Environmental And Area Support Capability Analysis For Seaweed Mariculture Development In Hading Bay Of East Flores Regency

Dominikus K. Da Costa, Mohammad M, Bambang S.

Abstract: East Flores regency has adequate marine resources potentials to develop seaweed aquaculture area. Animportant aspect of seaweed aquaculture is the site selection. Site selection is based on the marine area extent and its ecological quality. 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, East Flores Regency in March 2015. Data analysis was done using GIS based on area suitability value, and the method applied in the mariculture was long line method. Total Hading Bay water territory was864,676 ha. Site Awas135,345 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 units and seaweed territory capacity was 99%. Hading Bay waster has 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.

Keyword: Kappaphycus alvarezii, Hading Bay, Water capacity, Area support capability, Method unit

1. 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 assetsfor 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. Seaweed as one of the marine commodities, has high economic values and is easy to cultivate with low operational cost and its post-harvest-handling is also easy and simple. Marine culture is one form of managing and using marine resources which is environmentally sound. 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 an archipelago regency and one of fishery centers in the province of East Nusa Tenggara.It consist 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 08º04' - 08º40'S and 122º38' - 123º57'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. People of East Flores regency work not only as farmers but also as traditional fishermen. Recently, environmental damage as the effect of farming and plantation has been experienced by the locals. In regard to that problem, alternative efforts for marine culture are needed. Hading Bay water has marine resources and could be utilized as mariculture sites. Protected sites 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(Ismail, 2002), (Hartoko and Kangkan, 2009). 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.

- *Dominikus K. da CostaStudent of Universitas Brawijaya Malang, Marine Science and Fishery Faculty*
- *Mohammad M andBambang SLecturersMarine Science and Fishery Faculty Universitas Brawijaya Malang.*
- *Universitas Brawijaya Malang, Marine Science and Fishery Faculty. Email : dacosta_yanto@yahoo.co.id*

2. Method

2.1.Location and Time

The study was conducted in Hading Bay, Lewolema District, East Flores Regency in March 2015. Water quality measurement was done from 06.00 to 18.00Central Indonesia Time (WITA), and performed twice in a week for 45 days adjusted with the average cultivation period. Samples which can be measured directly were done on site, while samples which needed analysis were brought to Oceanography Laboratory of Nusa Cendana University, Kupang. The locations were in three stations, station A, B and C. Water analysis was performed in 37 points of the bay. The map of locations can be seen in Figure 1 below.

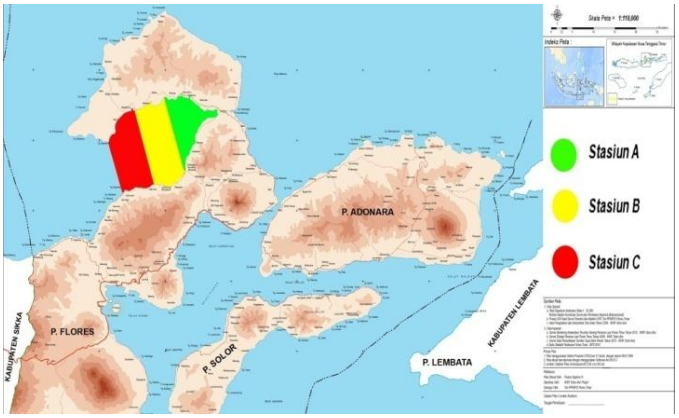

Figure 1. *Map of locations of the study.*

2.2. Procedure of the Study

The results of water quality parameter were analyzed in tables and adjusted to water quality standards then they were calculated along with the suitability measurement to determine the feasibility of the water territory for seaweed maricultureand to know the extent of the feasible area for the seaweed mariculture development. The study used three observation stations; station A, B and C. 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. (Sugiyonoand Alfabeta, 2008). Coordinates determination used random method(vertical and horizontal) sampling which the distribution represents all locations of the study. Sampling location was determined during the initial survey before going to the sites and it was based on certain consideration such as the reachable sampling points, time and cost efficiency. Water quality aspects analyzed in the study were temperature, depth, water current, transparency, turbidity, salinity, pH, Do, tidal current, nitrate, phosphate, COD and BOD.

3. Results

3.1. 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 temperature ranged 25 - 31^{o}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.pHranged 6 – 8.0. DOranged 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. Tidal current ranged 3 – 6 m. Map of water quality analysis results can be seen below.

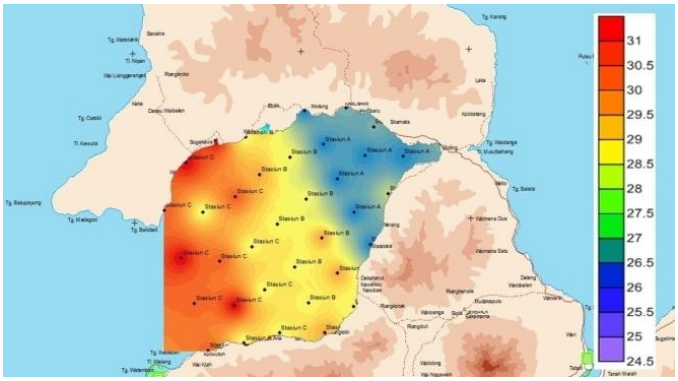

Figure 2.*Temperature range.*

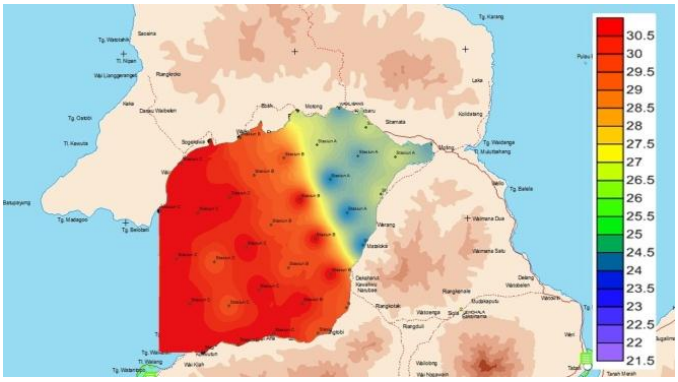

Figure3. *Salinity range.*

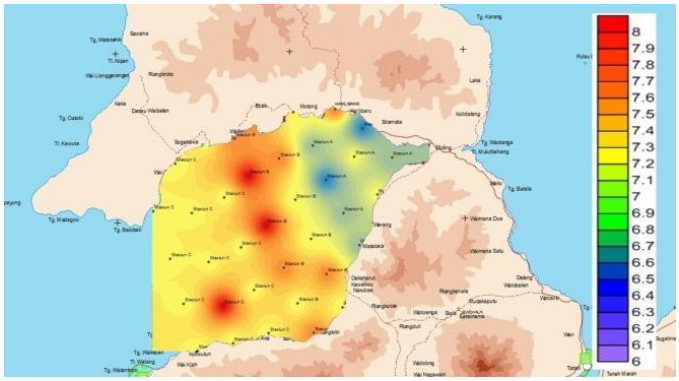

Figure4. *pH range.*

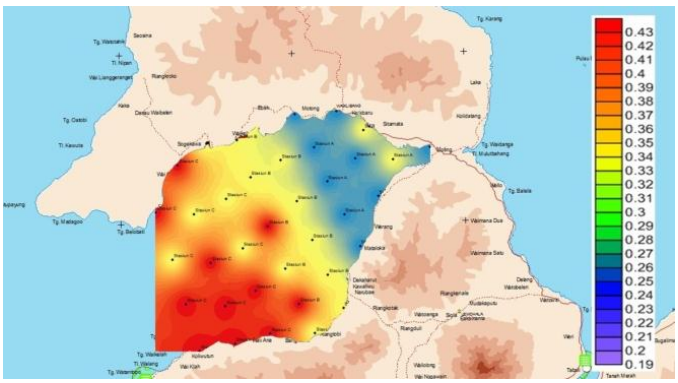

Figure5. *Current range.*

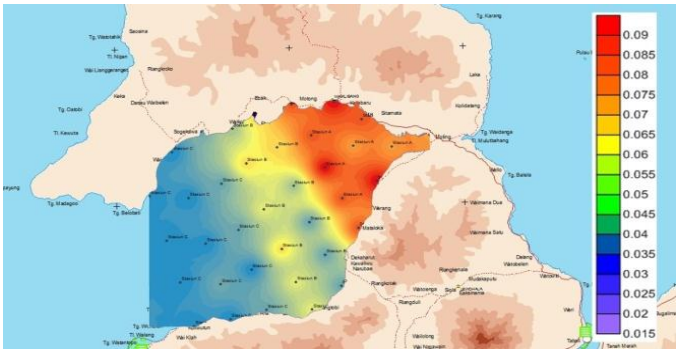

Figure6. *Phospate range.*

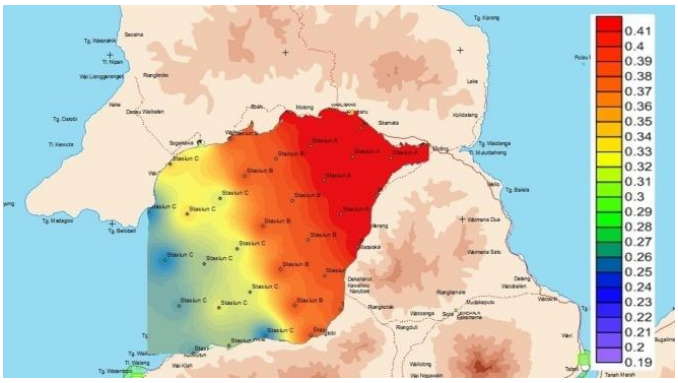

Figure7.*Nitrate range.*

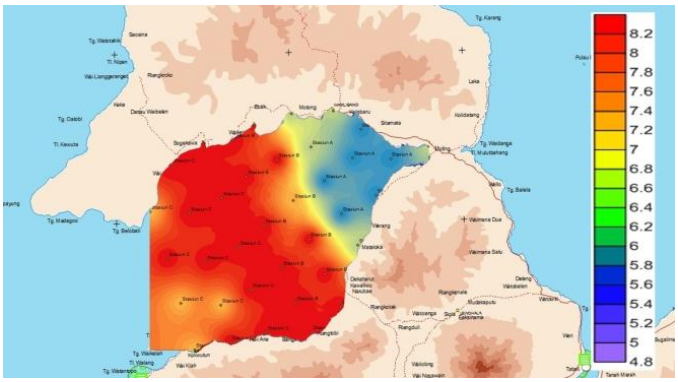

Figure8. *DO range.*

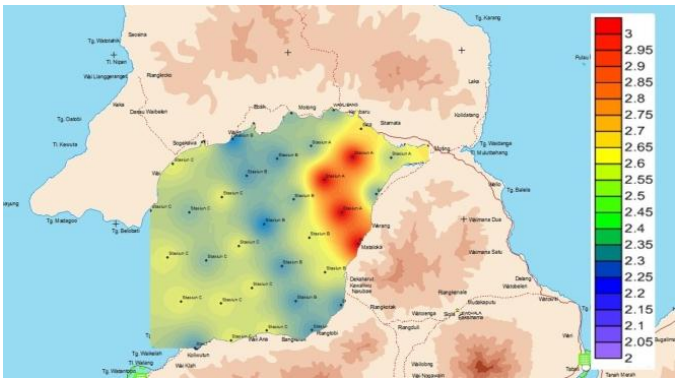

Figure9. *BDO range.*

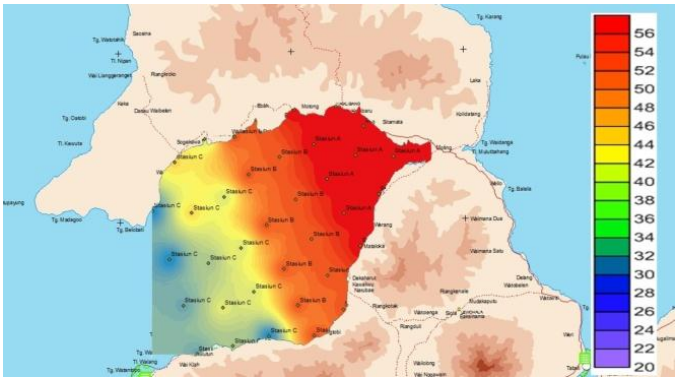

Figure10. *COD range.*

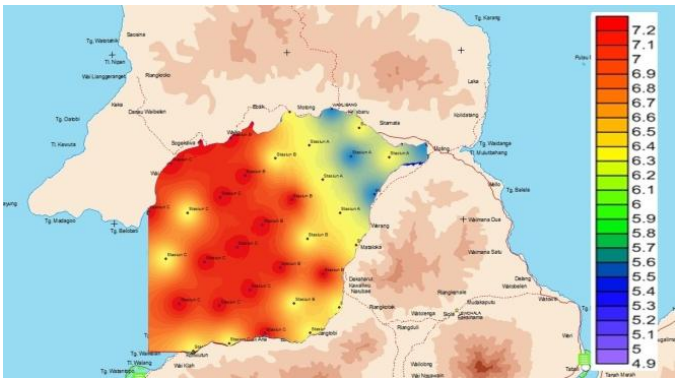

Figure11.*Transparency range.*

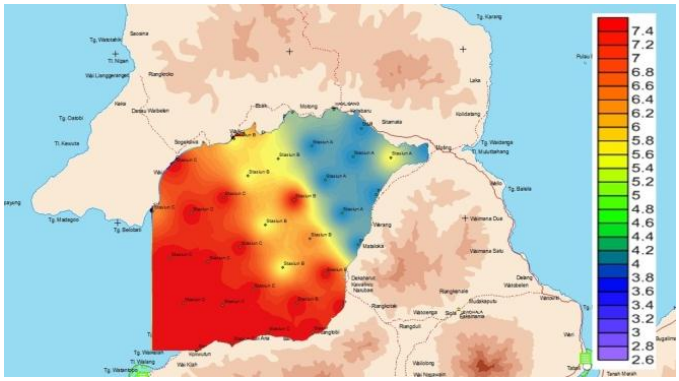

Figure12. *Depth range.*

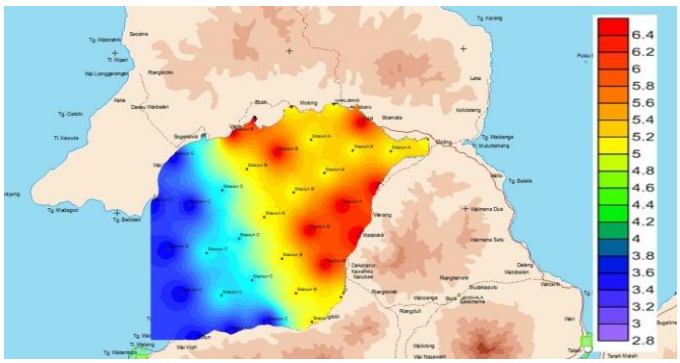

Figure13.*Tidal current range.*

3.2. Hading Bay Territorial Topography.

Based on visual observations of bottom water condition on

three sites, sandy reef substrate was seen. Bottom water substrate in Hading Bay 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.

3.3. Territorial Capacity of Effective Seaweed Mariculture

Based on the survey results and area extent calculation, Hading Bay area is 864,676 ha with each site of study area; A. 135,345 ha, B. 474,222 ha and C. 255,108 ha. From that extended area of Hading Bay, area with marine potentials on category S1 and S2 was 864,676 hawhich was the area of site A, B and C. Considering the area extent and the effective distance for each mariculture unit, then acquired capacity of the territory for seaweed mariculture with long line method was 99% from the total area of Hading Bay.

3.4. Area Support Capability for Seaweed Mariculture.

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.

3.5. Seaweed Mariculture Units

In this study, one unit seaweed mariculture with long line method was 50 x 50 m, if it was converted into hectare then it was 0.25 ha/unit. Considering the effective mariculture area in Hading Bay which was in category S1 and S2 and the extent of long line method then we can acquire the support capability in Hading Bay for seaweed mariculture. By calculating the support capability (ha) and the number of unit (unit/ha), then we acquire 194,552 units of seaweed mariculture.

3.6. Mapping of territorial feasibility for seaweed mariculture.

The making of suitability map for seaweed mariculture in Hading Bay was done using software *ArcGIS* 10.1 and*Surfer v10.1.561*with kriging and overlay method. Maps used in the study were in the form of shapfiles (SHP) of East Flores regency. From water quality analysis and the areal extent of Hading Bay showed that its location has effective feasibility value for seaweed mariculture. Location feasibility map for seaweed mariculture was made based on water suitability evaluation (National Coordinating Agency for Surveys and Mapping (Bakosurtanal), 1996) where the class range for very suitable (S1) = 150 -165, suitable (S2) = 135 – 150, suitable with conditions (S3) = 120 – 135 and not suitable (TS) = < 120. Hading Bay water territory showed that the location had feasibility level S1 and S2. S1 level was in site B and C with feasibility score 165 while S2 level was in site A with feasibility score 149.From the study results feasibility maps could be made for *K. alvarezii*seaweed mariculture.It can be seen in Figure 14 below.

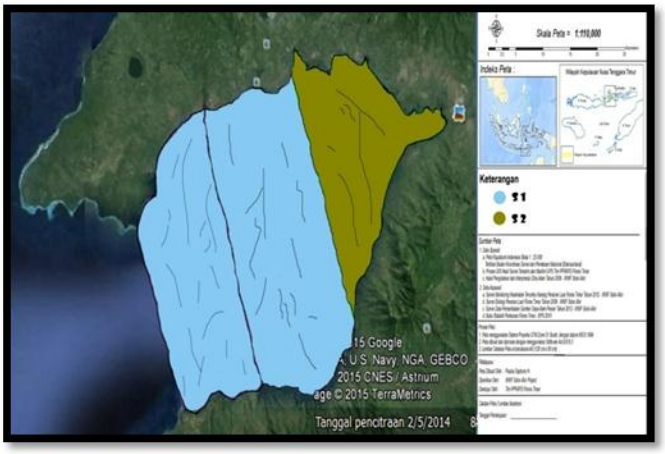

Figure 14.*Hading Bay Feasibility Map.*

4. Conclusion

Hading Bay has feasible support capability for *Kapaphycus alvarezii* seaweed mariculture locations. Site A was categorized in feasibility level S2, site B and C were categorized in feasibility level S1.

5. Acknowledgement

Gratitudes to Universitas Brawijaya Malang, Marine Science and Fishery Faculty, Universitas 45 Makassar and Hendrikus Leven Foundation which always support so the writer can finish this final task.

REFERENCES

[1] Aslan, L. M., 1991, BudidayaRumputLaut, Kanisius, Yogyakarta.

[2] Bakosurtanal. 1996. Pengembangan Prototipe Wilayah Pesisir dan Marin Kupang-Nusa Tenggara Timur. Pusat Bina Aplikasi Inderaja dan SistemInformasi Geografis, Cibinong.

[3] Boyd, C. E. And F. Lichtkoppler. 1982. Water Quality Management in Pond Fish Culture. Auburn University, Auburn.

[4] Budiyanto, Eko , 2002, Sistem Informasi Geografis Menggunakan ArcView GIS, Andi, Yogyakarta.

[5] Dahuri, R. 2003. Keanekaragaman Hayati Laut ; Aset Pembangunan Berkelanjutan. Penerbit PT. Gramedia Pustaka Utama, Jakarta.

[6] Doty, M.S., 1988. The production and Use of Euchema in Case Studies of Seven Comersial Seaweed Resources.In Doty, M.S.Caddy, J.F., Santellices, B. (ED). FAO Thecnical Paper No. 281. Rome.

[7] Hartoko and Kangkan. 2009. Spatial Modeling for

Mariculture Site Selection Based on Ecosystem Parameters at Kupang Bay, East Nusa Tenggara, Indonesia.

[8] Ismail W.E. Pertiwi, Wedjatmiko, E. Savitri, Suwidah, dan A. Wijono. 2002. Analisis Kebijakan Pembangunan Usaha Budidaya Laut dalam Haruwati et.al. (eds) Analisis Kebijakan Pembangunan Perikanan. Pusat Riset pengelolaan produk dan Sosisal Ekonomi Kelautan dan Perikanan. P. 1-20.

[9] Kangkan, Alex, L. 2009. StudipenentuanlokasiuntukpengembanganbudidayaLautberdasarkan parameter fisika, kimiadanbiologi Di teluk Kupang, Nusa Tenggara Timur. Program PascasarjanaUniversitasDiponegoro. Semarang.

[10] Khan, S.I., and Satam, S.B. 2003. Seaweed Mariculture. Scope and Potential in India.Aquaculture Asia.Vol. VIII No. 4. pp. 26-29.

[11] Largo, DB.,Fukami, K., and Nishijima, T. 1995. Occasional Pathogenic Bacteria Promoting ice-ice Disease in The Carrageenan-Producing Red Algae Kappaphycusalvarezii and Eucheumadenticulatum (Solieriaceae, Gigartinales, Rhodophyta). Journal of Applied Phyciology 7: 545-554.

[12] Meneses I. 1996. Sources of morphological variation in populations of Gracilaria chilensis Bird, McLachlan & Oliveira of Chile.Revista Chilena de Historia Natural. 6: 35-44.

[13] Morain, S. 1999. GIS Solution in Natural Resource Management: Blancing the Technical-Political Equation. On Word Press USA, 361 pp.

[14] Munuz, J., Pelegrin, Y.F., and Robledo, D. 2004. Mariculture of Kappaphycusalvarezii(Rhodophyta, Solieriaceae) Color Strains in Tropical Waters of Yucatan, Mexico. Aquaculture 239 (2004) 161-177.

[15] Radiarta, I N., Saputra, A., dan Prino, B. 2004. Pemetaan kelayakan Lahan untuk Pengembangan Usaha BudidayaRumput Laut di Teluk Saleh, Nusa Tenggara Barat. J, Pen. Perik. Indonesia, 10 (5): 19-32.

[16] Samad, Firmansyah. 2011. AnalisiskesesuaianlahanbudidayarumputLautmenggunakanpenginderaanjauhdan SIG di tamannasionalkarimunjawa.

[17] Standar Nasional Indonesia . 2010. Produksi rumput laut kotoni (Eucheuma cottoni) – Bagian 2: Metode Long-line. Badan Standarisasi Nasional. SNI : 7579.2:2010.

[18] Sugiyono dan Alfabeta, 2008) Metode Penelitian Kuantitatif, Kualitatif.Bandung.