IDENTIFYING OF LAND SUITABILITY SEA CUCUMBER *(Holothuria scabra)* USING GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE SENSING BASED ON PHYSICS PARAMETERS IN WEST LOMBOK

[*)]Laily Fitriani Mulyani, [**)]Marsoedi, [**)]Guntur
[*)]Study Program of aquaculture, Agriculture Faculty, Mataram University
[**)]Fisheries and Marine Science Faculty, Brawijaya University
Corresponding Author. Email: lailyfitriani@unram.ac.id

Abstract

This study was conducted on 17th October - 27th November 2016 at Gili Asahan, Gili Layar, and Gili Gede in West Sekotong, Lombok, West Nusa Tenggara. The purpose of this study was to analyse a suitable area for sea cucumber cultivation (Holothuria scabra). Data collection had been done by survey method, acquiring primer and secondary data directly related to sea cucumber's life and analyzed by using Geographic Information System software. A physical parameters include temperature 29,14 – 30,24^{0}C, the water transparancy of the 0,78 – 1,35 m, the current speed from 0,2 to 0,7 m/s, rainfall of 174 mm, protection: protected, fairly protected and unprotected, depth 0,78 to 1,35 m, the tide of 0,9 m. Land suitability classes are determined based on the interval between the other classes S1 (40-42), S2 (37-39) and N (34-36). Based on the results of scoring that has been adapted to the class interval obtained sample points with a very appropriate category (S1) including A1, C1, C4, C5. Then for the corresponding category (S2) between the A2, A3, C2, C3. Meanwhile, according to the category is not contained in the sample points B1, B2 and B3.

Keywords: GIS, Sea Cucumber, Land Suitability, Physics Parameter, West Sekotong

Introduction

Sea cucumbers are a group of invertebrate animals from the Echinodermata phylum of the Holothurioidea class (Purcel *et al*., 2012). Sea cucumbers are an important component in the food chain because of their role as deposit feeders and suspension feeders. Ecologically, sea cucumbers function to help the process of decomposition of organic substances in sediments and release / produce nutrients into the food chain (Darsono, 2003). These sea cucumbers include animals in the CITES Appendix II category, the population continues to decline every year. One effort to maintain this resource is restocking. So that sustainable management is needed to determine the appropriate area. Therefore, adequate information is needed that can be used for sustainable management of sea cucumbers. One method used is to use a geographic information system (GIS). GIS can make it easier to analyze data and determine suitable cultivation areas. Given the importance of the function of sea cucumbers, it is necessary to manage good sea cucumber resources.

The purpose of this study was to analyze the suitability of the sand cucumber cultivation area *(Holothuria scabra)* in Sekotong Barat waters based on physical parameters.

Materials and Methods

The Experimental Design

The study sites are located in Gili Asahan, Gili Gede Barat and Gili Layar Timur, Sekotong District, West Lombok. The study was conducted in October 17 - November 27, 2016, covering the necessary data collection and sampling conducted directly on the three dyke. The method used in this study is a survey, which collects field data on the condition of sea waters in the West Sekotong Waters and the data obtained are analyzed using geographic information system software. The tools used are ships, scissors, sample bottles, stationery, measuring cups, stopwatches, paralon pipes, cameras, ropes, tide boards, GPS, thermometers, refractometers, pH meters, DO meters,

secchi disks and current meters. The materials used are sea cucumbers, tissues, label paper, alcohol, sample containers.

Weighting and Scoring Matrix Spatial Analysis

Table 1. Weighting Results and Scores for Land Suitability Values for Each Parameter.

Parameter	Criteria	Assessment Scale	Weight	Score
Temperature (Marizal, 2012)	26 – 31,6 20 – 25 <19 or >31,6	5 3 1	2	10 6 2
Brightness (Marizal, 2012)	1 – 1,5 0,5 – 0,9 <0,4 and >1,6	5 3 1	1	5 3 1
Current Speed (Hutabarat, 2000)	0,4 – 0,5 0,2 – 0,3 or 0,6 – 0,7<0,2 or >0,7	5 3 1	1	5 3 1
Protection (Nirmala *et al.*,2014)	Protected Protected enough Protected	5 3 1	1	5 3 1
Depth (Marizal, 2012)	1 – 1,5 0,5 – 0,9 <0,4 and >1,6	5 3 1	1	5 3 1
Tides (Hutabarat, 2000)	0,5 – 0,7 0,2 – 0,4 or 0,8 – 1,0 <0,2 or >1,0	5 3 1	1	5 3 1
Rainfall (Mustofa, 2012)	208 – 250 125 - <208 or 250 – 300 <125 or >300	5 3 1	3	15 9 3

Overlay Analysis

After the database and spatial data have been formed as above, the next step is analyzed. The analysis conducted is overlapping analysis or overlay which combines several map information to produce new information, Overlay is aspatial analysis capability that can be carried out effectively in GIS. The results of the spatial analysis are a map for the suitability of sea cucumber cultivation areas.

Class of Suitability

$$N = \frac{\Sigma BI \text{ x } Si}{Overall\ Weight}$$

Description :
N = Overall value
ΣBi = Weight of each Criterion
Si = Scores For Each Criterion

Determination of the value of suitability class of sea cucumber cultivation area, is:

$$N.min = \frac{\Sigma \text{ Weight of each criterion}}{Overall\ Weight}$$

$$N.max = \frac{\Sigma\ Overall \text{ Score}}{Overall\ Parameters}$$

$$the\ interval\ between\ the\ other\ classes = \frac{\Sigma \text{ N. max} - \text{N. min}}{3}$$

Results and Discussions

Observation parameters in this study are physical parameters including rainfall, temperature, protection, tides, depth, brightness and current speed. The parameters used are parameters related to the requirements for sea cucumber growth to be cultivated. Determination of living conditions is adjusted to the sea cucumber standard quality standards. The results of research conducted directly or through observation of satellite imagery data that indicate differences in values between each sampling point. The difference in values between points is then adjusted to the quality standard of each parameter. The use of quality standards makes it easier to score land suitability levels.

Rainfal.

Rainfall data was obtained from the Geophysics Climatology and Meteorology Agency Class I West Lombok, West Nusa Tenggara Province. The results of observations in this study obtained the average value of rainfall during the last 12 months in the range of 45-353 mm/month. Observation stations are calculated based on districts. Average rainfall at the study site during the study was 174 mm/month. Map of rainfall distribution at the research location can be seen in Figure 1.

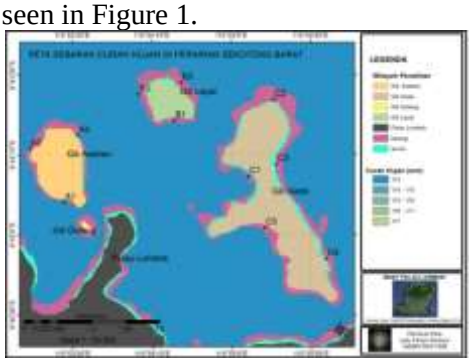

Figure 1. Map of Rainfall Distribution in West Sekotong Waters

Temperature

Water temperature values obtained from observations in the field show a

range that is not much different. The temperature range in the District of West Sekotong is in the range of 29 - 31^{0}C. The lowest temperature range is at sample point A1 which is on Gili Asahan and the highest is at sample point A3 (Gili Asahan), sample points B2 and B3 (Gili Layar), and sample points C1, C2 and C3 (Gili Gede). interpolation of water temperature distribution shows green to red color in the range of 29 - 31^{0}C. Based on the results of the analysis, the comparison using sea cucumber culture quality standard there is only one category of suitability class that is very appropriate (S1). Map of temperature distribution at the study site can be seen in Figure 2.

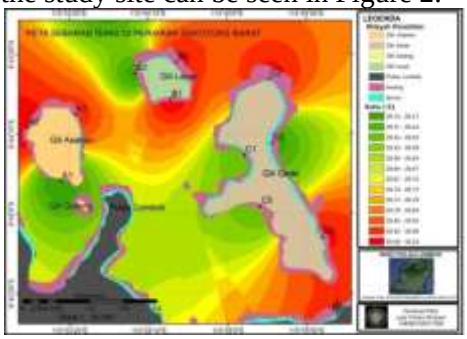

Figure 2. Temperature Distribution Map in West Sekotong Waters

Protection

The results of observations for the parameters of protection at the study site, there are three categories, including those that are very suitable in the study sites A1, A2, B3, C1, C4 and C5. Then for the appropriate category there are at the point of location A3, B1, C2 and C3. Locations not suitable are at point C2.

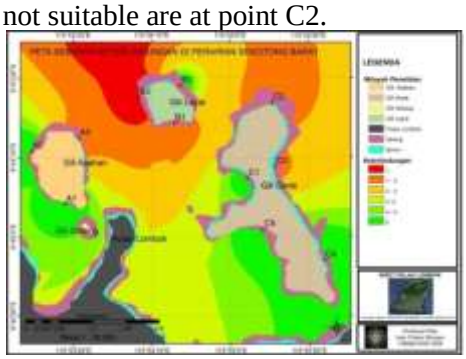

Figure 3. Map of the Distribution of Protection in the West Sekotong Waters

Tides

Tide data obtained from the Office of Kesyahbandaran and Authority Lembar Harbor are processed and produce tidal constants and tidal graphs. Samples were taken for the first two replications on October 17, 2016 with tidal height of 1.0 m, while the second test on November 27 with a tidal height of 0.8 m. So that the average value of tides obtained during the study was 0.9 m.

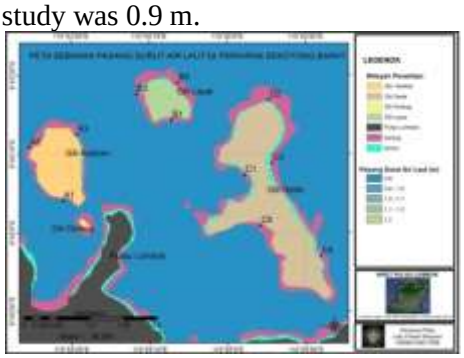

Figure 4. Tidal Distribution Map in West Sekotong Waters

Depth

The depth of water at the location of cultivation should range between 0.5 - 1 m calculated at the lowest ebb time, while at the highest tide the water depth should be no more than 2 m. This is to prevent sea cucumbers from drought or rising water temperatures that can interfere with their lives (Martoyo *et al*., 2007).

The results of observations of water depth at the study sites obtained ranged from 0.78 to 1.35 m. There are two classes that can be seen in this parameter including a very suitable class and a suitable class.

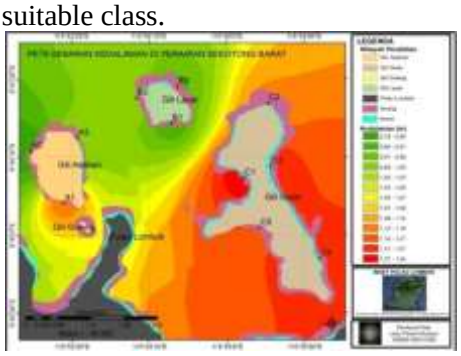

Figure 5. Depth Distribution Map in West Sekotong Waters

Classes that are very suitable are given at A1, A3, B2, C1, C2, C3, C4 and C5. Depth that is very suitable to be dominated in the waters of Gili Gede, all locations in the area have a very suitable depth of water suitability. Then, the appropriate classes are in the A2, B1 and B3 points. The depth distribution map at the research location can be seen in Figure 5.

Brightness

Based on the results of interpolation, most of the areas are green to red, this shows that the level of water brightness in the study area is still good. Based on the standard quality of waters brightness for sea cucumber cultivation, there are only two types of land suitability, namely very appropriate (S1) and appropriate (S2) categories. The very appropriate category (S1) is at the sample points A1, A3, B2, C1, C2, C3, C4 and C5 while the other sample points are in the appropriate category (S2). The map of the distribution of brightness at the study site can be seen in Figure 6.

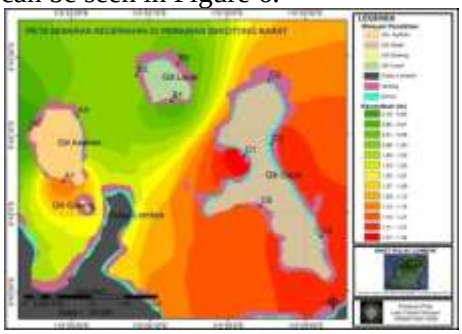

Figure 6. Brightness Distribution Map in West Sekotong Waters

Current Speed

The results of observing current velocity in this study ranged from 0.2 to 0.7 m/s. Martoyo *et al*. (2006) explained that sea cucumber organisms are able to live in waters with current rates ranging from 0.30 to 0.50 m/s. The value of the current velocity obtained at the study site produces two land suitability categories, which are very appropriate and appropriate.

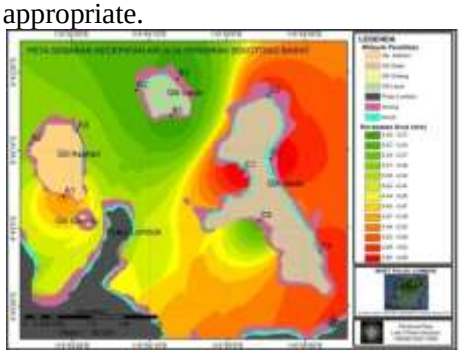

Figure 7. Current Speed Distribution Map in West Sekotong Waters

The very appropriate category (S1) only exists on Gili Asahan (A1, A2 and A3), while the corresponding category (S2) is found on Gili Layar (B1, B2, and B3) and Gili Gede (C1, C2, C3, C4 and C5). Map of current velocity distribution at the study site can be seen in Figure 7.

Overlay of Land Suitability Sea Cucumber (H. scabra) Based on Physics Parameters

Observation results of physical parameters including temperature, brightness, current speed, rainfall, protection, depth and tides in West Sekotong Waters were analyzed using the Geographic Information System (GIS) method which produced thematic maps of land suitability of sea cucumber sand cultivation (H. scabra) can be seen in Figure 8.

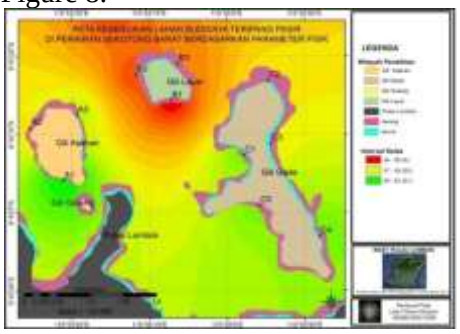

Figure 8. Overlay of Land Suitability Sea Cucumber (H. scabra) Based on Physics Parameters

Based on the results of interpolation, the West Sekotong District area is green to red. The interpolation pattern shows that there are three land suitability categories on the land suitability of sea cucumber cultivation based on physical parameters. Land suitability classes are determined based on class intervals namely S1 (40-42), S2 (37-39) and N (34-36). Based on the results of the scoring that has been adjusted to the class interval, it is obtained the sample points with very appropriate categories (S1) namely A1, C1, C4, C5. Then for the appropriate category (S2) found at points A2, A3, C2, C3. Meanwhile, the inappropriate category is found in the sample points B1, B2 and B3 where the sample point is located on Gili Layar.

Research conducted when observing the abundance of sea cucumbers in the study location, sea cucumbers were found only slightly less than 8 individuals. This is in accordance with the statement of the Wildlife Conservation Society (WCS) (2014), the abundance of sea cucumbers in the waters of Lombok is classified as very

low, from 64 survey points, the existence of sea cucumbers was only found in 10 survey points, namely Gili Asahan, Gili Gede, Gili Layar (West Lombok), West Gili Lawang, East Gili Sulat, East Sapakoko, Heaven on the Planet, Gili Maringki (East Lombok), West Sire and Soraya Reef (North Lombok). The abundance of sea cucumbers found is less than 50 ind / ha.

Overall, based on regional physical parameters suitable for the cultivation of sea cucumber sand *(H. scabra)* is the Gili Asahan and Gili Gede areas, while Gili Layar is not suitable for sand sea cucumber cultivation *(H. scabra)*. Most of the Gili screen area also has substrates that are not suitable for the cultivation of sand cucumbers *(H. scabra)*. This is as explained by Nybakken (1992), that sea cucumbers include members of the Echinodermata phylum which commonly inhabit sandy beaches. One of the adaptation patterns carried out by coastal aquatic organisms with sandy substrates is to immerse themselves in the substrate. When the biota digs up the substrate, fine organic particles other than grains of sand will be digested in the body. Mercier *et al*., (2000) explain why sea cucumbers avoid substrate that is only muddy because the substrate may be an anoxic or oxygen-free living environment. Sea cucumbers may have difficulty in moving on muddy substrates (Dissanayake and Stefansson, 2012). Sea cucumbers tend to concentrate in areas with high levels of organic matter (Slater et al. 2011).

Conclusion

The conclusion obtained based on the results of research in the District of West Sekotong is the level of suitability of the Teripang Pasir cultivated land in the District of West Sekotong for the very suitable category S1 (40-42) are A1, C1, C4, C5. Then for categories corresponding to S2 (37 - 39) found at points A2, A3, C2, C3. Meanwhile, the category of non-conformity N (34-36) is found at sampling points B1, B2 and B3.

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