinophyceae (6.31). The highest value compared to the other classes.

The results of calculating the diversity index value (H') from all stations obtained a diversity index value range of 0.98 – 1.91. According to Odum (1971) a diversity value of 1-3 is included in the moderate level of diversity. Clark (l974) suggested that low diversity values in an aquatic environment indicate that there is pressure or that degradation has occurred due to the presence of pollutants. The value of species diversity can be seen from the number of species and abundance. The number of species leads to richness while abundance leads to similarity, diversity values between 0.98 – 2.47 indicate that the community has higher richness, but rather lower similarity. A uniformity index between 1.0 – 2.0 is included in the lightest category. Based on this uniformity index, the observation area is included in the category of areas experiencing light pollution. The value of the species uniformity index from all observation stations obtained a value in the range of 0.36 – 0.71. So the condition of phytoplankton at each station in the river area shows an even distribution of individuals.

Estimation of the Carrying Capacity of the Aquatic Environment

Estimation of the carrying capacity of the Tanjung Merdeka aquatic environment for the development of Tilapia fish cultivation in floating net cages (KJA) was carried out using an approach that refers to (1) the availability of dissolved oxygen in the waters;

Observation results show that oxygen levels in the waters observed for 24 hours with an interval of 3 hours showed an average oxygen level of 6.5 ppm, while the minimum level desired by cultivated organisms was 3.6 ppm (Boyd, 1989; Wedemeyer, 1996) . This means that oxygen availability is 2.9 ppm. Furthermore, it is known

that the volume of water available for aquaculture activities is 1,946,280 m3, so the available oxygen capacity is 263.75 kg O_2. Thus, the capacity of the waters to accommodate organic waste is 1,318.75 kg. If the percentage of feed given is an average of 5% per day, then the carrying capacity of the aquatic environment for cultivation = 26, 375 kg or 26.38 tonnes of fish. The production level for cages measuring 3 x 3 x 2 m3 = 0.25 tons/cage, then the maximum number of cages that can be operated under carrying capacity conditions = 105.5 cages = 106 cages.

4. CONCLUSION

From the observations it can be concluded that floating net cage cultivation activities in the coastal waters of Tanjung Merdeka, the quality of the aquatic environment is still in a suitable condition for tilapia cultivation. Observation results show that the capacity of waters to accommodate organic waste is 1,318.75 kg. If the percentage of feed given is an average of 5% per day, then the carrying capacity of the aquatic environment for cultivation = 26, 375 kg or 26.38 tonnes of fish. The production level for cages measuring 3 x 3 x 2 m3 = 0.25 tons/cage, then the maximum number of cages that can be operated under carrying capacity conditions = 105 cages. The capacity (carrying capacity) of waters to accommodate organic waste resulting from cultivation activities in floating net cages (KJA) is based on the availability of dissolved oxygen of 263.75 kg O_2. The oxygen level required to decompose/remodel 1 kg of organic feed waste is 0.2 kg. This means that the capacity of the waters to accommodate organic waste is permitted from the results of floating net cage cultivation activities without exceeding the carrying capacity of 1,318.75 kg of organic waste. Based on this carrying capacity, the ability of coastal waters to produce fish is 26.38 tons.

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