The Relationship Water Physical-Chemical Parameters In Seaweed Cultivation Eucheuma Cottonii With Long-Line System

Ihsan Sanggar Rahman, Mohamad Fadjar, Agus Tjahjono

Abstract: Water physical-chemical parameters are an important indicator of success in seaweed cultivation cycle using the Long-line method. The purpose of this study is to determine the relationship between the water physical chemistry parameters of Eucheuma cottonii seaweed cultivation based on dynamic modeling simulation concepts. This research was conducted during the period of Eucheuma cottonii cultivation with the observed variables were the physico-chemical parameters of water at the culture site. The results of the study mentioned based on water quality standards, in general the condition of water quality in the study location is very supportive for seaweed cultivation business. As well as based on the simulation of dynamic modeling concepts it is shown that the productivity rate of ecological seaweed cultivation is significant influenced by dissolved oxygen levels and water temperature fluctuations. So it can be concluded, that dynamically fluctuations in temperature and dissolved oxygen parameters caused by weather conditions or other natural factors have a positive correlation with the rate of growth and productivity of Eucheuma cottonii seaweed cultivation.

Index Terms: Eucheuma cottonii, Long-line, seaweed cultivation.

1INTRODUCTION

Seaweed cultivation is one of the potential commodities from the fisheries agribusiness sector in Indonesian which has quite high economic value (Wijayanto et al, 2011). The priority seaweed commodity developed in Indonesia is Eucheuma cottonii (Ismal el al, 2018). Then, to answer of the increasing market demand, E. cottonii seaweed has been widely developed in various coastal areas with several cultivation methods that are often applied, such as the basic rope method, net bag, and long line (Aslan, 1991 and Soenardjo, 2011). The method of floating rope (long line) is a method of cultivation with a medium long rope (ris rope) which is placed floating on the surface water with 2 sticks from wood (Wijayanto et al, 2011). This method is used on the basis of considerations for intensification of productivity by cultivated land with different spacing (Soenardjo, 2011 and Widowati et al, 2015). In seaweed cultivation, there are external and internal factors which in its development greatly affect to growth rate of seaweed (Gultom et al, 2019). One of these important factors is water quality. Water quality parameters are physicochemical indicators of environmental ecosystems that are highly needed on seaweed cultivation (Rusdi et al, 2017 and Warnadi et al, 2017). Dynamic modeling system is a concept of analytical approach that is developed referring to conditional simulations that are described simply (Van Geert, 2014 and Robinson et al, 2015). This analysis is used as a tool for simulative planning and management of a resource (Toledo et al, 2015). In addition, this analysis is also used as a conceptual technique for managing an object that is multivariable (Agbali et al, 2018). So, from description of seaweed cultivation, the purpose of this study is to determine the relationship between chemical physics water parameters in the seaweed cultivation of Eucheuma cottonii based on the dynamic modeling concept.

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2 MATERIAL AND METHOD

This research was conducted in the Eucheuma cottonii seaweed cultivation area on Laju Village, Bima Regency, Nusa Teggara Barat ($8^0$8"NL - $8^0$57"SL and $118^0$44 " - $119^0$22 EL) in May-July 2019 or when Eucheuma cottonii seaweed cultivation was culture operation. The research variables observed were physical and chemical parameters of water quality which included pH, dissolved oxygen, temperature, current velocity, tranparency, substrate, and salinity with in-situ. Measurement of pH water parameters used the EcoTestrTM pH 2. Measurement of dissolved oxygen and temperature used LUTRON DO meter type DO-5510. Water current velocity measurements are used with current mater devices. The level of water tranparency is determined using secchi disk. Determination of water substrate is determined by taking sediment substrate using sediment grab, which then can be analyzed kirologically according to the procedure from the study of Riniatsih et al, (2009). While the water salinity parameters were measured using Hand-held Refractometer Master N-1α ATAGO. Furthermore, the research data variable were analyzed using dynamic modeling concept simulation with the help by StellaTM ver 9.02 software to determine the dynamic relationship of water chemical physics parameters during Eucheuma cottonii seaweed cultivation.

3 RESULT AND DISCUSSION

3.1 Water Quality Data

Water quality data profile on Eucheuma cottonii seaweed cultivation in Laju village can be seen in the Table 1 about water quality cultivation parameters. Based on the data in Table 1. it can be seen that the pH water value of Eucheuma cottonii seaweed cultivation is measured between 6.4-6.5. The pH range is still within the optimum pH range for seaweed cultivation, which is around 6-9 (Amiluddin, 2007). While dissolved oxygen levels at the study site, ranged from 5.0 to 6.5 mg/L. According to Arthana et al, (2012), states that the level of dissolved oxygen recommended for seaweed cultivation is in the range of 3-7 mg/L. While the temperature

of the waters ranges from 28^0C-31^0C. Good temperature conditions for Eucheuma cottonii cultivation range from 27^0C-30^0C (Aslan, 1991). The temperature value is high quite, because during the cultivation period is during on the dry season. Water temperature that is too high is suspected to cause the color of seaweed to turn pale and unhealthy (Burdames and Ngangi, 2014). Meanwhile, the current velocity at the seaweed cultivation location has an average speed of between 1.5-10 cm/s. In nutrient-rich locations, current velocity of around 10 cm/s are sufficient to support the potential of seaweed cultivation (Mustafa et al, 2017). Dynamics stability of current velocity, very supports to the process of nutrients mixing and chlorophyll-a distribution to be utilized by the macroinvertebrate community (Schoen et al, 2013 and Zulhaniarta et al, 2015).

TABLE 1
WATER QUALITY PROFILE IN SEAWEED CULTIVATION PERIODS

Parameters	pH water	DO (mg/L)	Temperature (^{0}C)	Current Velocity (cm/s)	Transparency (m)	Substrate	Salinity (gr/L)
Value	6.4-6.5	5.0-6.5	28-31	1.5-10	2-5	mud, muddy sand, and coral sand	30-36

The value of transparency at the elevation point of the study site, calculated between 2-5 m or approximately 13-33% of the depth on the cultivation site as deep as 15 m. according to Sudradjat, (2008), a transparency appropriate point for the location of seaweed cultivation should be in the range of >2-5 m. Because the transparency value is too low it will tend to make the waters become eutrophic (Islam et al, 2017). For the type of substrate at the location of cultivation tends to be dominated by mud substrate, muddy sand and coral sand. This is very good, because for the potential utilization of seaweed cultivation, the dominant substrate conditions of the mud bottom are needed (De San, 2012 and Tandel et al, 2016). Because this substrate is an ecological factor that determines by distribution and growth of seaweed (Lee et al, 1999). While salinity levels in seaweed cultivation measured between 30-36 gr/L. Based on the opinion of Burdames and Ngangi (2014), a appropriate salinity value to support the growth of Eucheuma cottonii seaweed ranges from 28-33 gr/L. In field cultivation studies, seaweed tends to grow optimally under hypohaline salinity conditions (Van Ginneken, 2017). So, based on the analysis of the water quality profile at the study site, it can be said that in general the conditions in the Laju village are very potential and supportive for use as Eucheuma cottonii seaweed cultivation.

3.2 Model Conceptual Relationship of Water Chemistry-Physics Parameters

The dynamic modeling concept is a method of approaching a case or object study to be analyzed systematically and effectively (Homer and Hirsch, 2006). In addition, with this analysis it is hoped that later we can predict the conditions of Eucheuma cottonii seaweed cultivation in a complex and practical manner based on cognitive understanding system (Sterman, 2001). Cognitive understanding is meant here is trying to make the concept of forecasting based on the physical chemical parameters of water to be associated with the dynamics of the productivity level of seaweed cultivation. The conceptual simulation model of the relationship between the physical chemical water parameters in Eucheuma cottonii seaweed cultivation can be seen in Figure 1.

The conceptual model in Figure 1. is built on a causal loop approach based on literature studies. This understanding is based on a description of conditions and situations or problems that exist to be recognized how to solve them (Sterman, 2001). Water quality parameters were chosen because this parameter is an environmental indicator that can have a significant influence on cultivation productivity (Neori et al, 1996). In addition, it is also used as an ecosystem feasibility assessment (Hasselstrom et al, 2018). From the description of the concept, it can also be mentioned that some variables have an influential or influenced relationship between each other. Or it can be made an analysis that in the dynamics of seaweed culture ecosystems there are multivariable ecological links relationship. The dynamic ecological linkages are due to diurnal gradient of water quality fluctuations affect from erratic weather or seasons (Rodrigue et al, 2012 and Mooij et al, 2019).

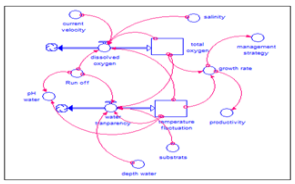

FIG 1. *MODEL CONCEPTUAL RELATIONSHIP WATER PHYSICO-CHEMICAL PARAMETERS IN E. Cottonii CULTIVATION*

3.3 Dynamic Relationship of Water Chemistry-Physics Parameters in Eucheuma cottonii Cultivation

Graphic images of multivariable dynamic relationships, presented in Figure 2., are based on the results of conceptual validation of models loop that have been built previously. The physical-chemical parameters of water that are interpreted are the pH of water, dissolved oxygen content, temperature fluctuations, salinity and estimated growth rate of seaweed as an indicator of cultivation productivity which is analyzed by 7 week projection based on the average Eucheuma seaweed cultivation period in the Laju village, these parameters are physics-chemical water that has a important role in the productivity level of seaweed cultivation (Hidayat et al, 2015; Zuldin and Shapawi, 2015; Nursidi et al, 2017; Melsasail et al, 2018). From the simulation results in Figure 2. show that the growth rate of seaweed has decreased the growth phase since the 5th or 2nd week before total harvest. This has a positive correlation with variable dissolved oxygen content and temperature in waters so similar constant fluctuation values (Figure 2.). The level of water temperature fluctuations will naturally affect to growth rate of seaweed, this is because dynamic temperature fluctuations due to season and weather will have an impact on nutrient solubility in seaweed cultivation locations (Charan et al, 2017 and Nursidi et al, 2017). While the variation of dissolved oxygen levels that affect to seaweed growth rate due to seasonal and weather fluctuations that cause the temperature and salinity of unsteady waters, so that the solubility of oxygen becomes volatile dynamics (Rahadiati et al, 2017). Besides dissolved oxygen as a water chemical parameter in marine culture, in general has a very significant influence on the effectiveness of the growth periods of organism cultivated (Loka, 2015; Zuldin and Shapawi, 2015).

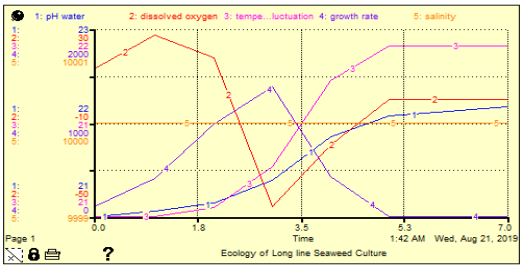

***FIG 2**. RELATIONSHIP BETWEEN WATER PHYSICS-CHEMICAL PARAMETERS IN THE CULTIVATION OF E. cottoni*

Meanwhile, the water salinity value during the cultivation period tends to be stable and the pH value of the waters tends to have a sigmoidal graph. The increase of the pH water value is caused by the increasing waste loading in the cultivation area so that it will affect to increase in the degree of acid-base waters or other chemical compound (Li et al, 2013 and Sharma et al, 2013). Generally analysis, it can be mentioned that the main factor influencing the productivity of Eucheuma cottonii seaweed is the uncertain weather factor. This condition makes some physical-chemical parameters of water such as temperature and dissolved oxygen be as fluctuating, so that it will have an impact on the growth rate of seaweed cultivated that is not effective.

4 CONCLUSION

Based on the simulation of the concept of the relationship between water physico-chemical parameters with on dynamic modeling analysis, it is shown that the temperature and dissolved oxygen parameters that tend to fluctuate have a positive correlation with the growth rate and productivity of Eucheuma cottonii seaweed cultivation.

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