RESEARCH ARTICLE

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Total Organic Matter Profile in Shrimp-Seaweeds Polyculture System

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This study focus on profile of organic matter in shrimp seaweeds polyculture system. Organic matter has important role in determining water quality to support shrimp growth and production. As increase in organic content tend to reduce oxygen level and inhibite the growth of shrimp. Introduction of seaweeds in shrimp ecosystem is supposed to reduce phytoplankton community and organic level in water all at once. The presence of seaweeds is hypothesized to reduce organic matter in shrimp pond. We proposed to used two species of seaweeds to create shrim seaweeds poly culture system. These are *Sargassum plagyophyllum* and *Gracillaria verrucosa*. The different density of *Gracillaria* was also introduced as this species was not only survive, but also perform a better growth rate. During the experiment, we monitored the profile of total dissolved organic matter, by assesing its content weekly. Results indicated that there were a constanc weekly increase of total dissolved organic matter during the experiment. In average the presence of *Gracilaria* capable in reducing organic content by 2,5%, while with *Sargassum* the organic content was slightly increase by 0,4%. In general, the presence of *Gracilaria* reduced the total dissolved organic matter in the water, however, the different between its density was not significant.

Keywords: Organic Matter, Shrimp, *Sargassum*, *Gracilaria*.

1. INTRODUCTION

Shrimp production is recently declining all over the world due to self pollution from excess nutrient input. Intensive shrimp farming requires high protein diets to maintain productivity. Intensive shrimp farming requires high protein diets to maintain productivity. As a result, an increase of organic matter accumulation in shrimp ponds is usually occurred. There was a negative impact of excess organic material shrimp pond. The increase of organic matter in shrimp ponds will deplete oxygen level and create microalga blooming. This condition will reduce shrimp survival and growth rate. Oxygen depletion will cause shrimp vulnerable to several diseases, while microalga blooming will damage shrimp gill. Shrimp production will finally decreasing. Hence, its is necessary to find better management in shrimp farming with focusing on reducing organic matter in shrimp ponds. Addition of seaweeds into shrimp ponds is one of efforts in attempt to reduce excess organic matter. The presence of seaweeds was capable in reducing nitrogen content (1). To reduce excess nutrient, seaweeds can be used to clean up dissolved nutrient (2). The use of selected seaweeds species is crucial to reach a certain target environmental condition (3). *Gracilaria* co culture in tank with fish capable in removing 50% of ammonium (2). Seaweeds has been used as besed design of Integrated Multi Trophic Aquaculture (IMTA) and resulted in environmental and economical benefits (4). Seaweeds are suitable candidate to reduce dissolved inorganic nutrient (5). Through phytoremediation, some plants can be used to reduce chemical pollutant, including dissolved organic carbon (6). In this research we evaluate performance and profile of dissolved organic matter during shrimp seaweeds coculture using plastic enclosures inside shrimp ponds. Two species of seaweeds were compared for their total organic profile during experiments.

2. MATERIALS AND METHODS

a. Experimental designed

This research was done in 10 m × 20 m of concrete shrimp ponds. Saline water was pumped into the ponds from adjacent estuary, reaching approximately 1,5 m deep. As much as 20 plastic bag of the size of 2 m × 2 m × 1,5 m volume were randomly placed inside the ponds, and filled with saline water at the same depth to outside water. Stones was placed inside every corner of bottom of the plastic bag to avoid from unwanted movement. Every top corner of the plastic bag was lift up using plastic string tighted to wood or bamboot stick that was plugged into pond bank.

b. Preparation of *Sargassum*, *Gracilaria* and shrimp seeds.

This study was conducted in 12 m × 20 m square of concrete pond. Into the pond, water from adjacent estuary was pump in to reach 1 m depth. Into the pond, 9 polyethylene sach (2 m × 2 m × 1,2 m) was placed and arranged equally. In this study the

species of seaweeds being used were *Sargassum plagyophylllum* and *Gracilaria verrucosa*. These seaweeds seeds were collected from near sea. Each species of collected seaweeds was clean from dirt and weighed of each of 100 grams and tied it ina plastic rope. Each of seaweeds bundle was hanged on a wire string that was stretched to two bamboo stick that were plugged on every edge of opposite site of pond bank (see picture 1). The seaweeds were let grow for 1 week, until shrimp seeds was then inputed into each plastic bag. The shrimp stocking density were approximately 50 seed/m^2. This first experiment were conducted for 4 weeks.

c. Preparation of *Gracilaria* at different density

For treatment with different density of *Gracilaria*, we used the similar method to previous preparation, the only different was that the seaweeds inputed to polyethilene sach was only *Gracilaria*, but the difference was on its density. The density applied was 1 kg/m^3, 2 kg/m^3 and 3 kg/m^3. Polyethylene without *Gracilaria* was served as controls.

d. Dissolved organic matter monitoring

Dissolved organic matter was monitor weekly using titration methods, Kalium permanganate and Natrium oxalate was used to create red wine color, and neutralize by H_2SO_4.

3. RESULTS AND DISCUSSION

1. Total Organic Matter Differences Between Ecosystem Models with Different Seaweeds Species

The average of total organic matter between model of ecosystem with different species of Seaweeds was analyzed. Results indicated that, in control, where seaweeds was not presence, the average content of organic matter was the highest. The presence of seaweeds was capable in reducing the average of total organic matter in shrimp pond. Reduction of total organic matter in shrimp pond in the presence of *Sargassum* and *Gracilaria* is presented in Figure 1.

Seaweeds species affected the efficiency in reducing total organic matter. *Gracilaria verrucosa* reduced organic total more than *Sargassum polycistum*. Organic matter in shrimp pond is mostly caused by nutrient input in attemp to reach its maximum shrimp growth and production. However, accumulation of organic matter is undesirable, as it can negatively impact on fish yields due to release of toxic elements such as hydrogen sulfides and nitrites (7). High organic matter deposition may also

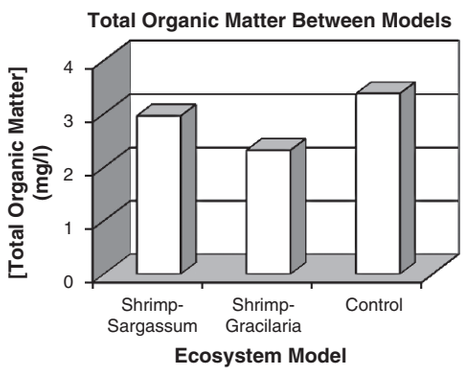

Fig. 1. Total organic matter in shrimp pond in the presence of *Sargassum* and *Gracilaria*.

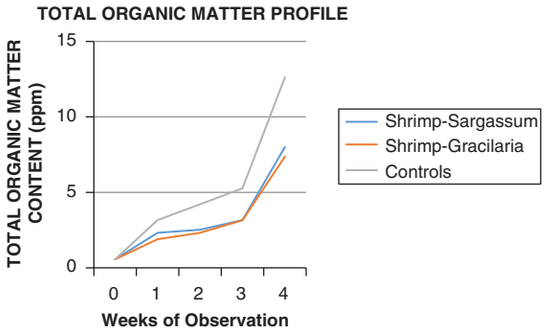

Fig. 2. Total organic matter profile between different seaweeds species.

impact a high oxygen demand and lead to oxygen depletion (8). The higher reduction of organic matter in shrimp pond by the presence of seaweeds may through reduction of phytoplankton population. Reduction of phytoplankton population in shrimp seaweeds polyculture system is mainly through the capability of seaweeds to remove nutrient (9). According to Lara et al.,[10] particularly particulate organic matter is positively correlated with chlorophyl concentration in water (10). Beside that, the presence of seaweeds in shrimp pond also improve water clarity. According to Canfield et al.,[11] colonozation of aquatic plants will positively related to higher transparency (11). Cako et al.,[12] mentioned in their research that water transparency is mostly caused by particulate, sediment and phytoplankton (12). In this research, the presence of seaweeds may cause lower growth of phytoplankton due to nutrient and sunlight competition.

2. Total Organic Matter Profile During Experiment

During experiment, approximately 4 weeks, indicated that total organic matter in shrimp pond was all sharply increased by the end of experiment. Without seaweeds, the increase of organic matter was very high. However, this increase of total organic matter was slower if seaweeds was present. The presence of seaweeds was significantly reduced total organic matter almost 50%. *Gracilaria* reduced total organic matter slightly higher compared to *Sargassum*. Total organic matter profile between this two ecoystem is explained in Figure 2.

Gracilaria is the type of seaweeds that is more effective in reducing of total organic matter compared to *Sargassum*. If capability of reducing organic matter is due to reducing population of phytoplankton, it may because *Gracilaria* growth rate in shrimp pond is much higher than *Sargassum* (13). If the growth rate of seaweeds is higher, then logically, the capability in inhibite the growth of phytoplankton is also higher. Therefore, total organic matter will be lower.

3. Total organic matter in different density of Gracilaria

In order to find the best treatment to reach the lowest total organic matter in shrimp pond, we tried to use a different total density of *Gracilaria* applied in shrimp pond. The density applied were 1 kg/m^3, 2 kg/m^3 and 3 kg/m^3. The difference performance of total organic matter among different density of *Gracilaria* is figured out in Figure 3.

During approximately 9 weeks of experiment, we found that, *Gracilaria* density affect on average of total organic matter. The presence of seaweeds it self already capable in reducing organic matter. Density of seaweeds in approximately 3 kg/m^3 reduce the most of organic matter, followed by 1 kg/m^3 and 2 kg/m^3 respectively. The most effective reduction of total organic matter

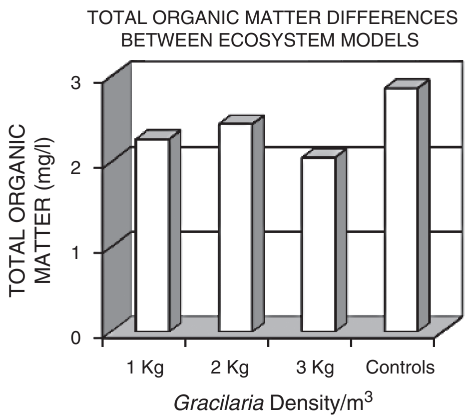

Fig. 3. Total organic matter among different density of *Gracilaria*.

in 3 kg may be due to the lowest population of phytoplankton in shrimp pond. As resulted in research by Izzati,[13] indicated that the higher population of seaweeds, population of phytoplankton will be reduced (13). Reduction of phytoplankton population by seaweeds presence probably also caused by nutrient depletion. According to Hafedh et al.,[14] seaweeds capable in reducing inorganic nutrient in the water (14).

4. Total organic matter profile during experiment at different density of *Gracilaria*

During the experiment, this research indicated that total organic content in the water tend to increase by time. At the end of this research (week 9), in average of total organic matter reach almost 6 fold of initial concentration. The increase of total organic matter is mainly caused by the addition of shrimp feed added everyday. However the presence of *Gracilaria* in this pond could reduce the accumulation of total organic matter in shrimp pond. Total organic matter profile was lower in all of *Gracilaria* density. The different total organic matter profile among *Gracilaria* density present in shrimp pond is explained in Figure 4.

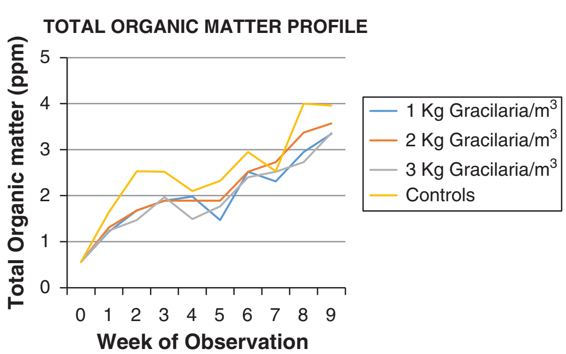

Fig. 4. Total organic matter profile during experiment with different density of *Gracilaria*.

Very high average concentrations of organic matter in shrimp ponds reflect high inputs and intensive remineralisation (8). High organic waste from shrimp or fish pond has recently raised many concern (15). As seaweeds could reduce organic level in shrimp pond, it is widely applied as one component in application of Integrated Multi Trophic Aquaculture (IMTA). In IMTA, the presence of seaweeds in is the main factors that makes aquaculture sustainable, economically feasible and socially accepted (16). Rearing seaweeds is efficient for remedying the eutrophization produced in farming with only monoculture (16). It is suggested for shrimp farmer to applied seaweeds, particularly *Gracilaria verrucosa* to maintain environmental quality.

4. CONCLUSION

Seaweeds presence in shrimp pond, could reduce accumulation of total organic matter. However, species of seaweeds determine the efficiency in removing total organic matter. *Gracilaria* reduce total organic matter better than *Sargassum*. *Gracilaria* density also affect the efficiency in reducing total organic matter. With density of 3 kg/m^3, reduction of total organic matter is the most efficient. It is suggested to applied using *Gracilaria*, with density of 3 kg/m^3 to obtain lowest accumulation of total organic matter.

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