Nigerian Journal of Fisheries and Aquaculture 3(1&2): 13 – 21, 2015

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Available on line: http://www.unimaid.edu.ng
ISSN-2350-1537

Feasibility Study on the Seaweed *Kappaphycus alvarezii* Cultivation Site in Indari Waters of West Bacan District, South Halmahera Regency, North Moluccas Provinces, Indonesia

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Received March 15, 2015 Accepted April 21, 2054

ABSTRACT

The aim of this research was to observe the feasibility of seaweed *K. alvarezii* cultivation site based on the physico, chemical and biological parameters in Indari waters in West Bacan district, South Halmahera Regency in North Mollucas Provinces Indonesia. The calculation of physico-chemical parameters towards the depth, clarity, flow velocity, temperature, pH, salinity, dissolved oxygen, and water sample for analysis on nitrate, phosphate, and the abundance of phytoplankton were conducted in rainy season and dry season. The measurement of temperature, pH, salinity, and dissolved oxygen by used water checker. The depth waters used depth meter and clarity used *secchi disc*. The analysis on nitrate was conducted by applying salicylate method, and the analysis on phosphorous was by applying spectrophotometer by means of ascorbic acid. Meanwhile, the charge of suspended solids was calculated using gravimetric method, and calculation of phytoplankton was conducted using filtration method. Furthermore, the feasibility study on site was conducted using a set of Geographic Information System (GIS) of *Arc View 3.3*. The procedure of the assessment of feasibility level of seaweed *K. alvarezii* cultivation site was conducted using the feasibility and weighting matrixes. The results of the research showed that all physico-chemical parameters of waters, except biological parameter (abundance of phytoplankton), were feasible to support the seaweed *K. alvrezii* cultivation. As shown from the result of the feasibility study on the seaweed *K. alvarezii* cultivation site, the potential site in the rainy season was at 47,975.80 m^2 (4.79 ha) and in dry season wasat 68,355.64 m^2.

Keywords: Feasibility, physico-chemical parameters, seaweed cultivation, North Moluccas

INTRODUCTION

Kappaphycus alvarezii is a species of seaweed as one of the most important sources of carrageenan, food sources for humans. It contains some mineral elements such as Ca, K, Mg, Na, Cu, Fe, and Mn (Trono, 1992). Its capability to produce carrageenan has been used in food, drugs, cosmetics, textiles, paint, tooth paste and other industries. This then shows that seaweed *K. alvarezii* is an economic commodity that has a commercial value (Sievanena *et al*., 2005).

Site feasibility refers to adaptability of a site for certain purpose through value determination (class) of a site and the pattern of land use correlated to the its potentials in its region. The objective of this is for a more directed land use along with the attempts to maintain its sustainability (Hardjowigeno and Widiatmaka, 2007). The evaluation of site feasibility is a systematic evaluation of a site by grouping it into a number of catergories based on the equality of its characteristics and quality that can influence its feasibility for a business and for certain purpose. For the purpose of the coastal area development targeted to determine the site feasibility for the business of fishery cultivation, the classification of its site feasibility is targeted to reduce or prevent any negative impacts that might arise and to guarantee the optimal, integrated, and sustainable development of business activity both in ecological and economical perspective (Winarsih, 2008). South Halmahera Regency has a land area of 40,263.72 km^2, comprising of the mainland of 8,779.32 km^2 (22%) and marine of 31,484.40 km^2 (78%) and coastline of around 2.384.40 km^2 (DKP of South Halmahera, 2011). Indari Village in West Bacan district is one of regions of South Halmahera Regency that has quite a great potential of seaweed cultivation development. In this region, the seaweed cultivation has been being run well but not with optimal use.

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This is due to a number of problems in seaweed cultivation development such as the low level of human resources (seaweed cultivators) in that area, traditional method applied in most of cultivations in which technical requirements (i.e. unsuitable selection of location and the inaccurate handling in post-harvest time) are not paid well. In addition to that, the production of seaweed so far is still obtained from nature and has not achieved the expected standard. Frequently, the cultivation production or the number of production achieved fluctuates both in wet or dried productions.

To cope with those problems on purpose to realize the sustainability of the seaweed cultivation activity in Indari waters of West Bacan district, evaluation on any factors to support the achievement of seaweed cultivation itself is necessary. One of the factors is site environment as an important factor in determining the achievement of the seaweed cultivation. This research is designed to observe the feasibility of *K. alvarezii* seaweed cultivation site in the waters of Indari in West Bacan District, South Halmahera Regency.

MATERIALS AND METHODS

This research was conducted in Indari waters in West Bacan district in South Halmahera Regency of North Mollucas Provinces. The observation of water quality was conducted in rainy season and dry season. The observation points of water quality were taken in 8 locations in accordance with the objective (*purposive*), including 4 observation points inside seaweed cultivation site, and other 4 points outside seaweed cultivation site. To determine the observation points, *Global Positioning System* (GPS) was used and to determine the season, the data taken from BMG (*Meteorology and Geophysic Agency*) of South Halmahera Regency was used.

The physico-chemical parameters such as temperature, pH, dissolved oxygen, flow velocity, clarity, and water depth were measured *in situ* each observation point in rainy season and dry season. Water sample for analysis of nitrate, phosphate, phytoplankton, and the charge of suspended solid was taken using *water sampler* with the volume of 2.5 liters. Meanwhile, the collection of the species of fish and aquatic plants was done by means of iron quadrat (1x1 m^2) and fishing gills net (2.5 inch). Nitrate analysis was performed using salicylate method; phosphorous analysis was performed using spectrophotometer to determine ascorbic acid. The charge of suspended solids and phytoplankton were performed using gravimetri method, and filtration method, respectively. The analysis on feasibility of site was done by means of a set of Geographic Information System (GIS) using software of *ArcView 3.3*. The procedure for assessing the level of feasibility of seaweed *K. alvarezii* cultivation site covered 2 methods: (1) Feasibility matrix (table 1); (2) Weighting and Rating (Mansyur, 2008; Ariyati *et al*., 2007; Pongmasak *et al*., 2010).

Table 1.Matrix of weight and score of each parameter of feasibility for seaweed cultivation site using *Long line* method

No.	**Criteria**	**Weight (g)**	**Feasibility Class (Score)**		
			S1(3)	**S2(2)**	**N(1)**
1	Depth (m)	15	2 - 10	1 - < 2 ; >10 - < 30	< 1 ; > 30
2	Flow Velocity (cm/sec)	15	20 – 30	31 – 34	< 20 and> 40
3	Clarity (m)	10	> 3	1 – 3	< 1
4	Nitrate (mg/l)	5	0.9 – 3.0	0.1 - < 0.9 ; > 3.0 – 3.5	< 0.1 ; > 3.5
5	Phosphate (mg/l)	5	0.02 – 1.00	0.01 - < 0.02 ; > 1.00 – 2,00	< 0.01 ; > 2.00
6	Temperature (°C)	5	27 – 30	25 – < 27 or > 30 – 32	< 25 or> 32
7	Salinity ($^{o}/_{oo}$)	5	32 – 34	28 – 31	< 28 and> 34
8	Basic Substrate	10	Sand, coral fraction and oral	Sand with little mud	Mud
9	pH	5	7.0 – 8.5	6.5 – < 7.0	< 6.5 ; > 8.5
10	TSS (mg/l)	5	< 25	26 – 50	> 50
11	Dissolved O_2 (mg/l)	5	> 4	2 – 4	< 2
12	Phytoplankton Abundance ind/liter)	5	15.00and< $5x10^5$	2.00– 15.00 and $5x10^5$ – 10^6	< 2.00 and> 10^6

13	Fish Species	5	Not exist	Less	Many
14	Aquatic Plants	5	Exist	Less	Nothing

Source: Modification from: Pramono *et al.* (2005), Wijaya (2007) Aziz (2011) Kangkan *et al.* (2006) Ariyati *et al.* (2007) Mansyur (2008) and (Pongmasak *et al*., 2010).

RESULTS AND DISCUSSION

Feasibility of physical, chemical and biological parameters in waters based on season

Table 2 presents the observation results on the physical, chemical and biological parameters in the waters in rainy season (May, July, and December) and dry season (September, October, and November). As seen in Table 1, the depth of waters in rainy season was in the range of 10 – 18.5 m with the averaged value of 13.98 m. Meanwhile, in dry season, it ranged from11.45 to 16.15 m with the averaged value of 14.39m.

Table 2. The Values Range of Physical, Chemical, and Biological Parameters of Waters in Rainy Season and Dry Season

Physical Parameter	**Rainy Season**		**Dry Season**	
	Range	**Average**	**Range**	**Average**
Depth (m)	10-18.5	13.98	11.45-16.5	14.39
Clarity (m)	8.25-12	10.33	9.8-11.15	13.06
Flow velocity (cm/sec)	21.42-29.41	24.35	20.9-28.98	24.41
Temperature (ºC)	28.1-30	29.40	29-30	29.8
TSS (mg/l)	9.5-106.9	40.06	5.6-168.7	64.87
Substrate	coral sand	muddy sand	coral sand	muddy sand
Chemical Parameters				
pH	6.7-6.9	6.84	7-7.3	7.12
Salinity (‰)	32-33	32.58	34-35	34.54
Dissolved O_2 mg/l	4.1-5.5	4.68	5-5.8	5.37
Nitrate (mg/l)	0.066	0.066	0.066	0.066
Phosphate (mg/l)	0.02-0.052	0.027	0.02-0.502	0.059
Biological Parameter				
Phytoplankton (ind/l)	2.5-34.5	31.77	11.5-42.5	48.36

The depth was correlated to the penetration of sunlight to the waters for the seaweed growth. Utojo *et al*. (2004) stated that the waters depth for aquaculture is in the range of 7 – 30 m, and for the seaweed *K. alvarezii* cultivation with the *long line* method; it is more than 2 m (Tuhumury, 2011). The waters depth feasible for *K. alvarezii* cultivation is in the range of 1-7 m (DKP, 2009). A depth less than 1 m, in contrast, can increase the temperature, particularly in the low tide during the day. Meanwhile, the depth above 7 m can make the installation of cultivation facilities difficult and can increase the production cost. Kangkan *et al*. (2006) found that the waters depth between 5-25 m can still be feasible for the seaweed cultivation.

The clarity of waters was found in the range of 8-12.5 m with the averaged value of 10.33 m in rainy season and 9.8-11.5 m with the average of 13.06 in dry season. This then showed a difference in the clarity value, which was higher in dry season compared to the ones in rainy season. This difference was determined by the intensity of sunlight penetrating the waters since the condition of the waters was clear – not being contaminated by the good condition of coral reef. Gundo *et al*. (2011) stated that the clarity of sea waters is correlated to what extent the sunlight needed for the photosynthesis can penetrate the waters. The seaweed cultivation needs waters with high clarity due to the sunlight energy penetrating the waters needed in the process of photosynthesis (Kangkan *et al*., 2006).

Flow velocity is one of the essential factors influencing the growth of the seaweed, indirectly preventing the significant increase of pH and temperature and playing a role in the gas exchange in water column (Effendi, 2000). Sea flow also has a significant impact on the nutrient transportation and water stirring; thus, bringing an impact on the acceleration of *K. alvarezii* (Farid, 2008). It was found from the calculation that flow velocity in rainy season was at 21.42-29.41 cm/sec with the average of 24.35 cm/sec and the one in dry season was at 20.9-28.98 cm/sec with the average of 24.41 cm/sec. At this, the flow velocity obtained in both two seasons did not show any significant difference but was still considered feasible for the seaweed cultivation since both of them could make the seaweed grow well with the stable cultivation.

Kadi and Atmadja (1988) stated that a good flow velocity for the cultivation of *K. alvarezii* was in the range of 20-40 cm/sec. A too strong flow, in contrast, could break the seaweed and damage the spread; while the flow that is too slow can lead the seaweed to lack of nutrient needed for the growth and can cause any waste and disturbing organism (pest) easy to adhere. The disturbing organism or pest can ingest the seaweed or compete in the use of nutrient. Meanwhile, the waste adhered could make the process of photosynthesis not optimal as it hinders the sunlight to penetrate until the *thallus* (Aziz 2011). The flow velocity also functions to homogenize the water mass to prevent the fluctuation of salinity, temperature, pH and dissolved substances (Amin *et al*., 2005).

Meanwhile, based on the parameter of temperature, it was found that the in rainy season temperature was in the range of 28.1-30ºC with the average of 29.40ºC and in dry season, the temperature was in the range of 29-30ºC with the average of 29.8ºC.The temperature obtained both seasons anyway did not show any significant fluctuation and both are relatively stable. Such condition occurred since the observation po/int was located in the sea waters with some similarities – particularly in terms of spread towards the sunlight as the impact of high clarity (reaching the see floor). The different temperatures were caused by the differences in sunlight energy absorbed by the waters. The temperature increased in the increase of the sunlight energy entering into the waters. This then could increase the acceleration of the photosynthetic process until certain radiation levels (Lobban and Harisson, 1997). Munoz *et al*., (2004) explained that the maximal flow of photosynthesis for *K. alvarezii* was at the temperature of 30ºC. In contrast, the temperature above 32ºC could hinder photosynthetic activity.

Radiarta *et al*. (2004) stated that the water temperature for the seaweed cultivation was in the range of 20-28ºC. In another study, Fatmawaty (1998) stated that the water temperature at around 28-31ºC was still feasible for the seaweed *K. alvarezii* cultivation. The seaweed can grow well in an area with the range of temperature of 26-33°C (Tuhumury, 2011). Farid (2008) stated that the water temperature feasible for the growth of *K. alvarezii* seaweed is the range of 27-30ºC. An optimal temperature is able to increase the process of nutrient absorption; thus, accelerating the growth of seaweed in as much as it can make the metabolism easy (Effendi, 2000). The water temperature obtained was still in the range feasible for the seaweed *K. alvarezii* cultivation.

The content of TSS obtained in rainy season was in the range of 9.5-106.9 mg/l with the average of 40.06 mg/l, and in dry season it was in the range of 5.6-168. 7 mg/l with the average of 64.87 mg/l. TSS refers to the suspended substances within the water. The higher the value of the charge content suspended in water, the more hindered the physico-chemical process in waters (Arthana, 2006). Furthermore, Sediadi and Edward (1999) stated that the highly suspended substance content can hinder the sunlight penetration to the sea; then it can lead the photosynthesis process to run ineffectively. This condition, as a result, can decrease the production of organic substances and oxygen. The high value of TSS commonly found in the location close to the area of prawn pond, lower course, or muddy beach is potential to make the water easily muddy in the occurrence of flood and big wave. In line with this statement, it was assumed that the high content of TSS that was partially obtained was caused by the observation point influenced by the muddy substrate and sandy substrate that were easily spread to the water surface in the strong water motion.

The TSS content in waters expected for the mariculture is less than 20 mg/l and the one allowed is less than 80 mg/l (Sulma *et al*., 2005). In line with the statement, the average of the TSS content obtained in the research location both in rainy and dry season was still allowed thus still possible to support the growth of seaweed *K. alvarezii*. The substrate in the seabed in the research site consisted of coral and sandy substrate, and muddy and sandy substrate in which the coral and sandy substrate was so dominant. Such condition of the substrate was considered suitable still for the life of seaweed *K. alvarezii*. The condition of seabed that consists of coral fractions, coarse sand, seaweed and coral reef is viewed suitable for the cultivation of seaweed *K. alvarezii* in which this condition comes to be an evidence of the existence of good water motion (DKP, 2009). Sediadi and Budihardjo (2000) explained that the condition of the substrate that consists of coral sand, fragment coral (rubble) is very good for the growth of seaweed *K. alvarezii* as it has a good water motion. The rubble substrate is useful to reduce the waste risk occurred in seabed that is caused by a relatively high flow rate. The type of substrate in the form of coarse sand and rubble is an indicator for the relatively high flow rate; meanwhile, the muddy seabed commonly has a low flow rate (Gundo *et al*., 2011)

Of the other factors, pH is an essential factor for the life of seaweed. The result from calculating pH (Table 2) showed that the value of pH in rainy season was between 6.7-6.9 with the average of 6.84 and in dry season, the value was in the range of 7-7.3 with the average of 7.12. However, as a whole, the value of pH obtained in both rainy and dry season experienced a relatively little change as the waters had a buffer system towards the drastic change of ion; thus, the pH value obtained was still suitable to support the cultivation of *K. alvarezii*. Seaweed requires a typical pH for its life (Munoz *et al*., 2004). It commonly grows in the pH of 6-9 (Tuhumury, 2011). Sediadi and Budihardjo (2000) stated that the pH requirement for seaweed cultivation is around 6-9 with the optimal value in the range of 7.5-8.0. As stated by Farid (2008), the range of pH for *K. alvarezii* is 7.3-8.2. Seaweed *K. alvarezii* requires an optimal pH for its growth in the range of 7-9 with the optimum range of 7.3-8.2 (Aziz, 2011; Zatnika and Angkasa, 1994).

Further, salinity is one of the core factors influencing the seaweed growth. The result of the calculation towards salinity (Table 2) showed that the value of salinity in rainy season ranged from 32-33‰ with the average of 32.58‰, and in dry season, it ranged from 34-35‰ with the average of 34.54‰. The high salinity was caused by the absence of the lower course around the cultivation site; therefore, no flow of fresh water entered to the sea waters. This condition then led the condition of salinity to be unchanged - even with the rainfall. According to Nontji (1987), the spread of salinity is highly influenced by a number of factors such as the pattern of water circulation, evaporation, rainfall, and water flow. The high salinity occurs if the rainfall in waters is insufficient; then producing the high evaporation. Conversely, in high rainfall, the evaporation will be decreased and the salinity is to be lowered. If the salinity is low, far below its limits of tolerance, the seaweed will be sallow, prone to be broken and soft, and finally decayed (Aziz, 2011). Arisandi *et al*. (2011) stated that the parameter of water quality playing a very essential role for the growth and the morphogenetic development of seaweed is salinity. It is because salinity is directly related to the osmo-regulation occurred in cells. The different concentrate between the liquid inside and outside the cell will stimulate the golgi body to keep on balancing until becoming isotones. This then brings an impact on the higher use of energy and in turn makes the growth and development of seaweed low. Salinity required by seaweed *K. alvarezii* is from 29-34 ppt Dawes (1985), 28-35 ppt DKP (2009), 33-35‰ Arfah and Papalia (2008), 30-34 ppt (Kadi and Atmadja, 1988), 18-35% (Farid, 2008). Thus, the salinity obtained in both rainy season and dry season is still suitable for the life of seaweed *K. alvarezii*.

Further, the result of calculation showed that the dissolved oxygen content was in the range of 4.1-5.5, mg/l with the average of 4.68 mg/lin rainy season and in the range of 5-5.8 mg/l with the average of 5.37 mg/l in the dry season. This difference occurred due to the different water motion in each observation point in which the water motion in dry season was higher and made the value of dissolved oxygen content higher than that of rainy season. As stated by Radiarta *et al*. (2004) the content of dissolved oxygen recommended in the activity of water cultivation is > 5 mg/l. When the dissolved oxygen content at waters is lower than 5.5 ppm, it then can indicate a disturbance in the waters for the increase of the temperature at day and the respiration of water organisms at night due to the oil layer on the sea surface and the coming of organic waste easily decomposed to environment (Fatmawaty *et al*., 1998).

Seaweed can grow well in waters with the dissolved oxygen content ranging from 3-8 ppm Ariyati *et al*. (2007), and > 4 ppm (Pongmasak *et al*., 2010). According to Zatnika (2009), the content of dissolved oxygen for the cultivation of seaweed *K. alvarezii* is 4.8-6.2 mg/l. For its good growth, seaweed should have the content of dissolved oxygen in the range of 4, 5-9, 8 ppm (Gundo *et al*., 2011). In turn, the result obtained from the calculation of dissolved oxygen was still feasible for the of the seaweed *K. alvarezii* cultivation

The result of analysis on nitrate in each site both in rainy season and dry season (Table 2) showed that it was found the average value of 0.066 mg/l. This nitrate content is categorized to be low to fulfil the need of cultivation of seaweed *K. alvarezii* if compared to the ones obtained by Fatmawaty *et al*. (1998) ranging from 0.1-0.4 mg/l, 0.2525-0.6645 mg/l (Fattah *et al.,* 2008), and by Ariyati *et al*. (2007) ranging from 1.091-1.311 mg/l. The low content of nitrate in the research site was related to the unavailability of the lower course in which in the rain no any supply of nitrate from the land would be brought by river flow to the sea or nearby the location of the seaweed cultivation. For this reason, the content of the nitrate obtained can be categorized as the nitrate content of natural waters. This is in line with what Effendi (2000) stated that the level of nitrate-nitrogen in natural waters is never above 0,1 mg/1; however, if the level of nitrate is above 0.2 mg/1, it can cause *eutrophication* (rich in nutrient) and then support the very rapid growth of algae and aquatic plants.

Nitrate refers to one of nutrients highly needed by seaweed. Insufficiency of it in waters means the hindrance of growth, metabolism and reproduction (Lobban and Harisson, 1997). Gundo *et al*. (2011) observed that the nitrate content around 0.004-0.002 ppm is still feasible the seaweed cultivation. In this research, based on the nitrate content obtained in the rainy season and dry season at research site, it was found that the waters is quite productive to support the cultivation of seaweed *K. alvarezii*.

The important parameters act as the nutrient element for the growth of the seaweed. From the analysis on phosphate as seen Table 2, it was found that it ranged from 0.02-0.052 mg/l with the average of 0.027 mg/l in rainy season and ranged from 0.02-0.502 mg/l with the average of 0.059 mg/l in dry season. The content of phosphate suitable for the seaweed *K. alvarezii* is 0.01-0.051 mg/l Fatmawaty *et al*. (1998), and 0.081-0.0435 mg/l (Ariyati *et al*., 2007). Effendi (2000) stated that in waters the phosphate content of 0,021- 0,050 mg/l has a sufficient fertility and the one of 0.051-0.1 mg/l has a good one. Being in line with the statement, the phosphate content obtained can still be suitable for the growth of seaweed. Frequently found in insignificant amount in sea waters, phosphate also comes to be a limiting factor for seaweed. The deficiency of phosphate in seaweed can cause the accumulation of fat in significant number in cells (Kushartono *et al*., 2009). Based on the opinion above, from the value of phosphate content obtained in rainy season and dry season at research site, it was then observed that the waters can be categorized as the one that is quite fertile to support the cultivation of seaweed *K. alvarezii*.

The abundance of phytoplankton was used to observe the number of organism in waters. From the analysis, it was found that the abundance of phytoplankton (Table 1) in rainy season was in the range of 2.5-345 ind/l with the average of 31.77 ind/l. Meanwhile, in dry season, it was found in the range of 11.5-42.5 ind/l with the average of 48.36 ind/l with the domination of *Synedra fulgena*. It was also found that the value of phytoplankton abundance in dry season was, in general, higher. This was related to the intensity of the sunlight used by phytoplankton for photosynthesis. Phytoplankton, as its existence is not directly related to the seaweed, can be viewed as the tertiary variable. However, phytoplankton is able to act as the constituent of fertility of waters, the buffer of water quality and the base in food chain at waters or primary producer.

In this research, the abundance of phytoplankton was lower than that obtained by Kangkan *et al*. (2006) at the waters of Teluk Kupang reaching 106760-210380 cells/l with the average of 149935 cells/l; Utojo *et al*. (2004) in Dompu, West Nusa Tenggara reaching at 45-750 ind/l. This then show that the abundance of phytoplankton in the research site both in rainy season and dry season is able to support the cultivation of seaweed *K. alvarezii*. The species of fish and aquatic plants found in and around the research sites is presented in Table 2.

Table 3. The Discovered Species of Fish and Aquatic plants

Species of Fish	**Aquatic Plants**
Beronang (*Siganus* spp)	Lamun *Enhalus accoroides*
Tanda-tanda (*Lutjanus* sp)	*Gracillaria salicornia*
Pisang-pisang (*Caesio* sp)	*Eucheuma spinosum*
Kuweh (*Caranx sexfasciatus*)	*Codium edule*
Lencam (*Lethrinus* sp)	*Halimeda opuntia*
	Halimeda macroloba
	Padina australis
	Turbinaria ornata
	Sargassum polycystum

Total: Species of fish = 5 ind ; Aquatic plants = 9 ind

As shown in Table 2, of the species of fish caught in and around the research site (Indari), there was a species of fish called as *Beronang* (*Siganus* spp) categorized as a predator to seaweed since it frequently ate the seaweed. Meanwhile, other species of fish were the species commonly staying or living in the area of coral reefs or around coral substrate. In this research, 9 species of aquatic plants were found including Lamun from the species of *Enhalus accoroides*, *Red Algae* from the species of *Gracillaria salicornia*, *Codium edule,* and *Eucheuma spinosum*, Green Algae from the species of *Halimeda opuntia* and *Halimeda macroloba*, Brown Algae of the species *Padina australis*, *Turbinaria ornata*, and *Sargassum polycystum*. The existence of the species of aquatic plants becomes one of the indicators that the location of the waters is very suitable for the seaweed cultivation.

The feasibility study on seaweed *K. alvarezii* cultivation site in rainy season and dry season

The result of evaluation on the site feasibility for seaweed *K. alvarezii* with each feasibility category has identified a potential site of 47,975.80 m^2 in rainy season. From the total of site, two feasibility classes were found; one was for *Very Feasible* class (S1) with the area of 16,919.55 m^2 and another one was *Feasibl*e class (S2) with the area of 31,056.25m^2. In dry season, the potential site was found at 68,355.64 m^2. Based on the total of area, two criteria of feasibility class; i.e. Very Feasible class (S1) at 12,528.32 m^2 and Feasible class (S2) at 55,827.32 m^2. Figure 1 and Figure 2 present the site feasibility for the seaweed *K. alvarezii* cultivation at the Waters of Indari in accordance with season.

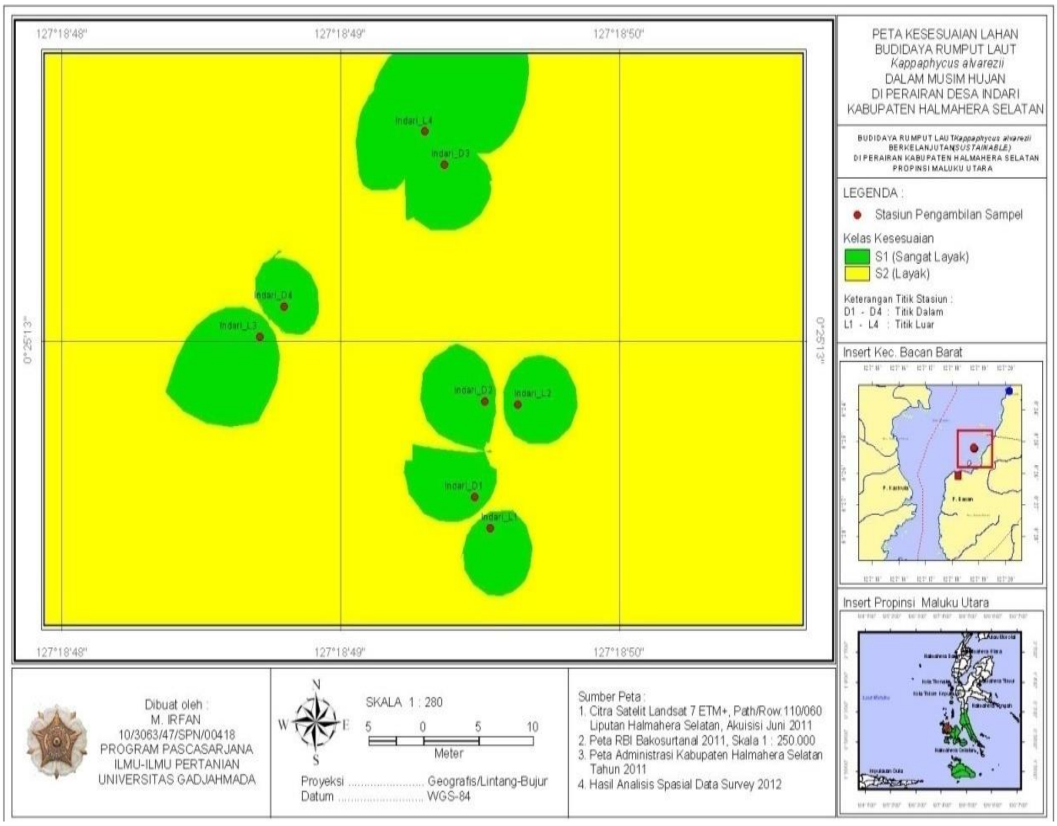

Fig. 1.Map of the Feasibility of Field for Seaweed *K.alvarezii* Cultivation in Dry Season

Conclusion

Based on the result of this research, it can be concluded that the physical parameters of waters (depth, flow velocity, temperature, TSS, and substrate of seabed) and chemical parameters of waters (pH, salinity, dissolved oxygen, nitrate, and phosphate) were still feasible to support the cultivation of seaweed *K. alvarezii*. In contrast, the biological parameter of waters (abundance of phytoplankton) was not feasible to support the cultivation of seaweed *K. alvarezii*. Two classes of feasibility of site for the cultivation of seaweed *K. alvarezii* were found; those are class S1 (very feasible) and class S2 (feasible) with the potential site in rainy season at 47,975.80 m^2, and in dry season at 68,355.64 m^2.

Acknowledgment

We thank PT MDF-Nuffic Fish-4 for funding the study. We also thank Abdullah Rumalean and Fajri Hamdjah who assisted in collecting the data in the research location.

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