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The Growth Rate Of Seaweed (Caulerpa Lentillifera) In Different Water Environments

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Abstract

Water environment is an important factor in determining the successful cultivation of seaweed. Caulerpa lentillifera is one type of seaweed that is currently being developed as one of seaweed farming in Indonesia. Lentillifera belongs to *feather seaweed*, a type of edible macro algae which have bioactive substances. Caulerpa lentillifera production at present still largely depends on the nature, thus its cultivation is needed to meet the demand for that type of seaweed. Production of seaweed (Caulerpa lentillifera) is generally influenced by the quality of the water environment, cultivation techniques and post-harvest. The quality of water environment of seaweed cultivation depends very much on the location of the water used for farming activities. Ponds and floating net cages (*Keramba Jaring Apung*/KJA) are types of water environment that are commonly used in the cultivation of fish, including seaweed. The objective of this research was to determine the growth rate of seaweed (*Caulerpa lentillifera*) cultivated in different water environments. The research used experimental methods and data were analyzed with quantitative analysis, by counting the daily growth rate of seaweed (*Caulerpa lentillifera*) cultured in ponds and floating nets. The results showed that the growth rate of seaweeds (*Caulerpa lentillifera*) cultured in ponds was 16.67 gr /day, which was higher than those cultivated in KJ which was 3:57 gr/day.

Keywords: *Caulerpa lentillifera*, Growth, Ponds, KJA

1. Introduction

Kelp (sea weed) is one of the important fishery commodities and it has a good potential to be developed in Indonesia. Seaweed (*Caulerpa lentillifera*) is one species of seaweed that is publicly known. Seaweed (*Caulerpa lentillifera*), in society, is known with various local names such as *Latoh* in Java, *Lawi-lawi* in Sulawesi and *Lat* in Kei Islands, Southeast Maluku. *Caulerpa lentillifera* is native to tropical regions of the Indian Ocean and the Pacific, though it was found as an invasive species in the Pacific, such as on the coast of California and Hawaii.

Caulerpa lentillifera can grow in the shallow lagoon, in the ruins of coral and rocks, and also in sandy and muddy seabed. Morphological features of seaweed (*Caulerpa lentillifera*) are: the whole body is composed of a single cell with the bottom radiating and resembling stolon, it has rhizoid as an adhesive on the substrate and the upright section called assimilator. Seaweed (*Caulerpa lentillifera*) resembles bunches of grapes, is slightly shiny, and has a bright green or bluish color. The growth size can reach up to 5 meters, a diameter of 2 mm, and the branch length of 20 mm (Dawes, 1998). Seaweed (*Caulerpa lentillifera*) has a unique characteristic compared to other species of *Caulerpa* in the fact that both the stalk and round tip (such as grapes) meet in a limited way. The texture of seaweed (*Caulerpa lentillifera*) which is chewy, crispy, and juicy makes it edible and taste like seawater. Seaweed (*Caulerpa lentillifera*) in Indonesia is used as a food ingredient; this type can be consumed directly as fresh vegetables or cooked depending on the habits of the surrounding community. Seaweed (*Caulerpa lentillifera*) has a high mineral, vitamin A, C, and several unsaturated fatty acids essentials. Seaweed (*Caulerpa lentillifera*) is also reported to have

anti-bacterial and anti-fungal, and can be used as a medicine for high blood pressure and arthritis. The high nutrient content makes seaweed (*Caulerpa lentillifera*) has a great demand in the international market and is very popular in Japan and the Philippines (Anggadireja, 1996).

The use of seaweed (*Caulerpa lentillifera*) generally depends on the production from nature, so the number is very limited. The production of seaweed (*Caulerpa lentillifera*) still relies largely on nature, thus it faces a lot of hurdles, such as low production because it depends on the season. This production dependence on nature makes the availability of seaweed (*Caulerpa lentillifera*) not continuous and the needs for seaweed not available at any time. These constraints also affect the market demand for seaweed which continues to increase from year to year, so as to achieve the demand, seaweed cultivation is highly needed in order to meet market demand and ensure its continuous availability (Azizah Ria, 2006).

Seaweed (*Caulerpa lentillifera*) can be cultivated with several methods of cultivation, either in ponds or in floating net cages (*Keramba Jaring Apung* /KJA). The cultivation of seaweed (*Caulerpa lentillifera*) in ponds has developed quite well since it replaces the failure of Asian tiger shrimp. The ponds of Asian tiger shrimp cultivation have been converted into the cultivation of seaweed (*Caulerpa lentillifera*). The location of cultivation in ponds and in floating net cages alleged was assumed to have different effects of growth because of the differences in water quality. This leads to the need for research on the effects of different planting locations on the growth of seaweed (*Caulerpa lentillifera).*

2. Research methodology

This study used an experimental method, located in the sea (floating net cages) and ponds. Tools and materials used in this research were baskets, nylon ropes of 10 mm, a sinker, a digital scale with a level of accuracy of 0.01 to measure the weight of *Caulerpa lentillifera*, and a boat as a means of transportation and *Caulerpa lentillifera* seeds.

The maintainance of *Caulerpa* seedling was done at two locations: the pond and floating net cage (*Keramba Jaring Apung* /KJA). The early planting of *Caulerpa lentillifera* in pond was done like planting rice, in which roots were placed at the bottom touching the ground, planted regularly with a distance of 15-20 cm. Seed planting was done by using the system of planting backwards, so the seeds which have been planted are not stepped. Planting in a floating net cage was done by planting seeds into the baskets, and the baskets were hung on a long rope. Baskets that had been attached to a long rope were then brought to the sea and spread using a float and sinker. The position of the baskets that contained the seeds was submerged beneath the ocean surface to a depth of 1 m, so the seeds did not suffer from drought as a result of not being submerged in sea water. Early number of seaweed seeds used was 300 grams.

The measurement of seaweed growth was done once a week through a sampling of seaweed (*Caulerpa lentillifera*) *cultured* in the pond and in a floating net cage. The measurement was done by measuring the weight of seaweed (*Caulerpa lentillifera*) to know the weight gain; the measurement was carried out for six weeks.

3. Data Analysis

Data analysis was done by measuring the daily weight growth of seaweed grown in the floating net cage and pond. The measurement of growth rate was done by calculating the daily growth rate using the following equation (Effendi, 2003):

$$G = (Wt - Wo) / t$$

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Description :
G = daily growth (gr / day),
Wt = final weight of maintenance (gr),
Wo = initial weight of maintenance (gr),
t = length of maintenance period (days).

4. Results and Discussion

Growth is the change in size or weight in the form of length or weight of an organism in a certain time period. Growth on the weight change is more commonly used because the measurement is easier and can be done on every organism whose growth will be calculated (Effendi, 2003). Maintenance performed on seaweed (*Caulerpa lentillifera*) for 6 weeks showed a weight change. The results of measurement on weight gain in a floating net cage showed an increase from 300 grams to 450 grams at the end of the study. Meanwhile, the gain weight in seaweed cultivated in ponds increased from 300 grams to 1000 grams at the end of the study.

The results of the study showed that seaweed (*Caulerpa lentillifera*) cultivated in the pond grew faster than seaweed (*Caulerpa lentillifera*) cultivated in the floating net cage. The daily growth rate in the floating net cage was 3.57 cm/day whereas that in the pond was 16.67 cm/day. The growth of seaweeds (*Caulerpa lentillifera*) in the pond was higher than those cultivated in the net cage. This was caused since seaweeds cultivated in ponds found it easier to get nutrients. Substrate in pond was muddy clay so it had high nutrients that could be used by seaweed (*Caulerpa lentillifera*) during the maintenance. For further details, the results of the weight gain measurement of seaweed (*Caulerpa lentillifera*) every week during the maintenance can be seen in Figure 1.

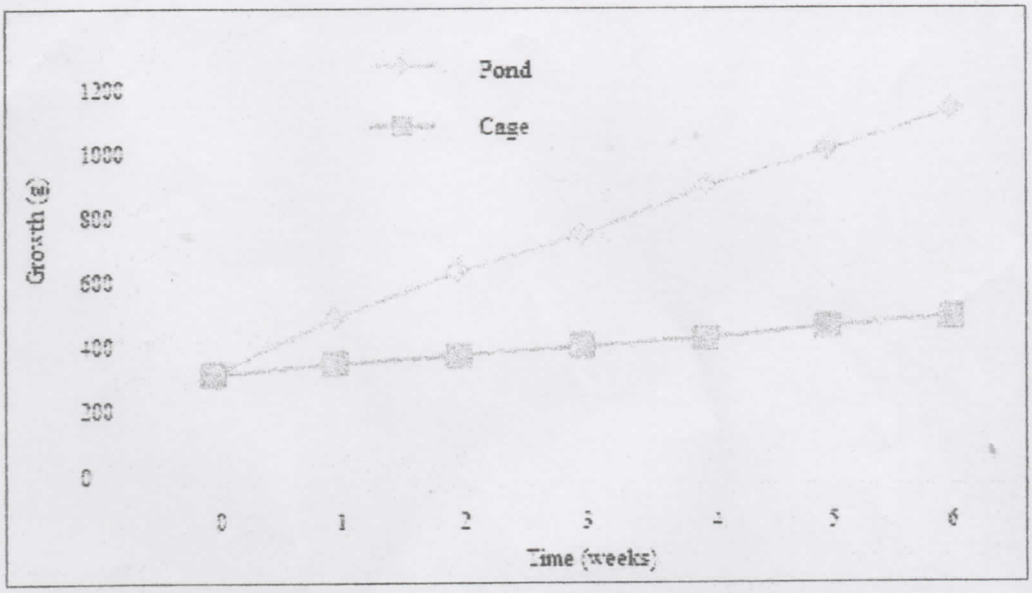

Figure 1. The growth of seaweed (*Caulerpa lentillefera*) in the ponds and floating net cage

The highest daily growth rate was recorded in seaweeds (*Caulerpa lentillifera*) cultivated in the pond. This is because the seaweed growth was influenced by stocking density and nutrients contained in water. The growth of seaweeds (*Caulerpa lentillifera*) in the pond had several advantages: morphologically, thallus was longer and had

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more branching. The growth of seaweeds (*Caulerpa lentillifera*) was faster since the planting techniques influenced the way seaweeds obtained nutrients. The planting of seaweed (*Caulerpa lentillifera*) at the bottom of the ponds facilitates the absorption of nutrients coming from the bottom of the ponds (Azizah, 2006). Planting in a pond with a depth of 80 cm made seaweed grows faster than they were planted at a depth of more than 1 meter. Depth had impacts on the sunlight penetration which would have an influence on the process of photosynthesis occurring in the cultivation of seaweeds (*Caulerpa lentillifera*). Depth is closely related to temperature, nutrients, oxygen and penetration of sunlight (Ari, 2014).

The cultivation of seaweeds (*Caulerpa lentillifera*) in the floating net cage had a slower growth than in the pond. The morphological characteristics of seaweeds (*Caulerpa lentillifera*) planted in the cage net were: small round beads were like shrinking and undeveloped grapes. It was caused because seaweeds (*Caulerpa lentillifera*) kept in the net cage were placed in baskets thus limiting the growth of seaweeds. Seaweeds (*Caulerpa lentillifera*) cultivated in the floating net cage had potentials to get nutrients; thallus came out of basket crevices to find a way out so that they became longer and had longer branching.

Seaweeds (*Caulerpa lentillifera*) cultivated in the cage had a slower growth due to the movement of water. Water movement due to currents and waves only occurred on the surface so there were also less nutrients on the surface. Planting seaweeds in locations that have low water movement causes the entry of nutrients into plant cells and the release of the remnants of metabolism hampered as well as causes the thallus blocked by mud, leading to obstruction of the process of photosynthesis so the growth becomes slow (Aslan, 1998).

Water quality was also one of the factors that played an important role in the growth and survival of organisms. Water quality also affected the growth of seaweeds (*Caulerpa lentillifera*) which are being cultivated. Water quality in the cultivation area should be in more or less the same with the original habitat of the organisms being cultivated. Water quality parameters in the floating net cage and pond can be seen in detail in the table below.

Table 1. Water Quality on the Cultivation of Seaweed (*Caulerpa lentillifera*)

Parameter	**Range**	
	KJA	Pond
Temperature (°C)	24 - 30	25 – 30
Salinity (ppt)	25 – 30	25 – 30
pH	7,5 – 8,5	7.5 – 9
Brightness (cm)	300 – 400	35 – 40
DO (ppm)	> 3,5	> 3,5

Water temperature affected the rate of photosynthesis and high temperatures could also make proteins undergo denaturation, which could damage cell membranes and enzymes that were unstable at high temperatures. Temperature had a high influence on the oxygen dissolved in water; water temperature in water was reserved with the content of oxygen dissolved in water. The higher the temperature, the lower the content of dissolved oxygen or vice versa. Idris (2003) states that the temperature and light intensity affect the growth of seaweeds.

Salinity was one of the water quality parameters which also affected the growth of seaweedd (*Caulerpa lentillifera*). Seaweeds (*Caulerpa lentillifera*) belong to the class of *stenohaline* so it cannot grow in water location with less than 25 ppt. The optimal range for the growth of seaweed (*Caulerpa lentillifera*) was 25-30 ppt. Meanwhile, the good

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value of pH for seaweed cultivation ranged from 6.5 to 9. pH was also influenced by the change of water coming in and out caused by the movement or flow of water in the cultivation area.

In addition to the parameters mentioned previously, DO and brightness were also the parameters of the water quality affecting the growth of seaweed. DO was influenced by the movement of water and water currents that existed in the cultivation area. DO affected the process of photosynthesis in plants with chlorophyll, including seaweeds (Effendi, 2003). Meanwhile, brightness was influenced by the presence of particles in the water, including the presence of organic materials or contaminants from industrial waste. Brightness also affected the growth of seaweed because it would affect the photosynthesis process of seaweed being cultivated.

5. Conclusion

Seaweeds (*Caulerpa lentillifera*) cultivated in the pond grew faster than those (*Caulerpa lentillifera*) cultivated in the floating net cage. Daily growth rate in the floating net cage was 5.36 cm / day while the those in the pond was 25 cm / day. The growth rate of seaweeds (*Caulerpa lentillifera*) cultured in the pond was higher than those cultivated in the floating net cage. Seaweeds (*Caulerpa lentillifera*) in their natural habitat required a substrate, so the seaweed cultivation in the pond had a similar habitat to their natural habitat and it made them easier to get nutrients.

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