A Study for Estimation of Bio Organism Content in Aquaculture Pond Based on Image Color and Light Intensity

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***Abstract*— The defense on food today is mostly depend on agriculture. However, it is predicted that on 2050, the food production from agriculture will reduce and be replaced by aquaculture. Indonesia may take the advantage from this situation. Since it has the second longest of its coastline in the world, Indonesia has a potential to be number one for fishery production from aquaculture field. Therefore, survival rate of the creature inside the pond must be very high. One of the factors that influence survival rate of creature in the pond is water quality, which is influenced by physical, biological and chemical properties. In this study, we deal with biological content in the pond, of which several bio-organism live in. Four type of planktons are taken as samples i.e., Chlorella Vulgaris, Thalasiosira Sp., Skeletonema Sp. and Skeletonema Costatum. Several plankton contents, 0%. 5%, 10%, 25% and 50% are prepared. This sample is then observed under digital microscope and RGB LED. The result from digital microscope and RGB LED are then plotted and taken into formulation model. From this model, four types of plankton are possible to be classified.**

Keywords—Aquaculture, plankton, fishery, bio-organism.

I. INTRODUCTION

World food security is an interesting issue, because the world human population tends to increase, and it is predicted that the population will reach 9.6 billion at 2050 [1]. This population number needs feeding. Today most of the world's food production is produced from agriculture. However, for the next 30 years, it is predicted that the function of agriculture will be replaced by the aquaculture sector. This situation will have a good impact for Indonesia because Indonesia has the second longest coastline in the world. This coastline provides the potential for Indonesia to build a good aquaculture system, so that it can become the world's largest fisheries producer. One of the factors that determine success in the context of aquaculture cultivation is maintaining water quality. Water quality depends on physical, chemical and biological properties. In our previous research [2, 3] we maintain water quality from chemical properties, which include salinity, pH, dissolved oxygen and temperature. In the other way, water quality is maintained based on biological properties. It can be done by maintain the bio-organism life in the pond [4, 5, 6]. In this paper we do a study to estimate the content of phytoplankton in the pond.

II. SYSTEM OVERVIEW

A. System Design

Block diagram of the system is shown in Fig 1. Two components for observing the sample, i.e, digital microscope and RGB LED and light detector is used in this study. Digital microscope produces digital image taken from the sample. While light detector produces analog intensity taken from the light after passing the sample. The analog intensity is converted into digital signal utilizing Analog to Digital Converter (ADC) and then sent to microcontroller (Arduino Nano). Both digital image and digital signal are then analyzed in the Computer. Fig 2 shows measurement chamber. Sample is placed under microscope. The distance between sample and microscope is preset so that the microscope is able to produce good image quality. Under the sample is back light, using white LED.

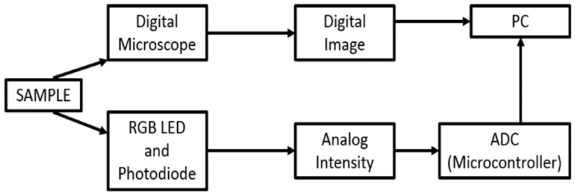

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Fig 1. Block Diagram

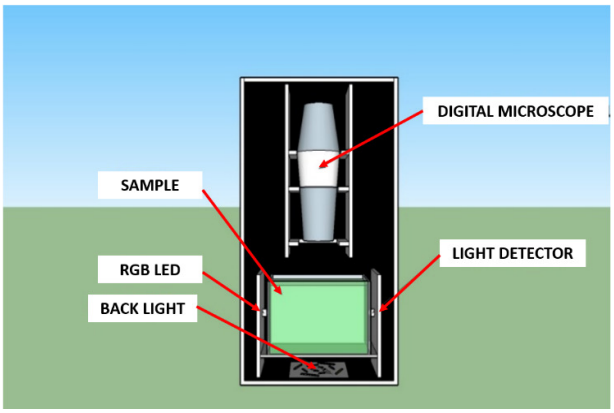

Fig 2. Measurement Chamber

B. Sample Preparation

The sample is made of phytoplankton content which is dissolved in pure water. This sample is then put in the container made from acrylic.

For the first study, the sample used in the experiment was not taken from pond water, but the sample was cultured phytoplankton from laboratory scale. For culturing plankton, Erlenmeyer flask is used. In the initial stages of preparation, all measurement tools and materials are sterilized using autoclave which aims to kill microorganisms that can interfere culture activities.

The seeds of phytoplankton for culture activities is obtained from Jepara BBPBAP in the form of pure mono-species culture. Four types of phytoplankton i.e., Chlorella Vulgaris, Thalasiosira Sp., Skeletonema Sp. and Skeletonema Costatum are used in this experiment. The sample is homogeneous, which consists only one type of plankton in the flask. The plankton density levels are varied, ranging from 0%, 5%, 10%, 25% and 50%, with the composition is shown in Table 1.

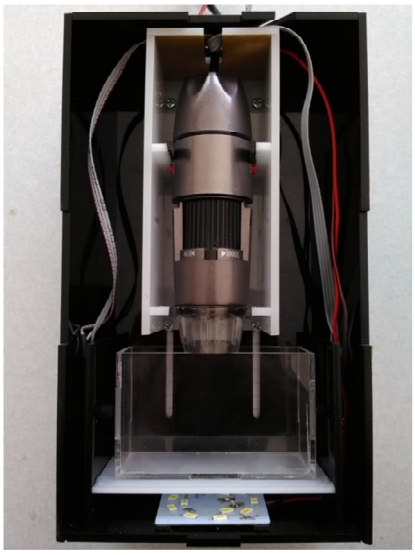

Fig 3. Realization of measurement chamber

TABLE I. PLANKTON SAMPLES DENSITY.

Concentration (%)	Plankton (ml)	Pure water (ml)
0	0	1000
5	50	950
10	100	900
25	250	750
50	500	500

C. How does the system work

The measurement procedure is as follows. The sample that has been prepared is put into a container with a predetermined height. Then the measurement room must be tightly closed to avoid interference from outside light. The first measurement is taking pictures using a digital microscope. This image is obtained by turning on the backlight under the sample, then the digital microscope takes a snap shoot. The second measurement is done by activating the RGB LED. Each of the lights, red, green and blue are activated sequentially, and their intensity is read by a light detector placed on the opposite side of the RGB LED.

III. RESULT

This section describes the results of several measurements. In the measurement, the sample is exposed to the RGB LED light, and the result is received by light detector. In the figure, red line shows the measurement results using a red RGB LED. The same matter is for green line and blue line. The other measurement, the sampled is exposed to the backlight white LED, and the result is received by digital microscope. The result from this measurement shows the component of red, green and blue color shown by red, green and blue line respectively in the figure. The experiment is started by measuring 0% and then followed by the other samples up to 50%. The intensity from each sample is then measured and normalized by the result of measurement from pure water (0% of phytoplankton).

Fig 4 shows the result of measurement using Chlorella Vulgaris as a sample. From the measurement, the higher the concentration the lower the intensity received by light detector. Red line is more dominant compared to the blue and green line when the concentration is under around 43%. It also can be seen that the green is getting higher than blue line when the concentration of Chlorella Vulgaris more than 22%.

Fig 5 and Fig 6 show the measurement result from Chlorella Vulgaris using digital microscope. Fig 5 shows maximum intensity, that is dominated by green line. Red line is under green line, but more dominant than blue line. From the picture, the difference between the green-red line and the red-blue line produces almost similar gap. Fig 6 shows the means intensity. The green line is the most dominant compared to the red and blue line. However, the red line looks very close to the green line. While the red-blue line looks producing significant gap. The trending of all line from Fig 5 and Fig 6 show decline in line with the increment of the concentration.

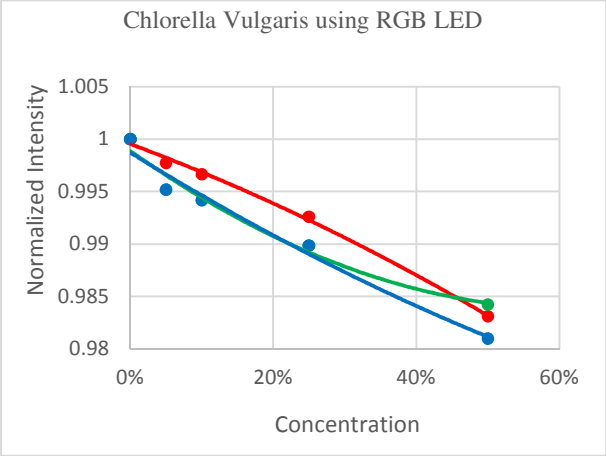

Fig 4. Measurement of Chlorella Vulgaris using RGB LED

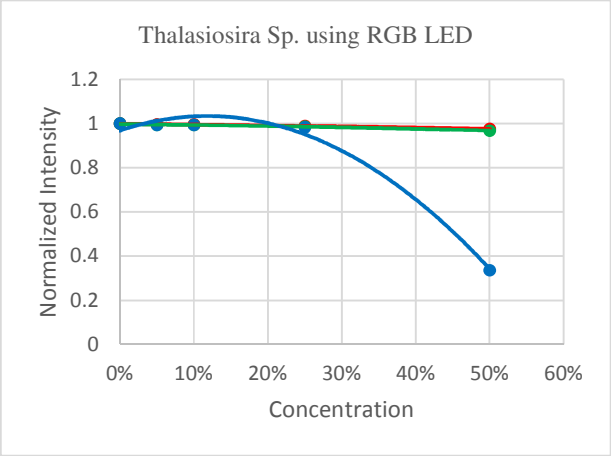

Fig 7. Measurement of Thalasiosira Sp. using RGB LED

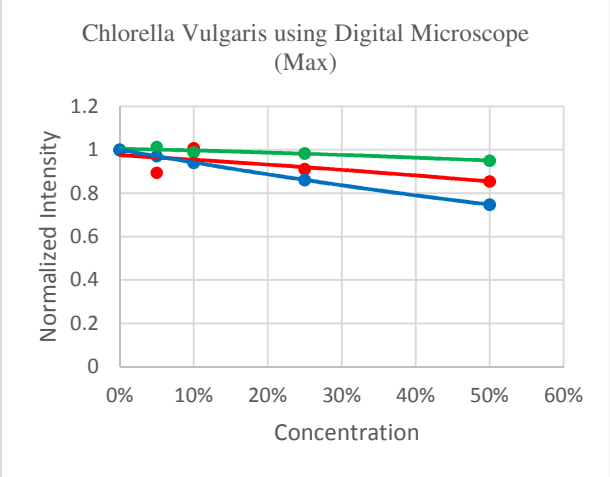

Fig 5. Measurement of Chlorella Vulgaris using Digital Microscope (Max)

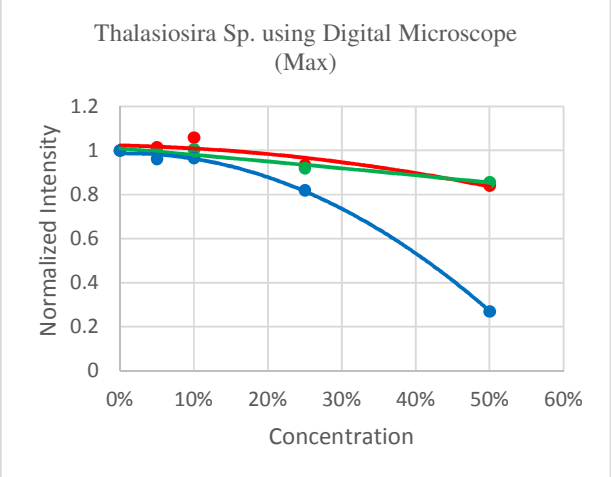

Fig 8. Measurement of Thalasiosira Sp. using Digital Microscope (Max)

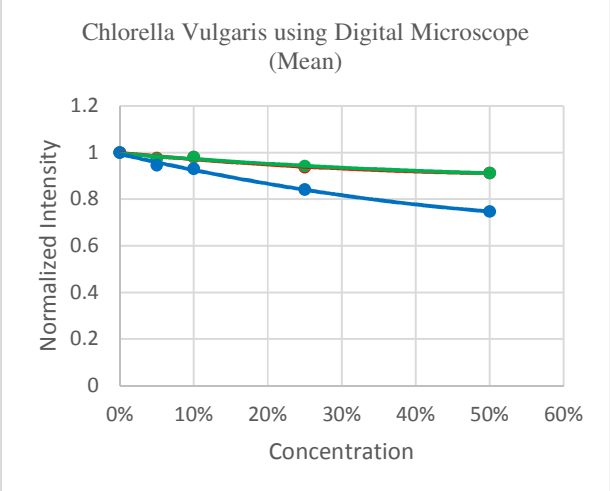

Fig 6. Measurement of Chlorella Vulgaris using Digital Microscope (Mean)

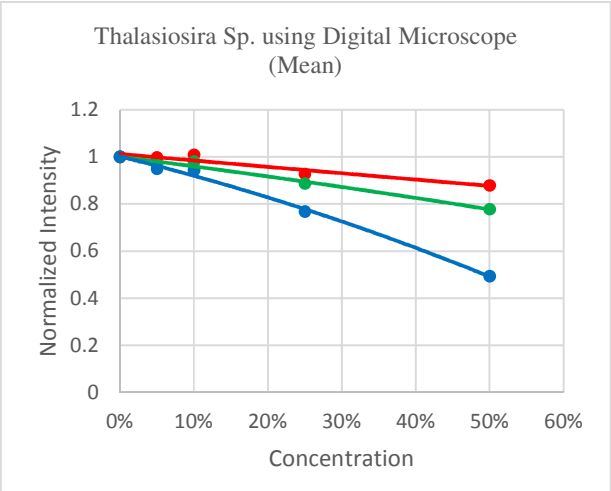

Fig 9. Measurement of Thalasiosira Sp. using Digital Microscope (Mean)

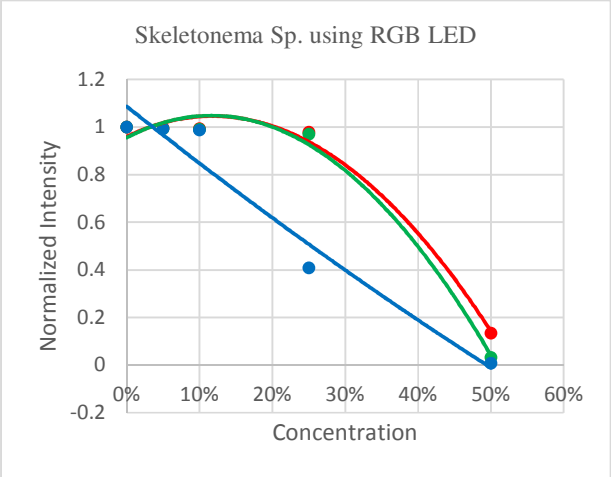

Fig 10. Measurement of Skeletonema Sp. using RGB LED

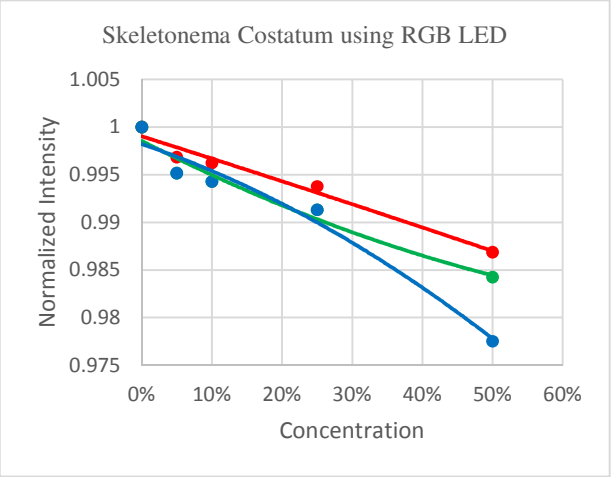

Fig 13. Measurement of Skeletonema Costatum using RGB LED

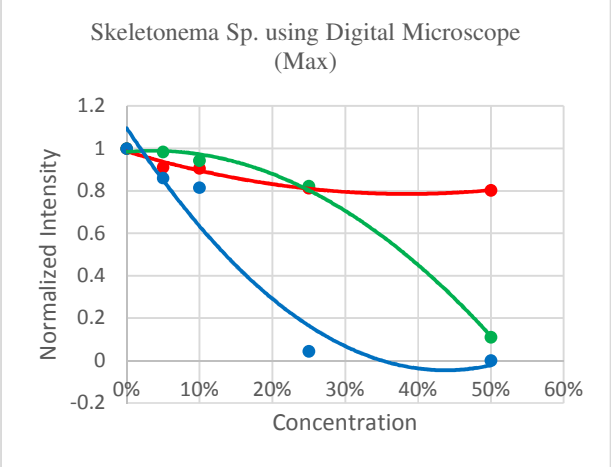

Fig 11. Measurement of Skeletonema Sp. using Digital Microscope (Max).

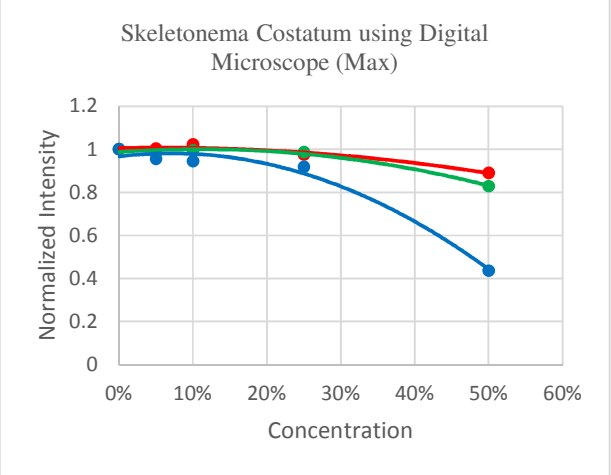

Fig 14. Measurement of Skeletonema Costatum using Digital Microscope (Max).

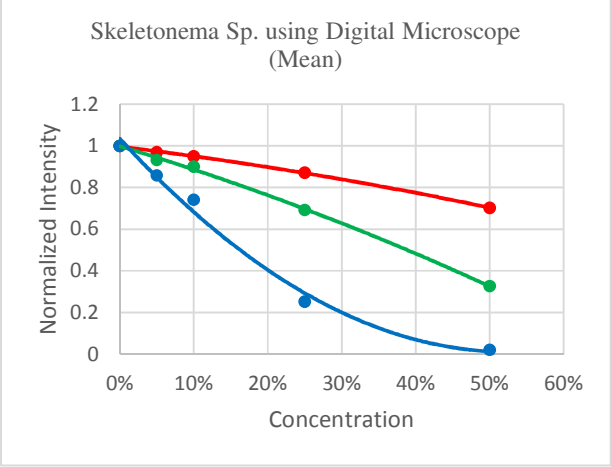

Fig 12. Measurement of Skeletonema Sp. using Digital Microscope (Mean).

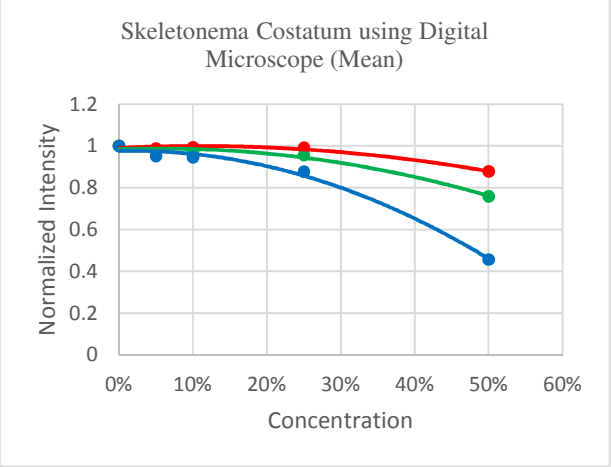

Fig 15. Measurement of Skeletonema Costatum using Digital Microscope (Mean).

Fig 7, 8 and 9 show the measurement results from Thalasiosira Sp. Fig 7 showe the result of measurement using RGB LED. Red, green and blue line looks have similar intensity, when the concentration is between 0% to 24%. From this concentration, blue line is drastically decrease compared to the red and green line. Fig 8 is obtained from digital microscope measurement using maximum intensity. The trending line of this measurement is almost similar to the results shown in Fig 7.

Fig 9 is the result of measurement obtained from digital microscope using means intensity. From the figure, red line is more dominant than green line and blue line. The intensity of blue line is the lowest from this measurement. However, all line tends to decline, in line with the increment of the concentration.

Fig 10, 11 and 12 show the result of measurement from Skeletonema Sp. Fig 10 is obtained from RGB LED measurement. Red and green line are very close to each other. While blue line looks have linear trending line. Fig 11 is obtained from digital microscope measurement using maximum intensity. In this figure, we have difficulty to describe the meaning of the graph. However, after concentration of 25%, red line is higher compared to the green and blue line. While blue line is the lowest. Fig 12 is the result of measurement obtained from digital microscope using means intensity. From the figure, red line is more dominant than green line and blue line. The intensity of blue line is the lowest from this measurement.

Fig 13, 14 and 15 show the measurement results from Skeletonema Costatum. Fig 13 is the result of measurement obtained from RGB LED. Red line is the most dominant in this measurement. Green and blue line are very close to each other before concentration of 25 %, and green line is higher than blue line after 25%. Fig 14 is the result of measurement obtained from digital microscope using maximum intensity. Red and green line are close to each other, with red line is more dominant than green line. The blue line is the lowest. Fig 15 is the result of measurement obtained from digital microscope using means intensity. The result from this measurement is almost similar to the result shown in Fig 14, with the gap between red-green line and green-blue line is greater than the gaps shown in Fig 14.

IV. Conclusion

A study to estimate the concentration of bio-organism based on image color and light intensity has been conducted. Four types of phytoplankton, namely Chlorella Vulgaris, Thambatosira Sp., Skeletonema Sp. and Skeletonema Costatum were used as a sample in this study.

From the results of measurement show that, in general the gap between the red, green and blue line become greater along with increment of sample concentration. In general, the value of intensity normalization for the three lines shows a decrease with increment of sample concentration. However, we feel there is hope that can be developed from this study. Due to limitations at this stage of the study, there are some cases of measurement results that cannot be explained. Future study must be taken carefully in order to improvement the research quality, involving the measurement chamber and also try to measure non-homogeneous sample.

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