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# Biofilter Application Using Seaweed (Gracillaria verucosa) to Increase Production of Vannameii Shrimp in Traditional Pond District Bangil-Pasuruan

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## ABSTRACT

The aims of this research were to know how to operate and develop the Vannamei production by using biofilter technology of seaweed to the farmer, keeper, young people and leader of the society. The results showed that the Integration of *Gracilaria verucosa* as a biofilter agent in aquaculture pond can increase the production of Vanname shrimp. The results were obtained 5 tons/ha of seaweed from the initial density of seaweed 1 ton/ha after 3 months of culture with daily growth rate of 4.18%/day. Vannamei shrimp growth of 0.5 grams to 16.7 grams/fish, shrimp production from 1 ton/ha to 3,5 tons/ha. Based on the economic analysis showed gains with the value of R/C ratio of 1.83 and a profitability of 80.08%. Biofilter methods is more likely, given the application is very simple, high adaptability, easy maintenance, and economic value. Socialization and counseling about the application of environmental friendly biofilter system using *G. verucosa* needs to be carried out at farmer pond.

**Keyword:** Seaweed, Vannamei production, Brackishwater.

## INTRODUCTION

Bangil Pasuruan is one of regence in East Java that has a particular fishery resources. Currently extensive pond is approximately 9,000 ha. Contributions fishing pond to the income of the people reach Rp. 25,179,110,- (25 billions) a year, or contributions to reach approximately 23% compared to other subsector. Shrimp production in Pasuruan from 1989 to 1992 increased an average of 2%, but starting in 1993 until now declining, even in 1996 shrimp production has decreased about 32.7% from the previous year. This decrease is due to the shrimp death allegedly due to poor water quality and the attack of various diseases.

Problems faced by fish farmer began in 1980 is enlargement techniques to achieve the targeted size, the achievement of maximum production, optimizing the use of feed and minimizing mortality of shrimp or fish during maintenance (Murjiyo, 1998). This problem can be triggered by several factors, among others, dirt in the pool caused by the cultivation of feed residue or disposal of the metabolism of the fish and shrimp. If the waste is continually allowed to have a negative impact on the environment of aquaculture including the occurrence of disease in shrimp farming because of the emergence of microorganisms that cause disease, the blooming plankton, that can cause crop failure. Reviewing it, it is very important to pay attention to water quality management that include several parameters: physical parameters (temperature, turbidity, dissolved solids, etc.), chemical parameters (pH, dissolved oxygen, BOD, metal content, etc), and biological parameters ( plankton, bacteria, etc.) (Effendi, 2003).

In addressing the issue of water quality management in the pond of shrimp, the application of technology that assist in the management of water quality environmental friendly. It means that in a given application solution, it will not impact negatively the lives of shrimp during the application process runs. Implementation of environmentally friendly shrimp farming is the solution. The use of the biofilter is one way to maintain water quality in aquaculture pond. Seaweed, in particular the type of *G. verrucosa* is seaweed that can be used as a biofilter in shrimp farming. Cultivation *G. verrucosa*, and other types of seaweed, can be done in monoculture and polyculture with the fish (finfish) in pond. It can be in favor of agriculturally in the estuary of the river, and in the pond although originally derived from the marine habitat, it is in because the tolerance level of the seaweed live up to the limit of 15 per mil salinity even 10 per mile.

Integration of seaweed in an effort to restore the quality of water, brackishwater ecosystem due to pollution, especially in aquatic cultivation, can be done with different types of technology, both with simple technology and complex technology. In biology, wastewater treatment by utilizing certain species of seaweed *G. verrucosa* is seen as more likely, given the method of application is very simple, high adaptability, easy maintenance, and economic value. With an emphasis on economic reason, it is expected that the integration of seaweed as a biofilter, will be easily accepted by society.

The aim of this research to know how to operate and develop the Vannamei production by using biofiter technology of seaweed to the farmer, keeper, young people and leader of the society.

## METHODS

**Material.**

This research was conducted in Bangil-Pasuruan pond with an area of 1 ha. It was uses seaweed (*G. verrucosa*) 1 ton/ha, Shrimp of Vannamei, 100 kg of Feed, Fertilizer that consist of 25 kg of calcium, 4 kg of KNO3, 20 kg of TSP 20 kg and 10 kg of Urea 10 kg.

**Methods**

**Preparation of pond**

Measuring the pH of the pond, if the pH is less than 6.5 it is necessary to do the washing pond bottom and 1000 kg of lime. And to keep algae growth organic fertilizer 2 times as much as 1000 kg, and the provision of UREA + 25 kg TSP.

**Preparation of media.**

a. Filling sea water with salinity 15-30 ppt into a pond with a height of 80-100 cm.
b. Taking seaweed that had previously been soaked in a solution of atonik and adapted in pond.
c. Weighing the initial weight of seaweed (Wo) then grown using bottom method with a density of 1 ton/ ha.
d. Spreading Vaname Shrimp size PL20: 75.000 shrimp/ha (weigt: 1 ton).

**Treatment during culture.**

a. Water change is done 2 times for 3 months.
b. Sampling was carried out at five stations in the pond. Measurement of water quality (pH, temperature, DO, and salinity) is done 3 times a day, namely at 05.00 pm, 14.00 pm and 21.00 pm and ammonia every 1 week.
c. Seaweed weight measurement is then performed once every month (Wt).
d. Measurement of weight/growth as much as 30 shrimps conducted once every month.

## RESULT AND DISCUSSION

**Daily Growth rate and Production Seaweed (*G. Verrucosa*).**

During growth culture period, wide variations in size were observed (Table 1 and Figure 1). At the end 90 days growth rate *G.*

*Verrucosa* reach 4,18% and production 5 tons.

**Table 1.** Data Seaweed weight gain during 3 months of observation.

| No. | Parameter | Culture Period (days) | | | |
|---|---|---|---|---|---|
| | | **0** | **30** | **60** | **90** |
| 1. | Wo (initial weight gram) | 25 | 25 | 235 | 645 |
| 2. | Wt (grams final weight) | 25 | 235 | 645 | 997 |
| 3. | Daily Growth Rate (%/day) | 0 | 2,52 | 3,68 | 4,18 |
| 4. | Production (Ton/Ha) | 1 | 1,5 | 2 | 5 |

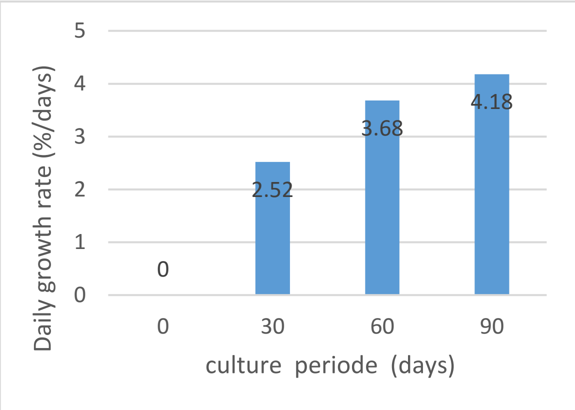


**Figure 1.** Effect of culture periode on daily growth rate *G. verrucosa*.

**Daily growth rate and Shrimp Production.**

The observed of daily growth rate Vanname obtained about 3,97% (Table 2 and Figure 2) and production after culture periode 90 days, the final size at harvest 350 kg/ha.

**Table 2.** Growth rate and Production of Vanname cultured for 90 days.

| No | Parameter | Culture Period (days) | | | |
|---|---|---|---|---|---|
| | | **0** | **30** | **60** | **90** |
| 1. | Wo (initial weight gram) | 0,5 | 0,5 | 3,6 | 10,1 |
| 2. | Wt (grams final weight) | 0,5 | 3,6 | 10,1 | 16,7 |
| 3. | Daily Growth Rate (%/day) | 0 | 1,02 | 3,29 | 3,97 |
| 4. | Production (ton/Ha) | 1 | - | - | 3,5 |

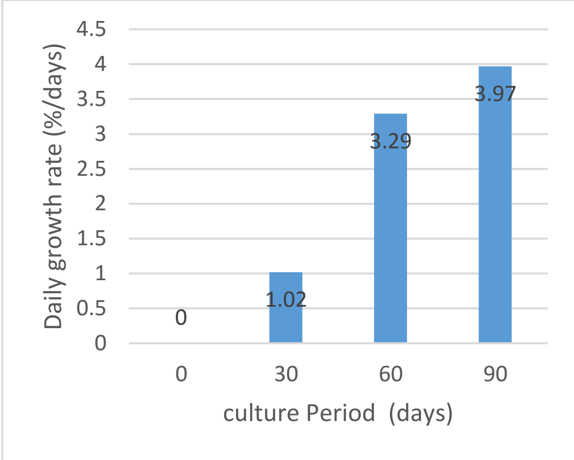


**Figure 2.** Relationship culture period of the daily growth rate of Vannamei.

**Water Quality.**

Water quality in pond for cultured during 90 days, all parameters are still within the range that is optimal to support growth of seaweed and shrimp Vanname (Table 3).

**Table 3.** Quality of water for culture of seaweed *G. verrucosa* and *Vannamei*.

| Parameter | Range | Literature * |
|---|---|---|
| Temperature | 26-30 $^{o}$C | 20-28 $^{o}$C |
| Salinity | 24 -29 $^{o}/_{oo}$ | 15-30 $^{o}/_{oo}$ |
| The degree of acidity (pH) | 6-8 | 6-9 |
| Dissolved oxygen (DO) | 3,1-8,5 ppm | 3-8 ppm |
| Carbon dioxide ($CO_2$) | 33,2-38,2 ppm | 34-56 ppm |
| Total Organic Matter (TOM) | 0,852-1,32 ppm | 0,65-15,48 ppm |
| Nitrat | 0,2-0,3 ppm | 0.01-0.8 ppm |
| Phosfat ($PO_4$) | 0,078-0,1 ppm | 0,021-0,1 ppm |

* Source: Boedi *et.al.*, (2014).

**Economic Analysis**

Based on the results of economic analysis known that the shrimp aquaculture and seaweed show the Table 4.

**Table 4.** Details the cultured of economic calculation.

| No. | Activity | Harvest (Rp.) | Result |
|---|---|---|---|
| 1. | **Capital investment / equipment**<br>▪ Land lease<br>▪ Equipment | <br>5.600.000<br>2.800.000 | **8.400.000** |
| 2 | **Costs of production**<br>▪ Cost of groundscare<br>▪ Fertilizer drugs<br>▪ Fry 17 rean<br>▪ Fertilizer + Drugs<br>▪ Seaweed<br>▪ artificial feed | <br>800.000<br>950.000<br>1.910.000<br>950.000<br>950.000<br>950.000 | **6.510.000** |
| 3. | **Production and reception**<br>Vannamei : 350 kg x 45.000<br>5 tons of seaweed: 5000 x 540 | <br>15.750.000<br>2.700.000 | **18.450.000** |
| 4. | **Advantages poin 3 – poin 2** | 11.940.000 | **11.940.000** |
| 5. | **If 1 year = 3x production** | 35.820.000 | **35.820.000** |
| 6 | Revenue/Cost Ratio | R/C=1,83 | |
| 7. | Rentability/Profitability | 11.940.000 x 100%<br>14.910.000<br>= 80.08 % | |

**Discussion.**

Based on observations obtained seaweed *G. verrucosa* weight to 997 grams of the initial weight of 25 grams for 3 months of maintenance. According to Danis and Andayani 2010), seaweed is stocked directly in the bottom waters (bottom method) can increase the weight of the seaweed from 25 grams to 235 grams for 21 days. The requirements growing this plants is the condition of water, light sufficient to the temperature variations and obtain the flow of water fixed (Kho and Foremost, 2001).

Shrimp Vaname indicate a fairly rapid growth. Vannamei shrimp weight average during the observation was 16.7 g/fish. Such growth is fairly rapid growth in traditional polyculture farming patterns, for their seaweed, shrimp environment Vannamei be free of toxic, food remains and metabolic waste in the water filtered in this system. Biofilter seaweed causing several water quality parameters are more stable and shrimp production is obtained 350 kg/ ha and the weight of an individual (from 0.5 to 16.7 grams) for 90 days of maintenance.

Based on the results of measurements on pond, all water quality parameters are still within the range that is optimal to support growth of seaweed and shrimp. Controlling by manipulate the environment such as by improving the quality of water through a system of biofilter that the remaining feed and of metabolism in the water filtered out by the system. Based on the research done Abdullah (2000) and Setyohadi dkk. (1999) the circulation system of water biofilter can lead to some stability the parameter of water qualities (the temperature, pH, eH, brightness and cloudiness and can increase the rate of growth and weight individual.

The main element for the growth of seaweed are the elements carbon (C). This element can obtained from carbon dioxide ($CO_2$) which is very much dissolved in the water. The seaweed cultivation on brackish water ecosystem with abundant nitrogen content is very favorable, on the one hand seaweed requires N sufficient for growth and on the other hand *G. verrucosa* expected to reduce pollution of N-organic occur in brackish water ecosystems, such as aquaculture area. The abundance of nutrients brackish waters is due to the accumulation of decomposition of plants, domestic waste, agricultural and industrial waste.

By using a biofilter system can improve the efficiency of land use pond and farmers income on an ongoing basis. Cultivation is based on the principle of the balance of nature. Seaweed serves as a producer of oxygen and shelter for fish and shrimp from predators and as a biological filter. Fish and shrimp discard the dirt that can be used as nutrients by the seaweed. Seaweed absorbs $CO_2$ dissolved respiratory outcomes fish and shrimp. Seaweeds are maintained on aquaculture pond to absorb nitrogen for growth, so forming ammonia nitrogen is reduced and the formation of ammonia, which causes toxins will be minimized. In general, the presence of seaweed in ponds of shrimp have a positive impact. According Pantjara (2009), seaweed G. able to absorb heavy metals such as $Al^{3+}$ and $Fe^{2+}$ is more than 1000 mg/L, can reduce the presence of ammonium in the pond (Harlin et. al., 1979) and Neori et al. (2004), reducing $NH_4^+$ in the pond is also resistance on ephipita higher (Crab et. al., 2007), capable of reducing excess nutrients (Msuya and Neori, 2002) and can increase fish growth by 40% (Troell et al., 1999 ).

Besides as biofilter, seaweed cultivation in pond give more the advantage than cultivation at the sea because it would protected from the unfavorable environmental as waves, a strong current, predators and simplify in control of water quality. Cultivation shrimp and seaweed impact on environmental changes cultivation. Environmental changes will be followed by improving the quality of water and nutrients that there is. With the existence of seaweed shrimp production increased (Sulistyo, 1988).

Based on the results of economic analysis known that the shrimp aquaculture and seaweed show the over table. Obtained values of R/C Ratio Vannamei farmers and seaweed = 1.85 this indicates that the cultivation of seaweed Vannamei and more profitable than traditional monoculture. Assuming constant farmers' income each production cycle and in the third year of planting (if first time planting takes 4 months), then the income of farmers in one year Rp. 35.820.000,-, while the business assets owned investment capital Rp. 14.850.000,-, thus Vannameii shrimp farming with seaweed give profitability 80.08%. Values shows that the profitability of farming and seaweed Vannamei profitable and efficient use of capital is quite good. This means that profits earned within one year 80.08% of the capital invested. If the value of those earnings as compared to the interest rate on bank deposits which currently average 12% per year, then invest in this business is more profitable than depositing money in the bank.

## CONCLUSION

The results were obtained 5 tons/ha of seaweed from the initial density of seaweed 1 ton/ha after 3 months of maintenance with daily growth rate of 4.18%/day. Vannamei shrimp growth of 0.5 gram to 16.7 gram/fish, shrimp production from 1 ton/ha to 3,5 tons/ha. Based on the economic analysis showed gain with the value of R/C ratio of 1.83 and Rentability of 80.08%. This research can be concluded that the presence of seaweed as biofilters generally will increase the specific growth rate of Vannamei shrimp. The biofiltration method is more likely, given the application is very simple, high adaptability, easy maintenance, and economic value increase.

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