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Sequence analysis of seaweed farming in Hundihuk Village, Rote-Ndao District

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ABSTRACT

Rote Ndao is one of the regencies in East Nusa Tenggara Province that is designated as the Center for Integrated Maritime Affairs and Fisheries. This area is expected to encourage economic growth in the periphery with the main driving locomotive being the fisheries sector. Seaweed cultivation has developed in Rote-Ndao District since a decade ago. The coastal area used for seaweed cultivation in this district in 2018 reached 1,718 ha (57.21%) of the potential area of 3,003 ha. Seaweed cultivation activities carried out in this regency are generally still limited to water areas that are considered safe to try and provide benefits that are considered quite good, even though the cultivation is technically inadequate or does not meet the technical requirements of seaweed cultivation. The purpose of this study was to analyze the suitability of the area of seaweed cultivation in Hundihuk Village. The data collection method used in this study is the survey method. Analysis of space availability is based on the suitability of the waters that support seaweed cultivation. The results showed that the analysis of the suitability of the waters of the village of Hundihuk was included in the category of very appropriate with the value of 267.5, this meant that the development of seaweed was still possible by taking into account the carrying capacity of the ecosystem.

Key words : *Land Suitability, Seaweed, Cultivation, Hundihuk Village*

Introduction

Rote Ndao is one of two districts (including East Sumba Regency) in the Province of East Nusa Tenggara (NTT), which has been designated as the Center for Maritime Affairs and Fisheries (CMAF) since 2017 through the Decree of the Minister of Maritime Affairs and Fisheries No. KEPMEN-KP / 51/2016, because it is a region of small islands and border areas between countries (Australia and Timor Leste). The basis for establishing the Integrated Fisheries Marine Center (CMAF) due to the large potential of fisheries that have not been managed to the maximum, it is expected that the CMAF Program encourages economic growth in the periphery with the main driving locomotive is the fisheries sector. The results of the Location Quotient (LQ) analysis for leading sectors in order to increase the income and welfare of coastal communities, determined three leading commodities of Rote Ndao Regency, namely: seaweed, sea cucumbers, and snapper. This LQ analysis is a measure to determine

the basis or non-base sectors in an area by comparing the economic sector at the lower level with the economy at the upper level (Ministry of Maritime Affairs and Fisheries, 2017). Seaweed cultivation has developed in Rote-Ndao District since a decade ago. The coastal area used for seaweed cultivation in this district in 2018 reached 1,718 ha (57.21%) of the potential land area of seaweed cultivation of 3,003 ha. Where the planned expansion of cultivated land per year / additional projections of seaweed production, among others: in 2015 amounted to 30 ha / 1,704 tons, in 2016 amounted to 45 ha / 1,704 tons, in 2017 amounted to 60 ha / 3,408 tons, and in 2018 amounted to 5 ha / 4,260 tons (ENT Maritime Fisheries Service, 2014). Rote-Ndao Regency seaweed production volume from year to year tends to increase, whereas at the district level in 2017 amounted to 15,776 dry / ton. The large production volume is related to the increase in land area and the amount of seaweed cultivation, wherein in 2017 there were 10,453 people with 1,073 business groups in Rote Ndao District (Rote Ndao in Figures 2018). The selection of a good location (water) and suitable for the development of seaweed culture in the context of increasing production is important because it is difficult to make certain treatment of the ecological conditions of the water that is always dynamic. This is because seaweed growth is greatly influenced by water conditions. Seaweed cultivation will experience a decrease in production if bio-ecologically and physically the waters that become cultivated land experience interference. Seaweed cultivation activities carried out in Rote Ndao Regency are generally still limited to water areas that are considered safe to try and provide benefits that are considered quite good, even though the cultivation is technically inadequate or does not meet the technical requirements of seaweed cultivation. The consequence is that the seaweed cultivation is not optimally cultivated, and the disruption the sustainability of coastal area resources in the area. While the area of seaweed cultivation in Indonesia continues to increase from time to time, the territorial waters of Rote Ndao Regency especially Hundihuk Village are not well developed and even tend to be exploited. Therefore, it is necessary to study the ecological aspects of the location of seaweed cultivation. This ecological aspect is very important in efforts to develop seaweed cultivation because it relates to the selection of cultivation sites, as well as the species to be cultivated and the method of planting is one important factor in determining its success.

Research Methods

The data collection method in this study is a survey method, According to Singarimbun and Effendi (1985). Data collected during this research activity include:

a. Biophysical data related to seaweed cultivation, namely: physical parameters (current, temperature, brightness, protection, depth, and substrate), chemical parameters (pH, dissolved oxygen, salinity, phosphate, nitrate, and DO), and biological parameters (community algae macro and herbivorous animals).
b. Data on the social, economic, and cultural conditions of seaweed cultivating communities in Rote Ndao Regency, namely: age, number of family members, education, income, length of stay, ethnicity, expenditure, and experience.
c. Data on the following factors of production costs used for seaweed cultivation during maintenance and production and selling price of seaweed.
d. Supporting data as well as data on the general condition of the study site.

Results and Discussion

An Overview of Seaweed Cultivation in the Waters of Hundihuk Village and surrounding areas

Rote Ndao Regency is one of the regions in East Nusa Tenggara Province which is designated as the Integrated Marine and Fisheries Center. This determination is supported by the existence of superior commodities such as seaweed, tilapia, and catfish for cultivation, Mokdale Fish Seed Center (FSC), UPR, Pokdakan, and fishermen in the CMAF area. The geographical location of Rote Ndao District is very supportive development of good aquaculture, freshwater, and brackish aquaculture. Utilization for seaweed cultivation is *Kappahycus alvarezii*. Marine culture has the potential to be developed because it is supported by the potential of the coastal population and the number of islands and the strait with protected waters from the waves. Seaweed farming activities in the waters of the village of Hundihuk and its surroundings have been started since 1999. Most of the people who live around the island earn a living as fishermen and seaweed cultivators. The

cultivation site in the southern part of the island is surrounded by mangrove forests with soft and slightly muddy substrates. The dominant type of seaweed cultivated in Hundihuk Village and its surroundings is *Kappahycus alvarezii* or called Sakol. This type was chosen because the selling price is relatively high, ranging between Rp. 20,000-22,000 per kg dry. Another type that is also cultivated but in small amounts is *Eucheuma denticulatum*, or what is known by farmers as *spinosum* (in the service program the AWCU team was also introduced to this species from Oeseli Village, Rote Ndao Regency; Bessie, 2019). This type is less desirable because the selling price is low, ranging from Rp. 6,000-7,500 per kg dry (the advantage of this type is the production period is relatively short between 10-14 days compared to 45 days of Sakol type).The cultivation method used is the long line method and the basic staple method. The basic peg method dominates the cultivation activities in Hundihuk Village and its surroundings, because according to the cultivators this method is easier to operate, is cheaper and stays loose without extra maintenance, easy to tie anchors, can put a lot of rope, especially in narrow locations, and best production. The weakness of this method is susceptibility to *ice-ice disease* compared to the long line method.

Seaweed Farming Land Suitability Analysis

The choice of location is crucial to the success or failure of a seaweed cultivation business. To get the best results, seaweed cultivation should be chosen in accordance with the requirements for growing seaweed. Some hydro-ecological parameters that affect the growth and development of seaweed are current speed, water brightness, salinity/salinity value, dissolved oxygen (DO), nitrate, phosphate, water temperature, pH value, water depth, protection, water pollution, substrate, and natural algae/seaweed.

Current

According to Afrianto and Liviawati (1993), the fertility of a cultivation location is determined by the presence of the current movement. The current movement is the transport of nutrients needed for seaweed growth. Current velocity is an important ecological factor in seaweed cultivation. Current velocity measurements during observation were only carried out on the surface and the measurement results ranged between 18-35 cm/sec where low-speed current categories were located at location IV (value 18 cm/sec) and high categories were at locations I and II (value 35 cm/sec). According to Aslan (1995), a good current speed ranges from 20-40 cm/sec. The current velocity conditions in the waters of Hundihuk Village, in general, are very helpful in mixing nutrients from the bottom of the water needed by seaweed in its growth.

Brightness

The results of brightness measurements for eight weeks ranged between 3 - 15 meters, where the difference in brightness is due to the time of measurement occurring at different tide height conditions. All locations have excellent (very appropriate) brightness values. At locations I-III the brightness can reach 100% where the penetration of sunlight can penetrate to the bottom of the water, while location IV with a muddy substrate and an area of mangrove ecosystems so that the penetration of sunlight in some parts does not penetrate the bottom of the water. According to Aslan (1995), the ideal brightness for seaweed growth is more than one meter, thus the brightness of the waters during activities is very qualified for seaweed growth.

Salinity

Salinity affects the growth of seaweed, besides temperature as the main factor. The range of salinity obtained during the observation was 29 - 35 ‰. Bakosurtanal (2005), gives a weight for the salinity of 10% of the total 13 parameters used. The detailed criteria are 28-36 ‰ for the very appropriate category,> 20-28 ‰ for the appropriate, 20- <24 ‰ for the conditional fit, and <20 ‰ for the inappropriate category. When associated with seaweed growth, increasing salinity greatly affects growth and can cause seaweed to be susceptible to disease. This is supported by Bessie et al (2018), which state that seaweed is a marine algae that cannot tolerate high salinity differences. At location I-III getting the optimum salinity value (35 ‰), this illustrates that the salinity value in the waters of Hundihuk Village is very suitable for seaweed cultivation.

DO

The results of measurement of dissolved oxygen content ranged from 5.3 to 7.4 mg / l. At all locations, the dissolved oxygen content has exceeded 4 ppm. This dissolved oxygen content gives an idea that all locations are very suitable for seaweed cultivation. Dissolved oxygen in water can come from

the process of diffusion from the air and results from photosynthesis by phytoplankton and other aquatic plants. Dissolved oxygen is an important element needed in the process of respiration and decomposing organic matter by microorganisms. Dissolved oxygen in the waters is the main substance for aquatic life, especially fish, microorganisms, and aquatic plants including seaweed. In the process of metabolism, the growth and propagation of seaweed require oxygen. Oxygen is needed by all creatures that live in water such as fish, shrimp, shellfish, and other animals including microorganisms such as bacteria and seaweed. Dissolved oxygen as a regulator of the body's metabolism of organisms to grow and multiply. Dissolved oxygen values lower than 4 mg /l can be indicated that the waters are experiencing disturbances (lack of oxygen) due to temperature rise during the day, and at night due to the respiration of aquatic organisms.

Nitrate

Nitrate content in the study location ranged from 0.087 to 0.530 mg/l, where the value is still included in the category that is very suitable for all sampling locations in the waters of Hundihuk Village, with this value very possible to do seaweed cultivation. Nitrates in sea waters are micronutrient compounds controlling primary productivity in the surface layer of euphotic regions. Nitrate levels in the euphotic region are strongly influenced by nitrate transport, ammonia oxidation by microorganisms, and nitrate uptake for primary production processes. Nitrate is the main form of nitrogen in natural waters and is the main nutrient for plant growth and algae. Good waters for seaweed growth must contain enough nutrients, both macro, and micro. Bessie, *et al.* (2018), stated that nitrate content can be very influential and can classify the level of fertility of waters.

Phosphate

A Phosphates is a form of phosphorus that can be utilized by plants and is an essential element for higher plants and algae, so this element becomes a limiting factor for plants and aquatic algae and greatly affects aquatic productivity. Phosphate content during the study ranged from 0.250 to 0.300 mg /l, the phosphate content of the sampling area included fertility levels between moderate to high fertility levels and included in the category of very suitable for seaweed cultivation.

Temperature

Water temperature greatly affects the life of biota in the waters. A good temperature for seaweed cultivation ranges from 27 ^{0}C-30 ^{0}C (Anonymous, 2005). Based on observations for eight weeks, the temperature range was between 30 ^{0}C-31 ^{0}C. This means that at the location of cultivation the temperature range is quite high. The highest temperature was obtained at location III i.e. 31 ^{0}C, while locations I, II, and IV had the same value at 30 ^{0}C. A very high temperature range can cause growth to be less good and susceptible to disease. This is supported by Basalamah (2002), which states that an increase in temperature that exceeds the optimum limit can suppress growth and can even cause the death of aquatic organisms.

pH

According to Kadi and Atmaja (1988), the degree of acidity (pH) that is good for the growth of seaweed species *Eucheuma* sp ranges from 7-9 with an optimum range of 7.3 - 8.2. The pH value is influenced by several parameters, including biological activity, temperature, oxygen content, and ions. Every marine organism requires certain pH conditions for its survival, seaweed is no exception. The results of pH measurements show that the pH value is in the range of 6.8-8.0. The lowest value at location IV (pH value 6.8) towards acid it is categorized as not suitable for seaweed cultivation. While location I-III has a pH value in the normal category, where the water quality standard for categorized seaweed cultivation is very appropriate.

The results of the analysis of hydro-ecological parameters in the waters of Hundihuk Village and its surroundings are shown in Table 2.

The process of determining area suitability was done by comparing the prerequisite parameters with the measured water conditions. Based on the results of the analysis of the suitability of the waters for seaweed cultivation in each suitability category, in general, the area suitability category in Hundihuk Village is in the category of very appropriate to the value at the location I was 300 with an area suitable for seaweed cultivation of 10 ha, location II was 290 with an area suitable for seaweed cultivation of 50 ha, and location III was 280 with an area suitable for seaweed cultivation of 20 ha, and there is only 1 location with a quite appropriate category namely location IV with a value of 200 with an area suitable for seaweed cultivation of 2 ha. The results of this

Table 2. Conformity Matrix of Seaweed Cultivation in Hundihuk Village Waters

Parameters	unit	Suitability (Location I)		Suitability (Location II)		Suitability (Location III)		Suitability (Location IV)	
		observation/ analysis	observation/ analysis	Value	Value	Value	Value	Value	Value
Current	m/detik	35	30	33	30	35	30	18	20
Brightness	meter	15	30	12	30	10	30	3	20
Salinity	%	35	30	35	30	35	30	29	20
DO	mg/1	7.0	30	7.1	30	7.4	30	5.3	30
Nitrate	mg/1	0.095	30	0.087	30	0.300	30	0.530	30
Phosphate	mg/1	0.250	30	0.300	30	0.290	30	0.287	30
Temperature	^{0}C	30	30	30	30	31	30	30	30
pH		7.9	15	8	15	7.7	15	6.8	10
Dept	Meter	5	15	8	15	5	15	5	15
Protection		Protection	15	Protection	15	Somewhat Protection	10	Protection	15
Pollution		non	15	non	15	non	15	non	15
Substrateh		sand	15	sand	15	Sandy muddy	10	Sandy muddy	10
Algae		Lots	15	enough	10	little	5	little	5
			300		290		280		200
The Total Value Suitability		Very high Suitability		Very high Suitability		Very high Suitability		Enough Suitability	

Source: Primary data processed, 2019.

analysis show that the waters of Hundihuk Village and its surrounding areas are very feasible for seaweed cultivation activities, but still, pay attention to the carrying capacity of the region in an effort to develop sustainable seaweed and also for optimal production results. A very suitable area (S1) is characterized by not having serious barriers (inhibitors) to determine the treatment given or only having barriers that are not significant or significantly affect their use and will not increase the input/level of treatment given. Some limiting factors in this area that are natural and apply to almost all seaweed cultivation areas include: (i) the location is on land that has current and wave movement conditions which in the west season / second transition season were extreme so that in the season the seaweed cultivation business cannot be carried out (but in the southern part of location I there is still a safe area for breeding), (ii) ice-ice disease that continues to infect/spread within the cultivation site even with a small intensity of attack (presumably a quality factor seeds and water quality such as salinity and temperature), (iii) location far enough from the transportation facilities, so it requires additional costs for transportation. To develop an environmentally friendly and sustainable seaweed cultivation business, it is necessary to arrange/provide an area for transportation routes so that fishing boats can still catch fish.

Conclusion

The conclusion of this research is the suitability analysis of waters in the Hundihuk Village in the category of very suitable with the value of 267.5, this means that the development of seaweed is still possible by taking into account the carrying capacity of the ecosystem.

Based on the results of this study, it is recommended that further studies be needed regarding land suitability in all areas of the Integrated Marine and Fisheries Centers in Rote Ndao District.

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