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The Effectivity of Plantation Depth on Seaweed *Sargassum* sp. Growth Using Longline Method

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Abstract

Due to many benefits of seaweed *Sargassum* sp. makes no longer possible to harvest directly from the habitat, because it may cause disruption of equilibrium in marine ecosystems.One profitable method is longline method. This research objective is to determine the effect of different plantation depth on the growth of seaweed *Sargassum* sp. with longline cultivation method. This research use four treatments with variation of plantation depths: 25, 50, 75 and 100 cm with 24 seaweed samples and repetition as much as six times per week for 4 weeks, total of 96 samples. The main parameter of this research is the growth of seaweed *Sargassum* sp. The supporting parameters are water quality parameters such as mineral content, temperature, DO, pH and salinity. The data was treated with ANOVA and continued by Duncan's test. The results showed that variation of plantation depth gave a highly significant influence (P <0.01) on the growth of seaweed *Sargassum* sp. with longline method. Treatment with

25 cm plantation depth had the best growth. In the fourth week, there was a significant growth resulted final weight 659.03% from its initial with specific growth rate 6.73%/day or nearly 5 times the growth depth of 100 cm

Keywords; *Sargassum* sp., Longline, Plantation Depth

1. Introduction

One of Indonesia's leading commodities in the fisheries sector is seaweed. This is because seaweed request continues to increase, both for domestic and overseas. Seaweed is expected to continue to increase along with the increasing need for direct consumption and industrial (food, pharmacy, cosmetics, textiles, bioenergy and others) (Dwiyitno, 2011).

Based on data from the Directorate General of the Ministry of Maritime Affairs the potential of aquaculture in Indonesia for fishponds 1,224,000 ha, ponds 526,000 ha, public waters 20,173,776 ha, rice field 5,936,000 ha and sea 24,000,000 ha. The area of potential waters of Indonesia's small islands is 1,560,000 km^2 with the area of water being used is 1,092,000 km^2 and the potential area for seaweed is 10,920 km^2 (Bengen, 2013).

The potential for production seaweed in Indonesia is very large, increase to 1.1 million hectares, because it is supported by a tropical climate with abundant sunlight throughout the year so that seaweed can almost be produced without knowing the season. Seaweed production is expected to increase every year so that it is able to meet the needs of seaweed both in the domestic market and in the world market. Indonesian seaweed production comes from seaweed collection and cultivation. Indonesia's potential for land is vast, and increasing demand for seaweed in both domestic and world markets is a good start for the prospect of seaweed development in Indonesia

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Seaweed production that is exported to various countries is still in the form of dried seaweed, so the trade profits are still very low. Product diversification is needed so that the production sold has more added values. Indonesia's seaweed export destinations are Japan, Hong Kong, China, the Philippines, Australia, America, France, Germany, Chile, Spain, the United Kingdom and others.

One type of seaweeds that has many benefits and also of high economic value, from genus *Sargassum*, which is the largest group of brown algae (Phaeophyta) in the tropical sea water. This seaweed has a very high abundance and distribution, found in almost all of Indonesia sea water. In general, *Sargassum* sp. not yet widely known and utilized. Based on several studies, it is also reported that seaweed has a high nutrient / nutrient content, such as proteins and some essential minerals, except that the analysis of nutritional composition is still incomplete (Mursyidin *et al.*, 2002). Based on the background outlined, this study aims to know the seaweed cultivation (*Sargassum* sp.) growth by longline methodand determine the correlation between variations in depth on the growth of seaweed (*Sargassum* sp.).

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2. Materials and Methods

2.1 Material

The material used in this study is *Sargassum* sp. seaweed weighing 50 grams, was taken from its natural habitat seawater in Sumenep, Madura Island, 50 km northside research location.

2.2 Location determination

This research was held in the Marine Waters Jetty of PT. Jawa Power, PT Jawa Power Laboratory and Faculty of Fisheries and Marine Microbiology Laboratory, Airlangga University. Sampling was carried out in the waters of Probolinggo Regency, East Java on December 2, 2017 - December 30, 2017.

The research was preceded by surveying research locations that were suitable for seaweed cultivation. Determining the location of the study includes the condition of the bottom of the water, the depth and quality of water including temperature, current speed, pH and brightness.

The depth of the water used is around 16 m at high tide conditions with a coral reef. The water quality at the location is 29°C, the current velocity is 0.08 - 0.23 m/sec, pH 8.0, and the brightness is 9 m. The location of this study is in the sea waters around the port of PT Jawa Power PLTU about 270 m from the coastline with a position of 7°42'45.99 "LS 113°34'35.02" BT.

2.3 Preparation of longline

The initial stage in preparing is to prepare bamboo with a length of 4.8 m and a width of 2 m each of 2 pieces. Bamboo is bound by polyethylene ropes to form a rectangular raft, which functions as a float (Fig 1).

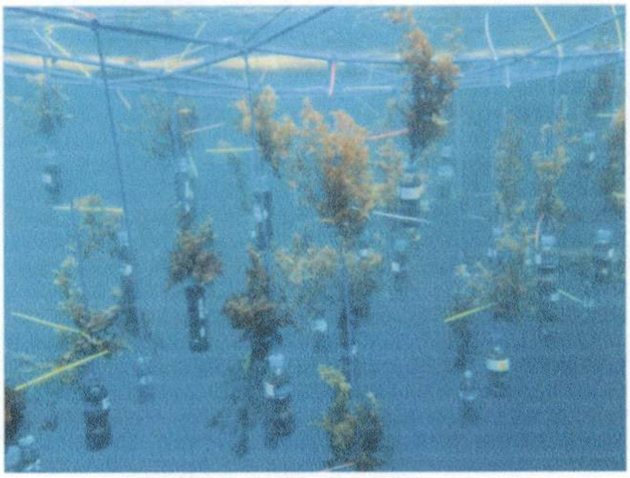

Figure 1. Longline Method

The bamboo side that has a width of 2 meters is connected with 4 pieces of polyethylene rope with a diameter of 10 mm with a distance of 50 cm each. The four ropes were installed with 96 vertical ropes which contained the treatment of independent variables 25, 50, 75 and 100 cm randomly with a distance of each 20 cm.

2.4 Seaweed preparation

The seaweed (*Sargassum* sp.). obtained weighed up to 50 grams. Seaweed used must be one clump. Before used seaweed needs acclimatization to adapt, by soaking seaweed in a place that will be used for planting. Acclimatization aims to prevent shock.

2.5 Experimental design

The study design used an experimental method with Randomized Block Design (RBD). Determination of the 4th layout of the treatment of *Sargassum* sp. seaweed was carried out in RAK with 6 replications. Every week there are 24 samples, so 4 weeks there are 96 samples. Statistical analysis uses. Analysis of Variance (ANOVA) to determine the effect. To find out the difference in influence between depths on growth, the treatment was continued with Duncan's Multiple Range Test (Kusriningrum, 2009).

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3. Results and Discussion

3.1 The effect of depth on the growth rate of *Sargassum* sp. seaweed

The nitrate content of the water used in this present study was under 0.16mg/L. This amount was in accordance with Frank (2011) stating that the amount of nitrate in a natural condition is under 0.2mg/L. The excess amount of nitrate (beyond 0.2mg/L), the conditions will cause eutrophication. Furthermore, the growth of algae and other aquatic plants will be extremely abundant which is well known as blooming algae inhibiting the growth of *Sargassum* sp. itself (Figure 2).

Phosphate is one of essential nutrient for cell metabolism that affects the water productivity. The standard amount of water required by living organisms is 0.015mg/L where the used water in this present study contained phosphate beyond 0.33mg/L.

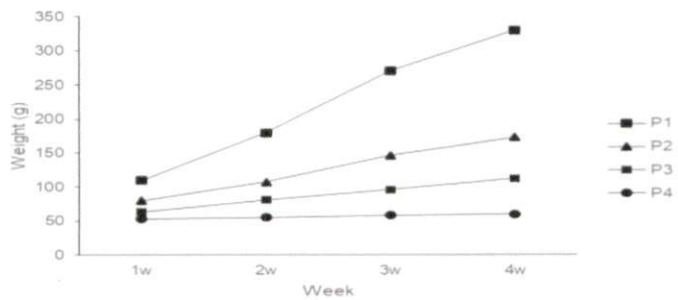

Figure 2. Cultivated seaweed weight observed within 4 weeks (P1, P2, P3, P4 represented the depth of25, 50, 75, 100cm)

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The depths of the cultivating water in this present study generated distinctive growth and growth rates within 4 weeks (Figure 3). Depth (P1) resulted final weight 659.03% from its initial with specific growth rate 6.73%/day which is the most growth rate generated within the treatment (Figure 4). This phenomenon was caused by the amount of absorbed nutrients in the used water; the least depth conducts the closest distance of the water surface to the cultivated seaweed that can stimulate the nutrient absorption by seaweed (Lapointe, 2014) which states that the oxygen circulation declines by the increase of water depth.

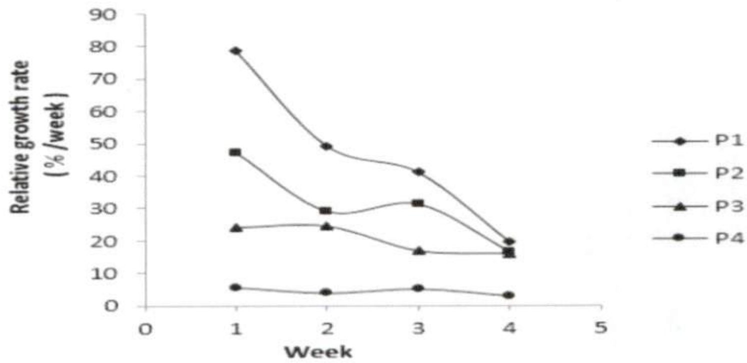

Figure 3. The relative growth observed within 4 weeks (P1, P2, P3, P4 represented the depth of25, 50, 75, 100cm)

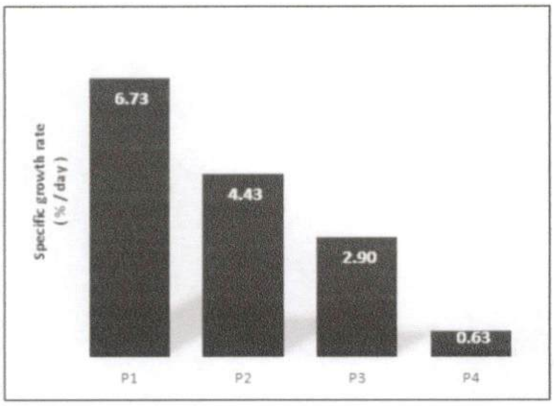

Figure 4. Daily growth rate observed within 4 weeks (P1, P2, P3, P4 represented the depth of 25, 50, 75, 100cm)

Atmadja (1996) stated that depth correlates to the temperature vertical stratification, light penetration, density, oxygen and nutrient content. According to Sunarto (2008), photosynthesis will more frequently occurs with the optimal light saturation. Light intensity also directly correlates to the primary productivity of the water where the more intensity, the more productivity generated. Franks (2011) shows that the energy generated and the absorption capacity declines when the depth increase.

Kune (2007) states that the most crucial factor affecting the growth rate of seaweed is light intensity absorbed by seaweed at the different depth then it affects the formation of new cell wall due to the lack of light intensity. In the depth of P3 and P4, ornamental fish, Rabbitfishes (*Siganus* sp.) that attacked the thalli of seaweed. This can be prevented by covering the cultivated seaweed by using nets.

3.2 Water quality parameter in the used water

The temperature of the used water was 29.4 – 31.2°C (Table 1). The temperature range during this study was still relatively optimal for seaweed growth. Temperature was a very important role for the growth of seaweed. Water temperature can affect several physiological functions of seaweed such as photosynthesis, respiration, metabolism, growth and reproduction (Samsuari, 2006). A good temperature for grass cultivation is between 27-30°C (Anggadiredja, 2009).

Table 1. Water quality parameters

Parameter	Week				
	0	1	2	3	4
pH	8.07	8.1	8.05	8.2	8.1
Salinity	28.5	28.5	28.4	28.3	28.4
Temperature (^{O}C)	31.6	31.2	30.9	29.4	29.6
Turbidity (meter)	6.4	6.7	6.2	5.9	6.0
Flow rate (m/s)	0.23	0.20	0.26	0.24	0.21

The acidity (pH) is the concentration of hydrogen ions present in these waters. The acidity (pH) also affects the *Sargassum* sp. seaweed cultivation. The used water pH was 8.05 to 8.2 that was in accordance with Anggadiredja (2009) which states that optimum pH for seaweed cultivation ranges from 6 to 9. Alkaline waters 7-9 are productive waters and play a role in stimulating the changes of organic matter in water to minerals that can be assimilated by phytoplankton. Sea and coastal waters have a

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relatively stable pH and are in a narrow range. pH is influenced by buffer capacity, namely the presence of carbonate and bicarbonate salts contained.

The salinity was between 28.3 - 28.5 ppm. This salinity was below the optimum salinity that was appropriate for the growth of seaweed. Anggadiredja (2009) states that appropriate salinity for the growth of seaweed was between 30-33.5 ppm. Salinity can limit the growth of seaweed if the media grows seaweed mixed with fresh water. The choice of location must be far from freshwater sources, namely small rivers or river estuaries.

The turbidity of the water at the cultivation location ranges from 5.9 to 6.7 m. With this turbidity sunlight can penetrate the waters of the research site. Sunlight when available sufficiently, seaweed will grow well, this is in accordance with the statement of Aslan (1998), namely the turbidity of a waters associated with the penetrating power of sunlight, which is associated with the growth of seaweed.

Dissolved oxygen is a basic requirement for the life of living things in water. The dissolved oxygen concentration in the research location was 5.8 mg /L, with this concentration the growth of seaweed would be optimal. This is in accordance with the statement of the Directorate General of Culture and Tourism (2008) that dissolved oxygen to support seaweed farming is 3 - 8 mg /L. Oxygen is the most important factor for aquatic organisms. All plants and animals that live in water need dissolved oxygen. Oxygen dissolved in water comes from the air and the photosynthetic results of plants in water. Oxygen derived from photosynthesis depends on the density of aquatic plants and

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the intensity of light to the water. Dissolved oxygen concentration is influenced by temperature, the higher the temperature, the lower the gas solubility (Papilia, 2013)

The speed of flow functions to carry nutrients that are used for the growth process and function to clean the dirt that attaches to thallus (Anggadiredja et al., 2008). At the location of cultivation during the research is 0.20 - 0.26 m / s, this is appropriate and suitable for the growth of *Sargassum* sp. In accordance with the opinion of Indriani (1991) that the range of current velocity, which is 0.2-0.4 m / s, is quite good for the growth of *Sargassum* sp. The research location had the basis of a coral reef. The geographical situation in the research location is a suitable place for seaweed to grow well. In accordance with Kadi (2005) that the most suitable watershed for seaweed cultivation is dead corals, volcanic rocks and massive objects that are in the bottom of the waters.

4. Conclusions

The variety of cultivation depth with longline method affected the growth of *Sargassum* sp. in this study. The optimal depth in this study was 25cm under sea level resulted final weight 659.03% from its initial with specific growth rate 6.73%/day which is the most growth rate generated within the treatment.

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