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Original Research Paper

Feasibility Study of Seaweed (*Kapaphycus alvarezii*) Mariculture Using Geographic Information System in Hading Bay, East Flores Indonesia

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ABSTRACT

The objectives of the study were to analyze the water ecology and its support capability and to determine the best site for continuous seaweed mariculture in Hading Bay of East Flores Regency. The study used descriptive method. It was conducted in Hading Bay, Lewolema District, and East Flores Regency in March 2015. Data analysis was done using Geographic Information System (GIS) based on area suitability value, and the method applied in the mariculture was long line method. Total Hading Bay water territory was 864,676 ha. Site A was135,345 ha, site B was 474,222 ha and site C was 255,108 ha. Area with S1 category was 729,331 ha extended in Site B and C. Area with S2 category was 135,345 ha as extended in Site A. Water territory support capability was 778,208 ha. The number of seaweed mariculture units was 194,552 and seaweed territory capacity was 99%. Hading Bay waters have the capacity and area support capability for *K. alvarezii* seaweed mariculture site. Site A was categorized S2 on suitability class and site B and C were categorized S1 on suitability class. The results showed different quality of water territory in those three sites was not significant and still in normal range of *K. alvarezii* seaweed mariculture development.

INTRODUCTION

Indonesia as an archipelago with 17,504 islands and 81,000 km coastline possesses marine resources in the form of diverse organisms, plants or animals, with high economic values and as important assets for mariculture development (Nurdjana 2007). Seaweed as natural marine resource has been utilized by Indonesian people as a source of their living, and in some regions as the main source of income. East Flores regency has adequate marine resources potentials to develop seaweed aquaculture area. But these potentials have not been optimized as the people still depend on their agricultural and plantation resources. East Flores regency is archipelago regency and one of fishery centers in the province of East Nusa Tenggara. It consists of three main islands: East Flores Island, Adonara Island and Solor Island and 12 small islands with total area of 5,983.38 km². The land area is 1,812.85 km² (31%) and the water territory is 4,170.53km² (69%). East Flores regency is located at 08°04' - 08°40'S and 122°38'-123°57'E and bordered by Flores Sea in the north, Sawu Sea in the south, Lembata regency in the east and Sikka regency in the west.

Marine culture continuity depends on marine resources utilization which does not exceed the support capability or the carrying capacity. According to Dahuri (2003) support capability should consider the area extent, food availability, spawning ground and the predators' cycle. Protected sites are usually established in the bay area. Ecological factors which need to be considered are temperature, water current, bottom water condition, depth, pH, salinity, DO, BOD, COD, nitrate, phosphate, transparency, turbidity and the tidal current (Doty 1988, Aslan 1991, Hartoko and Kangkan 2010, Munuz, et al 2004). The objectives of the study were to analyze the water ecology and its support capability and to determine the best site for continuous seaweed mariculture in Hading Bay of East Flores Indonesia.

MATERIALS AND METHODS

The study was conducted in Hading Bay, East Flores Indonesia in March 2015. Water quality measurement was done from 06.00 to 18.00 local time, and measured twice in a week for 45 days adjusted with the average cultivation period. Some samples were measured directly on site, while others were analyzed at Oceanography Laboratory of Nusa Cendana University. The water samples were collected at 37 locations within three stations, namely A, B and C.

Fig. 1 shows the map of the study area and stations. Site selection for the study used purposive method where samples were taken after the number of samples observed was decided in advance. Purposive method was used deliberately so that it could represent all locations of the study based on the geographical location, area extent, number of inhabitants, watersheds, etc. (Sugiyono 2008). Water qual-

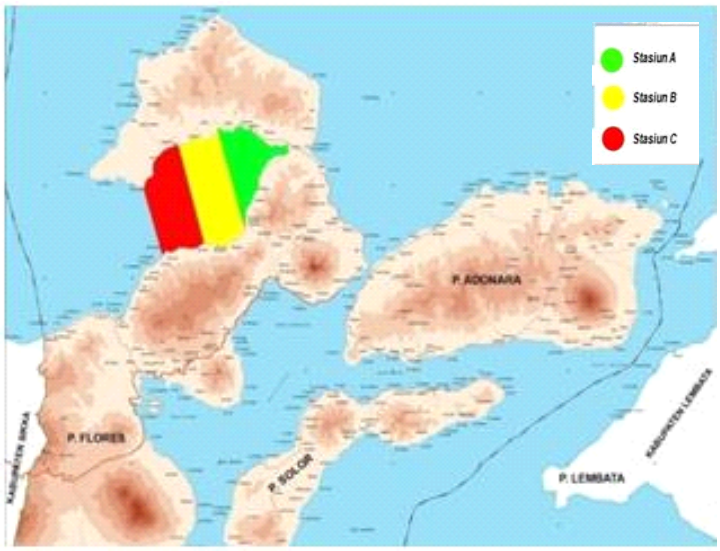

Fig. 1: Area of study and stations.

ity aspects analyzed in the study were temperature, depth, water current, transparency, turbidity, salinity, pH, DO, tidal current, nitrate, phosphate, COD and BOD.

Based on the feasibility scoring system of the Bakosurtanal (1996), the suitablity for seaweed mariculture is divided into four classes. The Score from 150 to 165 is categorized very suitable (S1), score from 135 to 150 is categorized suitable (S2), score from 120 to 135 is categorized suitable with conditions (S3) and score of less than 120 is categorized not suitable (TS).

RESULTS AND DISCUSSION

Water quality: Results showed differences between water quality acquired from *in situ* and *in vivo* observations. The differences of water quality in those three sites were not significant and still in normal range of seaweed mariculture.

Results of water quality measurement in three sites showed that temperature ranged 25-31°C, the depth ranged 3-7 m, the current ranged 0.2-04 m/second, transparency ranged 2-5 m, turbidity ranged 3-6 NTU, salinity ranged 22-30 ppt, pH ranged 6-8.0, DO ranged 5-8 ppm, nitrate ranged 0.2- 0.5, phosphate ranged 0.02-0.09 ppm, BOD ranged 2.0-2.9 mg/L, COD ranged 20-55 mg/L, and tidal current ranged 3-6 m.

Area support capability for seaweed mariculture: Based on the GIS spatial analysis (Morain 1999) the total area of Hading Bay is 864,676 ha which consited of area A of about 135.345 ha, area B of about 474.222 ha and area C of about 255.108 ha. Considering the area extent and the effective distance for each mariculture unit, we acquired capacity of the territory for seaweed mariculture with long line method which was 99% of the total area of Hading Bay.

The utilization of coastal areas for seaweed mariculture needs a system of cultivation which calculates the support capability of the area where the culture is established. It is needed in order to determine the business scale and business unit size which later guarantee the continuity of the mariculture activity. Area support capability shows the area's maximum ability to support seaweed mariculture activity. Area support capability of Hading Bay is 778,208 ha.

Based on bottom water condition, the three sites have sandy reef substrate. This substrate is very suitable for seaweed growth. The safety level of the locations was in the category of feasible for seaweed mariculture location as the sites were distant from port and industrial areas. Hading Bay is a strategic bay area for seaweed mariculture as it is not for transportation or shipping line. Furthermore, it has an adequate area for seaweed mariculture using long line method.

Generating the feasibility map for seaweed mariculture in Hading Bay was done using software ArcGIS 10.1 and Surfer v10.1.561 by Kriging and overlaying method (Budiyanto 2002). The water quality analysis and the areal extent of Hading Bay showed that its location has effective feasibility value for *K. alvarezii* seaweed mariculture. Fig. 2 shows that Hading Bay has the feasibility level S1 and S2. S1 level was in site B and C with feasibility score 165, while

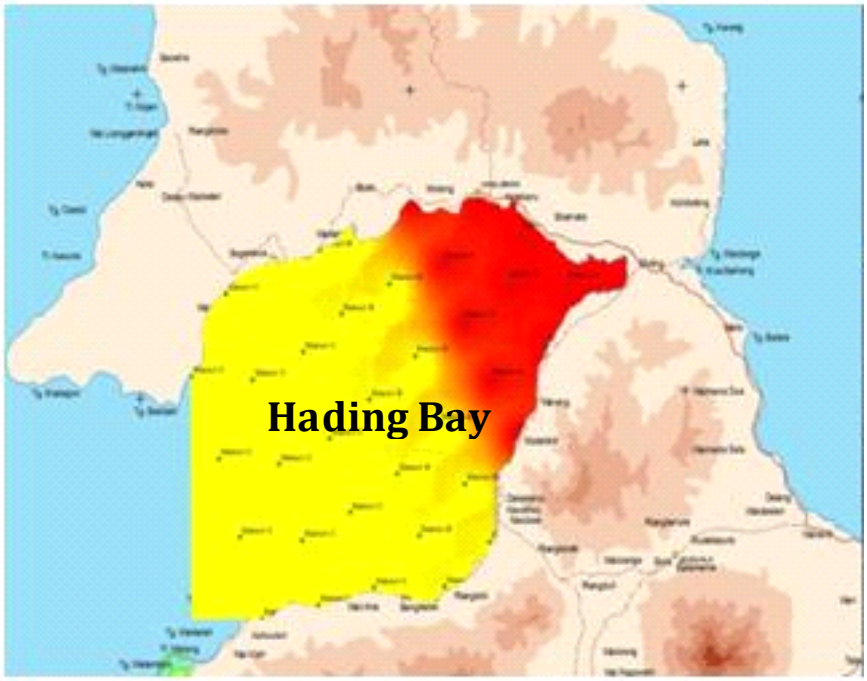

Fig. 2: Yellow indicated as the area with feasibility level S1 (very suitable) and Red indicated as the area with feasibility level S2 (suitable).

S2 level was in site A with feasibility score 149.

CONCLUSION

GIS analysis shows that Hading Bay has feasible support capability for seaweed *Kapaphycus alvarezii* mariculture locations. Location B (474.222 ha) and C (255.108 ha) were categorized in feasibility level S1 (very suitable) and Location A (135.345 ha) was categorized in feasibility level S2 (suitable).

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