Analysis of Using Bondre System to Cultivate Three Kinds of Seaweed Through Different Seed Weights in The Early Summer at Ekas Bay, Jerowaru, East Lombok.

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Abstract **-** This research aims to determine the effect of seaweed type, seaweed seedweight, and its interaction to the growth and seaweed yield on the Bondre system culture and knows the seaweed type that can grow optimally on the cultivation through the Bondre system. This research also is desgined using Fully Randomized Design (RAL) Factorial with two factors: seaweed type and seaweed weight. Factor of seaweed type (J) consists of three borders: J1: type of seaweed *Kappaphycus alvarezii*, J2: type of seaweed *Kappaphycus striatum*, J3: type of seaweed *Eucheuma spinosum.* Seed weight factor (B) consists of borders: B1: seed weight 4 kg, B2: seed weight 6 kg, B3: seed weight 8 kg, B4: seed weight 10 kg. Each of the treatment border is so combined that it is gained 12 treatment interactions. Treatment is repeated such three times (3 long lines) that is obtained an experimental unit with 36 trial units. Data of research variabel which is obtained, tabulated using Microsoft Excel and analyzed using *Analysis of Variance* (ANOVA) 5% on the real level. As long as there is significant influence, examination will be continued by using forwarded test of BNT on the real similar level. No interaction between type and seaweed seed weight on the Bondre system. Type that can be cultivated on the least optimal season is *Eucheuma spinosum* type. Seed weight is a technical factor which can impact to the seaweed growth. Seed weight is related to density in every Bondre. Strong competition on the seed weight that is dense can cause seaweed fall off as a consequence milling around. The many more seeds are used, the higher dense in every Bondre is.

Keywords: *Seaweed seed weight, Eucheuma spinosum, Karaginan level, Kappaphycus alvarezii, Kappaphycus striatum, growing*.

I. INTRODUCTION

Seaweed is natural resource having high economic value due to the high demand and selling price and cultural environment which is supported (Abdan, 2013). Seaweed is widely developed in the coast of Indonesia, so the potency of seaweed cultivation is very beneficial.

Indonesia and Philippinearethe world's largest seaweed producer country, and 90% of the world market has been dominated by Indonesia (KKP, 2010). Every year production of seaweed continues enhancing from 2.574 million tons in 2009 being 3.082 million tons in 2010 then to be 7.563 million tons in 2013 (DKP-NTB, 2013).

Seaweed cultivation has been developed in several areas suchWest Nusa Tenggara (NTB), East Nusa Tenggara (NTT), Southeast Sulawesi (Central Sulawesi), and other areas in Indonesia (Manikaya Kauci Foundation, 2000). Data of Marine Affairs and FisheriesMinistry shows that the potency of seaweed cultivation is 1.2 hectares and spread over 15 Provinces where West Nusa Tenggara province is one of them having potential area of 41,000 hectares (DKP-NTB, 2014).

The types of commercial seaweed cultivated in NTB are *Kappaphycus alvarezii*, *Kappaphycus striatum*, *Eucheuma spinosum* and *Gracilaria*. Potency of seaweed culture which is wide, high economic value and huge market demand causes NTB Regional Government determining seaweed as superior commodity of area to enhance coastal community income (Government of NTB, 2010).

Supporting this program, NTB government decides10 Minapolitan Seaweed Areas in NTB namely Pengantap urban village of West Lombok, Teluk Gerupuk of Central Lombok, Jerowaru (Teluk Ekas, Serewe Bay and Awang Bay) East Lombok Regency, Kertasari, West Sumbawa Regency, Labuan Mapin of Sumbawa Regency, Terano District, Kuangko Dompu Regency and Waworada Bima Regency (DKP-NTB, 2014). Otherwise, the government also specifically fabricates the factories of manufacture processing chip in East Lombok and Karaginan refinery factory in West Sumbawa Regency (KKP, 2010).

Industrializationbased seaweed is in need of good materials and is available during the year in adequate quality, but the problems being happened seaweed cultureare highly seasonal dependent. Therefore, it needs developing quality of seaweed culture technology throughout the year. One of the likely alternative which can be done is cultivating seaweed type that appropriates with the season (Nikmatullah et al., 2014) and uses the Bondre system to prevent crash due to thallus trouncing (Ghazali et al., 2014). Bond system is a system designed to form a net (net) using a polyethylenestring of ris with a diameter per hole ± 8 cm, width 60 cm and length 8 m.

Bondre has been used being production of seaweed seed as long as the extreme season (Nikmatullah et al., 2014), which the Bondre can prevent the loss of results caused bythallic loss.However, it has not known yet whether the Bondre system can be used for production throughout the year. In addition, it has not also known yet the number of optimal seeds to cultivate seaweed typeof Kappaphycus alvarezii, Kappaphycus striatum and Eucheuma spinosum in Bondre system.

Using different species and seaweed seeds weight in the Bondre system supposedly affect the growth rate of seaweed. Finally, the entitled research"Using Bondre System to Cultivate Three Kinds of Seaweed through Different Seed Weights in the Early Summer at Ekas Bay, Jerowaru, and east Lombok" is necessary.

This researchaims to determine the growth and three types result of seaweed by way of different seed weight in the cultivation of the Bondre system.

II. THE RESEARCH METHOD

This research applied in March until July 2015, at Ekas, Ekas Buana urban village, Jerowaru sub district, east Lombok regency, West Nusa Tenggara province and the level of *karaginan* test applied in Bioscience Laboratory and Biotechnology of Agriculture Faculty, Mataram University.

A. Method and Trial Design

Method used in this research is trial method with testing in the field. This research is designed using Fully Randomized Design (RAL) Factorialwithtwofactors namely seaweed type and seaweed seed weight. Factor of seaweed type (J) consists of three borders: J1: seaweed type of *Kappaphycus alvarezii*, J2: seaweed type of*Kappaphycus striatum*, andJ3: seaweed type of *Eucheuma spinosum*. Meanwhile, seed weight (B) consists of four borders namely B1: seed weight 4 kg, B2: seed weight 6 kg, B3: seed weight 8 kg, and B4: seed weight 10 kg. Each of the treatment borders are combined that gained twelve combinations/interactions. Every unit of twelve the treatment border is repeated three times repetition that gained 36 trial units.

B. Preparatory Step

Preparation applied by preparing the used equipments. Seaweed will be planted in the Bondre putted into *Longline* system. *Longline* used is having size of 25 m X 50 m. Bondre will be girded upon string to *Longline* with distance between Bondre 25 cm in a string and the distance of string 1 m. Every string has three Bondres. Bondre is made from Polyethylene (PE) rope with diameter 2 mm. Then string crocheted being net with diameter ± 8 cm per hole, wide Bondre60 cm and its length 8 m.

C. Preparing Seaweed Seed

Seaweed seeds used in this research are seed of *K. alvarezii, K. striatum* and *E. spinosum.* Seed earned from cultivator is seed being aged 25-30 days. Seaweed seeds used have lots of *thallus*, lush, and healthy. Then seeds cropped in the morning beforeusing in this research.

D. Research Implementation

*Longline*already establishedissetbyadjustingthe planned experimental unit (Table 1). *Longline* used a number of3 pieces. Seaweed seeds are weighed their weight initially suiting to the treatment (4 kg, 6 kg, 8 kg and 10 kg). Each of Bondre will be filled seaweed seeds with different types and seedweighs adjusting to the treatment.

Bondre used is knitted first forming a net. Seaweed seeds, as much as 4 kg-10 kg,are placed or spread evenly over the Bondre, then the Bondre folded towards the width, afterward the rope of ris is used to knit the opened part, so seeds are in the Bondre. The fastening rope of ris is 2 meters longer than the Bondre length, as it is used to knit and to bind the Bondre on the *Longline* then to be added float and aqua bottle (Ghazali et al., 2014). Followed by Bondre is tied to the longline. The distance of the Bondre in the ris is 25cm. Bondre is placed randomly like a in the (Table 1). Seeds been spread will be reserved for 49 days.

Table 1. Placement of Treatment Plots in Longline

Deuteronomy	R1	R2	R3	R4
U1 (Longline 1)	J1 B1 J2 B2 J3 B4	J2 B1 J3 B3 J1 B2	J1 B3 J2 B4 J3 B2	J1 B3 J1 B4 J3 B1
U2 (Longline 2)	J1 B1 J2 B3 J3 B4	J1 B2 J2 B4 J3 B3	J1 B3 J2 B1 J3 B2	J1 B4 J2 B2 J3 B1
U3 (Longline 3)	J3 B1 J2 B3 J1 B4	J3 B2 J2 B4 J1 B3	J3 B3 J2 B1 J1 B2	J3 B4 J2 B2 J1 B1

E. Water quality

Water quality parameters measured were temperature, salinity, pH, DO, intensity, strong influx and level of N and P in seawater.

F. Parameter of Research

The parameters of study consisted of rapid of weight change, total of weight change, calculating dry weight and *karaginan* level. Changing seaweed weight was measured totally using the formula G = *W*t-*W*0 (G = absolute average growth (gram), Wt = average weight in the end of this research (gram), W0 = average weight of seaweed in the beginning of the research (gram).

The rapid of weight change calculated using the formula namely:

LPS = Ln Wt - Ln Wo / t X 100% (Wt = average weight of seaweed at ti (g) (I = week I, week II ... t); W0 = Average weight of grass at ti-1 (g) t = Observation Period (days). The dry weight of seaweedearned by the following formula:

Total of dry weight/kg = sample of dry weight (gr)/Net Weight Sample (gr) x total of wet weight/kg (kg). The

formula to determine *karaginan* level is following (SNI, 1998): *karaginan* level= Wc / Wds x 100%, Wc = Dry weight of extracted *karaginan* (g), Wds = Dry weight of extracted seaweed (g).

G. Data Analysis

The data collected along this research was analyzed using Analysis of Variance (ANOVA) at 5% real level. If there is such significant (significant different) influence that testing will be continued by the assessment using advanced test of on the same real level.

III. RESULT AND DISCUSSION

A. Result

The analysis result of variation to know seaweed weight change in Bondre system uses three types of seaweed and different seeds weight seen in Table 2.Table 2 shows that seaweed type affects rapid of weight change at age 7 weeks after harvesting (mst), but dry weight and *karaginan* level did not influence on rapid of weight changeat age 2 mst and 4 mst, rapid of daily weight change, total of weight change and wet weight.

The opposite ofseaweed type, seaweed seed weight more influenced all observed parameters (rapid of weight change at 2, 4, 7 weeks, rapid of dailyweight change, total of weigh tchange, and karaginan level) than the wet weight and dry weight parameters. But no of interaction between seaweed type and seaweed seeds weight in affecting the rapid ofweight change,total of weight change, wet weight, dry weight and *karaginan* level of three types of seaweed planted on Bondre system with different seed weights.

The effect of seaweed type, seaweed seed weight and its interaction toward growth and result (dry weight and *karaginan* level) in Bondre system were analyzed using the smallest Least Significant Difference (LSD) at 5% real level, and this analysis was performed for the parameter showing a noticeable difference in the analysis of variance.

Table 2. Results of Fingerprint Analysis of the Effect of Seaweed Kinds, Seaweed Seed Weight and Interaction of Heavy Speed Changes in Bondre System

Factor	Speed of Change in weight				Total Change in weight	Gross Weight	Dry Weight	Degree of Carrageen
	2 mst	4 mst	7 mst	Speed Daily				
KIND (Kind of Seaweed)	Ns	ns	s	ns	ns	ns	s	s
WEIGHT (weight of seed)	S	s	s	s	s	ns	ns	s
KIND x WEIGHT (Interaction kind of seaweed x weight of seed)	Ns	ns	ns	ns	ns	ns	ns	ns

Table. 3. The Effect Of Seaweed Kinds in The Speed of Change in Weight In The Bondre System

Kind of Seaweed	Speed of Change in weight (%)				Total Change in weight (kg)
	2 mst	4 mst	7 mst	Speed Daily	
J1 (K. alvarezii)	0.49	-0.41	-1.58a	-0.65	-1.46
J2 (K. striatum)	0.40	-1.07	-0.19b	-0.27	-1.16
J3 (E. spinosum)	0.51	-0.17	-0.01b	0.09	0.00
LSD 0.05	-	-	1.32	-	-

Table 4. The Effect of Kind of Seaweed Seed in Wet Weight, Dry Weight and Carrageenan Rate in the Bondre System

Kind of Seaweed	The wet weight of the harvest (gr)	Dry weight of harvest (gr)	Bb : Bk	Degree of Carrageen (%)
J1 (K. alvarezii)	5352.80	545.19	9.8 : 1	58.97ab
J2 (K. striatum)	5861.10	573.78	10.2 : 1	51.80a
J3 (E. spinosum)	6847.20	927.94	7.4 : 1	63.69b
LSD 0.05	-	154.01	-	7.69

B. The Influence of Seaweed Type

The effect of seaweed type on the rapid ofweight change and total of weight change can be seen in Table 3.

The data in Table 3 indicates that the positive rapid of weight change gained ontwo weeks meanwhile the negative rapid ofweight change obtained on the fourth and seventh week. It means all of the seaweed types planted by the

Bondre system got increased weight on the second week, but on the fourth and seventh week got decreased weight. Nevertheless, no difference in the rapid of weight change in these three types of seaweed on second and fourth week, howeverlosing weight of *Kappaphycus alvarezii* (J1) seaweed type will be larger than losing weight of *Kappaphycus striatum* (J2)) and *Eucheuma spinosum* (J3).

Table 7 also shows that rapid of daily weight change and total of weight change of these three types in the Bondre system were similar but *Eucheuma spinosum* (J3) was lower losing seaweed weight.

This research, influencing seaweed type to dry weight and *karaginan* level observed in the table 4.

Data in Table 4 shows that there are no difference between weight and weight. The dry weight produced by *Eucheuma spinosum* (J3) is higher than *Kappaphycus alvarezii* (J1) and *Kappaphycus striatum* (J2) type, where there is no verysignificant (significant) difference between the treatment of J1 and J2 on the dry seaweed weight parameter. Like a dry weight, *karaginan* level produced by J1 seaweed type (Kappaphycus alvarezii) and J3 (Eucheuma spinosum) is higher than karaginan J2 (Kappaphycus striatum). Karaginan level in the J3 treatment is 63, 69% and J1 is 58, 97% but *karaginan* level of J2 id 51, 80%.

Ratio of wet weight together with dry weight, J2 (Kappaphycus striatum) and J3 (Eucheuma spinosum) showed lower ratio than J3 (Eucheuma spinosum) which contained higher karaginan level.

Table 5. The Effect of Seaweed Seaweed Weight on the Speed of Heavy Change and the Total Heavy Change of the Bondre System

Weight of seaweed seeds	Speed of change in weight (%)				Total Change in weight (kg)
	2 mst	4 mst	7 mst	Speed Daily (%)	
B1 (4kg)	1.83[c]	1.01[c]	0.24[b]	0.89[b]	2.20[c]
B2 (6kg)	0.67[b]	0.00[b]	0.17[b]	0.29[b]	1.00[c]
B3 (8kg)	0.08[b]	-1.29[a]	-1.39[a]	-0.94[a]	-2.20[b]
B4 (10kg)	-0.71[a]	-1.92[a]	-1.40[a]	-1.34[a]	-4.50[a]
LSD 0.05	0.78	1.00	1.52	0.69	1.50

Table 6. Effect of Seed Weight on Wet Weight, Dry Weight and Carrageen Content on Bondre System

Weight	The wet weight of harvest (gr)	Dry weight of harvest (gr)	Bb : bk	Degree of carrageen (%)
B1 (4kg)	5814.70	704.40	8.3 : 1	57.40[ab]
B2 (6kg)	6555.60	748.10	8.8 : 1	49.48[a]
B3 (8kg)	5766.70	624.00	9.2 : 1	61.66[b]
B4 (10kg)	5500.00	590.60	9.3 : 1	64.07[b]
LSD 0.05	-	-	-	8.88

C. The Influence of Seaweed Weight

The analysis result of various test before shows that seaweed seed weight implies to almost of parameters observed. The effect of seaweed seed weight toward changing of weight rapidity displayed in table 5.

Data in the table shows that Bondre planted by more insignificance seed (4 and 6 kg) got extra weight on week of 2, 4, 7 mst indicated with rapid of weight change positive, meanwhile Bondre planted with more than 6 kg (8 and 10 kg) seeds got decreased weight which was indicated by rapid of weight change negative. The similar thinghappened in the parameter of rapid of daily weight change where daily rapid of weight change in B1 and B2 treatment (4 kg and 6 kg) having positive value from B3 and B4 treatment namely (8 kg and 10 kg) getting negative value. Rapid average of treatment changing weight B1 (4 kg), B2 (6 kg), B3 (8 kg), and B4 (10 kg) is 0.89%, 0.29 %, -0.94%, and -1.34% successively. Thus total of weight change having positive value is B1 (4 kg) and B2 (6 kg) but B3 (8 kg) and B4 (10 kg) show negative result.

Beside of the rapid of weight change, this research also analyzes the effect of seed weight to wet weight, dry weight and *karaginan* level as contained in the table 6.

Data on the table 6 shows that there are no real differences from the fourth treatments of seaweed seed weight toward wet weight and dry weight. Butthere is a significance that wet weight and dry weight produced by treatment of B1 and B2 seaweed weight (4 kg and 6 kg) are higher than treatment of B3 and B4 (8 kg and 10 kg). Where B2 (6 kg) produces wet weight and dry weight that are highest with 5500.00 gram (B4) wet weight and 748.10 gram dry weight and the lowest wet weight is 5500.00 gram (B4) and dry weight is 590.60 gram (B4). Beside that, B1 and B2 treatment (4 kg and 6 kg) having comparison of wet weight and dry weight are 8.3:1 dan 8.8:1 lower.

Karaginan level of several seaweed seeds is range from 49-64% where B4 treatment producing the highest *karaginan* level (64.07 %) is followed by treatment B3 (61.66%) and B1 (57.40 %), and the lowest B2 is 49.48%.

D. Interaction between Type and Weight

There are no interactions between type and seaweed weight toward all parameters that are observed. Interaction between rapid of weight change to type growth and different seaweed seed weights in Bondre system can be seen in the table 7, 8, and 10.

Data in the table 7 shows that type and seaweed weight get decreased of rapid of weight change on weeks 2, 4, and 7 related to grow of seaweed seed weight in every treatment. Based on this three seaweed types, *Eucheuma spinosum* (J3) type is higher rapid of its change and seaweed weight which is higher is B1 (4 kg), of the three types being lower are *Kappaphycus striatum* (J2) type and seaweed weight to be lower is B4 (10 kg).

Data in the table 8 shows that daily rapid of weight change and total of weight change to the three types are decreased along with increased seed weight. B1 and B2 (4 and 6 kg) treatment get increasing positive weight in the three type seaweed but B3 and B4 treatment (6 and 10 kg) get decreasing weight or negative value. From the three seaweed types, J3 (*Eucheuma spinosum*) has daily rapid of weight change and total of weight change is higher.

Data in the table 9 shows that the data is trend of wet weight. Dry weight seaweed of the three types decreased together with increasing seed weight used in every treatment. J3 B1 treatment is *Eucheuma spinosum* (J3) having weight 4 kg. It means J3 is higher than another treatment. The most influence of increasing weight seed of the three types is *Eucheuma spinosum* (J3) and the lower type is *Kappaphycus alvarezii* (J1). Thus in the table 10, *karaginan* level of three seaweed types is higher on J3B3 treatment; *Eucheuma spinosum* having weight of 8 kg, and J2B2 treatment is *Kappaphycus striatum* (J2) having weight 6 kg that *karaginan* level is lower.

Table 7. The Speed of Weight Seaweed Changes on Bondre Systems of Kind And Different Weight Seeds

Kind of Seaweed	**speed of change in weight 2 mst (% per daily)**				**speed of change in weight 4 mst (% per daily)**				**speed of change in weight 7 mst (% per daily)**			
	Seed Weights				**Seed weight**				**Seed weight**			
	B1	B2	B3	B4	B1	B2	B3	B4	B1	B2	B3	B4
J1	1.28	0.55	0.28	-0.15	1.17	0.68	-1.27	-2.24	0.52	0.08	-4.07	2.86
J2	2.21	0.74	-0.15	-1.18	0.80	-1.05	-1.52	-2.51	-0.36	0.30	-0.02	-0.69
J3	2.00	0.72	0.12	-0.8	1.06	0.36	-1.09	-1.01	0.38	0.32	-0.12	-0.60

Table 8 Daily Change in weight and Total Change in weight on Bondre System Of different kinds and weight of seedlings

Kind of seaweed	**Daily change in weight rate (% per daily)**				**Total Change in weight (kg)**			
	Seed weight				**Seed weight**			
	B1	B2	B3	B4	B1	B2	B3	B4
J1	0.92	0.39	-2.02	-1.91	2.33	1.33	-3.86	-5.67
J2	0.70	0.04	-0.48	-1.35	1.67	0.16	-1.67	-4.83
J3	1.04	0.45	-0.33	-0.78	2.67	1.50	-1.16	-3.00

Table 9. The Interaction between Kind and Weight of Seaweed to Dry Weight and Wet Weight On Bondre Systems

Kind of Seaweed	**Wet weight of seaweed (gram)**				**Dry weight of seaweed (gram)**			
	Weight of seaweed seeds				**Weight of seaweed seeds**			
	B1	**B2**	**B3**	**B4**	**B1**	**B2**	**B3**	**B4**
J1	5611.1	7333.3	4133.3	4333.3	57.63	55.22	46.23	49.16
J2	5777.8	6166.7	6333.3	5166.7	45.43	53.03	47.30	49.00
J3	6055.3	7500.0	6833.3	7000.0	77.10	69.13	64.97	61.67

Table 10. The Interaction between Weight Seaweed Kinds of Carrageenan Content in Bondre Systems

Kind of Seaweed	**Degree of carrageenan (gram)**			
	Seed weight			
	B1	**B2**	**B3**	**B4**
J1	55.44	49.76	58.89	66.33
J2	55.44	37.22	58.22	60.33
J3	65.33	56.00	67.89	65.56

E. Water quality

Water quality throughout the researchis obtained results of pH ranged from 7.7-8.8, temperatures ranged from 27.3-27.6oC, salinity ranged from 33-34 ppt, DO ranged from 7.4-8.7 mg / l, brightness 4-5 m, stream velocity 0.09 - 0.13 m / s. The six water quality parameters are measured in

the observation section, but Nitrate (NO3) with 1.7 mg / l and Phosphate (PO4) 0.45 mg / l measured once ontwo weeks after planting (mst).

F. Discussion

This research is applied in the inappropriate season; May until July 2015. It is to analyze whether Bondre system can be used producing excellent seaweed long year. This research aims to know type and seaweed seed weight and its interaction to the growth and seaweed result into Bondre system cultivation.

This research uses planting method of Bondre system with seaweed type and different seaweed seed weight namely *Kappaphycus alvarezii, Kappaphycus striatum* and *Eucheuma spinosum* types with weight 4 kg, 6 kg, 8 kg, and 10 kg. Likewise, parameter of growth and result observed in this research is rapid of weight change on 2 mst, 4 mst and mst, daily rapid of changing, changing weight total, wet weight, dry weight, comparison between wet weight with dry weight and karaginan level. Total of weight change observes increasing of changing weight during test. While rapid of weight change observes increasing of seed weight onto 2 mst, 4 mst, 7 mst and its average is 40 days. Rapid of weight change in this research explained by specific growth trend and its average, but total of weight change is used to describing absolute growth.

The analysis result of variety (table 3) shows that seaweed type influences rapid of weight change on 7 mst, dry weight and *karaginan* level. However, seaweed type does not influence to rapid of weight change onto 2 mst and 4 mst, wet weight and total of weight change using Bondre system.

Seed weight influences all of parameters except wet weight parameter and dry weight. Otherwise, it has no an interaction between type and seaweed seed weight in affecting growth and result. It means that type and seaweed seed weight affected growth and result observed by separated where the effect of seaweed type does not depend on seaweed seed weight used, on the contrary, influencing seed weight depends on seaweed type used.

This research table used three seaweed types: *Kappaphycus alvarezii, Kappaphycus striatum* dan *Eucheuma spinosum.* Table 7 and 9 shows that seaweed type has influenced to rapid of weight change on 7 weeks after harvesting (mst), dry weight and karaginan level. From the three seaweed types, *Kappaphycus alvarezii* took decreased significance of rapid of weight change along this research. *Eucheuma spinosum* (J3) is the highest, dry weight and karaginan level.

Aquatic environment condition is the main factor affecting growth and result of three seaweed types. When this research is applied, environmental condition of cultivation is less optimal.

The result of observing water quality parameters shows that strong stream is very low 0.09-0.13 m / s within optimum 0.33-0.66 m / s, aquatic salinity in the cultivation area ranged from 33-34 ppt, where salinity to growth and seaweed production suitable are 28-35 ppt with optimum 32 ppt (Kadi and Atmaja, 1988; Zatnika & Space 1994). Beside of those two parameters, pH, DO and brightness are still optimal which Nitrate and Phosphate are 1.7 mg / l and 0.45 mg / l with a nitrate optimum 1.0-3.2 mg / l and phosphate 0.02-0.10 mg / l (Zatnika & Space 1994).

Environmental condition which has yet to be optimal can cause the growth of seaweed seed being decreased even it cannot get to be growth. It can be affected by wave and ebb and flow marine, stream velocity, solar radiation intensity, brightness and nutrient that are in the marine.

Aslan (1998) said that *Kappaphycus alvarezii* had already generally grown well in reef area where its characteristic habitat was an area that got constant seawater flow which is 0.33-0.66 m/s,small daily temperature variety and coral reef were dead. Cokrowati (2013) revealed that in selecting seaweed cultivated area already needed of considering strong aquatic wave. Strong wave having an important role in cultivating *Kappaphycus alvarezii*due to good wave would give nutrition for plants, wash or clean the otherseaweed that is so adhesive that seaweed would be clean out of dirty or adhesive sediment then would floated off by wave.

Soegiarto in Sinaga (1999) revealed that the more strong wave of aquamarine had, the faster growth of seaweed as nutritional diffusion into thallus cells would be so faster that metabolism was prompted. Beside of that, wave would influence sedimentation onto the aquamarine, which was the end it would affect radiance (Doty, 1973).

The faster wave, the more inorganic nutrientthat flowed and infiltrated by plants through diffusion process. Because of it, the growth of *Kappaphycus alvarezii* in the strong wave condition that was weak at this research also analyzed causing plants got nutrient minimum, radiance, and adhered epiphytes or parasitethat destroyed photosynthesis process and its growth.

From the three seaweed types, *Eucheuma spinosum* (J3) type is more defenses in the season which is less optimal. It is caused *Eucheuma spinosum*known by *spinosum* meaning incisive thorn. Beside of that, it has sign of cylindrical thallus, wax and elastic (Sudradjat, 2008). The thorn sticking out to side and its thallus is very slippery causing epiphytes difficult to stick on thallus of *Eucheuma spinosum* (Romimohtarto dan Juwana, 2005). Speed of *Eucheuma spinosum* wave is 0.33-0.66 m/d, 27-28^{o}C temperature, and 30-37 ppt salinity (Kadi dan Atmaja, 1988), it making *Eucheuma spinosum*can is defense in this research than *Kappaphycus* that has thallus branch to several sides with centralized main branches on base and facilitates prickled marine biota growth attached on its substrate. *Kappaphycus* type is seaweed being vulnerable relatively to low wave speed with ideal wave speed to growing *Kappaphycus*that is 0.5 m/d.

Low growth caused by planting done in early summer. Yulianto (2003) revealed that the cultivation of seaweed should avoid the one until two weeks before summer. Now is season where disease appears after *algae blooming*or aquatic condition get explosion of plankton population to make aquatic appearance be green and high salinity enough.

Some macro pests which is seldom founded in this research are barnacle (picture 1), even sea cucumber bout is always followed by growing lichen in the thallus area which is such adhered that adhered thallus will be white eventually. Beside of barnacle, brunts of seaweed and sea urchins are also founded (picture 1). This snail will eat the part of young seaweed tip and the part that will grow and develop. If this part of thallus is eaten such snail that seaweed will not grow even will be eaten completely by the snail (Directorate General of Fisheries, 2004).

Figure 1: Epiphytic attacks (A), thallus whitening due to barnacles attack (B) and pork larvae attached to seaweed (C)

Seaweed pest adhered on the seaweed thallus, it caused seaweed cannot receive nutrient and oxygen available on optimal aquatint due to its appearance closed off adhesive pest. Epiphyte pest is pest that adhered and took nutrient from seaweed thallus to survive as parasite (Atmadja dan Sulistijo, 1977).Seaweed pest preyed seaweed generally that will make physical damage toward thallus, where thallus would be exfoliation easy, be broken or eaten completely by pest.

Micro pest is sea organism that generally has a long less than 2 cm and macro pest that is in cultivation area and already measured big or full-fledged. Micro pest lives staying with seaweed thallus, as (*Tripneustes* sp.), (*Holothuria* sp.), lichen of louse, egg horde and epiphyte founded in this research where they are plankton, drifted in the water and then adhered on seaweed plant. Adhesive plant in this big colony enough will agitate seaweed plant. The adhesive plants are *Hipnea*, *Dictyota*, and *filamen* as *Lyngbya* and *symploca* (Atmadja and Sulistijo, 1977).

It can decrease penetration of radiation received by seaweed that can affect cultivated growing seaweed indirectly. Seaweed, which already adhered epiphyte its thallus would be flabby, fright thin until shattered. Seed weight is one of technical factor that can affect to grow of seaweed.

Seed weight related to density in every Bondre. Closed rivalry on the full seed weight can cause seaweed broken or down by scrambling. The more seed used that will be higher density in the Bondre.

Poncomulyo etc, (2006) said that seaweed growth assumed enough had upper 3 % incresing weight per day. The density of seed seaweed, when planted will affect seaweed thallus area which is radiated, would affect to photosyntesis process, the part of plants absorbing nutrient and another rivalry betweem one clump and others in the Bondre. The many more seaweed seedsare, the higher density will be. So possibility of rivalry will also be higher in absorbing nutrient. Another factor assumed that had caused losing B3 treatment result (8 kg) and B4 (10 kg) was caused by competing space being scramble then down from Bondre.

Another reason, the heavier seaweed seed putted in a Bondre that higher rivalry between thallus in absorbing radiance was. Seed weight that is more 6 kg is assumed seaweed thallus in Bondre closing each other that caused photosynthesis process. Meiyana (2001) said plant closing each other will prevent process of photosynthesis. Process of photosynthesis is bio chemical process that has been done by plant to produce energy (nutrition) with using sun energy. Competition to get this radiance is very caused by growth and to growing plant. Its minimum radiance gained will delay process photosynthesis that will be caused in seaweed growth (Santika, 1985). The plant meant is process adding weight where changing of seaweed weight describes whether seaweed in this research gets growth or not (Meiyana 2001).

Erpin (2013) said that seaweed growth correlated to *karaginan* level which causes high or low level of *karaginan* in harvest period and seed weight. The part of thallus tip indicated that wet weight plant being higher would have produced dry weight and *karaginan* level that is also high. Where the higher dry weight of seaweed is, the higher *karaginan* seaweed is too (Wenno, 2009). Mendoza et al. (2006) said that amount and *karaginan* quality coming from various cultivation of sea, not only is it based on type but also plant age, radiance, nutrient, temperature and salinity.

Based on data above that this research is not suitable using Bondre in minimum season due to the fact that wove movement is low. If wanting cultivation on this month, it should use type of *Eucheuma spinosum* with seed weight 4 until 6 kg per Bondre.

IV. CONCLUSION

Type of seaweed does not cause to plants and results except rapid of weight change at 7 mst, dry weight and *karaginan* level. Seaweed seed weight caused to rapid of weight change at 2,4,7 mst, daily rapid change, total of weight change and *karaginan* level, yet it does not cause to wet weight and dry weight. Nothing interaction between type and seaweed seed weight in influencing growth and seaweed result in Bondre system.

The three seaweed types do not give growth and optimal result, but there is significance that *Eucheuma spinosum*type is cultivated by Bondre system in early summer with seed weight 4 until 6 kg per Bondre.

SUGGESTION

The farmers suggested in early summer to be focus to maintenance seed. Yet, if they want cultivating seaweed, they do not use Bondre system in that month. An additional research is required using Bondre and non-Bondre system to cultivate in early summer. The further research about Bondre system suitability with another month is also required using seed weight until 6 kg per Bondre.

REFERENCES

Abdan, R., 2013. *The Influence of Planting Distance to The Growth and The Seaweed Karaginanlevel (Kappaphycusalvarezii) Using Long Line Method [Thesis, unpublished] Department of Fisheries and Marine, Lampung University*. Page 113-123

Aslan L.M., 1998. *Seaweed Cultivation Series*. Kanisius. Yogyakarta.

Atmadja WS., Sulistijo., 1977. *Effort of Utilizing Eucheuma Spinosum Sea Algae Steak seeds (L) J. Agard at the Pulau Seribu to Cultivate*. Jakarta LON LIPI. Hal 433-449.

Cokrowati, N., 2013. *Textbook of Cultivating Seaweed Technology. Aquaculture Study Program. Mataram University.*

Fisheries Department. 2004.*Indonesia's Seaweed Profile*Jakarta.

DKP-NTB., 2014.*NTB Exported Seaweed to Vietnam http://www.m.antaranews.com/berita/469721/ntb-ekspor-rumput-laut-ke-vietnam.*[5 Mei 2015].

_____., 2010.*NTB Exported Seaweed to Vietnam. http://www.m.antaranews.com/berita/469721/ntb-ekspor-rumput-laut-ke-vietnam.*[5 Mei 2015].

Doty, M.S., 1973. *The Production and Eucheuma Usage in The Botani Department, Hawaii University*. Hawaii.

Erpin, A., 2013. *The Influence of Harvest Age and Seed Weight to Growth and Seaweed Karaginan level (Eucheuma spinosum) Using the Long Line Method*. [Thesis, unpublished]. *Department of Fisheries, Hasanuddin University Makassar.*

Ghazali M., Kurnianingsih., Sunarpi., Aluh, N., 2013. *The Bondre System to be Seed Granary along Year*. Prosiding Seminar Nasional Pariwisata. Mataram, 12 September .Hal 101.

Kadi, A. and Atmadja, S., 1988.*Algae Seaweed Type, Reproduction, Production, Cultivation, and Post-Harvest. Study Project of Potency of Indonesia Natural Resources Oceanographic Development Research Center, Indonesian Institute.*

KKP., 2010. *Strategy Plans of Marine and Fisheries Development.* Ministry of Marine Affairs and Fisheries, Jakarta.

Meiyana, M., Evalawatidan Prihaningrum, A., 2001.*The Seaweed Biology*, Aqua culture Center. Lampung.

Mendoza et al., 2006.*Critical Success factors For a Customer Relationship Management Strategy*. *Information and Software Technology.*

Nikmatullah, A., M, Ghazali., R, Kurnianingsih., Sunarpi., 2014. *Species Improvement Towards Improved Adaption of Eucheuma/Kappaphycus* Spp*/to Mitigate Climate Changes*. Climate Change Adaptation Project, CSIRO, Mataram.

Pemerintah Daerah NTB., 2010. *Seaweed Culture*. *Department of fisheries and Marine.*WesatNusa Tenggara.

Poncomulyo, T., H, Maryani., dan L, Kristiani., 2006. *Cultivation and Seaweed Management.* Agro Media Pustaka. Jakarta.

Romimohtarto, K. dan S. Juwana. 2009. *Marine Biology*: *Marine Biota Science*.Djambatan. Jakarta

Santika, I., 198. *Seaweed culture. Aqua culture Center*.Lampung.

Soegiarto, S., 1999. *Factor of Water Movement*. Seaweed Paper. Makassar.

Sudrajat, 2008. *Seaweed Culture*. Penebar Swadaya. Jakarta. Hal 148.

Wenno, M.R., 2009. *Daily Study of Growth Movement, Dry Weight Production and Karaginanlevel from Eucheuma cottonii in various parts of Thallus, Seed Weight and Harvest Age. [Thesis, unpublished]. Department of Fisheries Product Technology. Pattimura University. Sulawesi.*

Yayasan Manikaya Kauci., 2000. *Nusa Penida Seaweed Business Administration: People's Interest Conflict and Coastal Environment Tourism Entrepreneurs.htt://www.manikayaterranet.or.id*. Accessed in April 25, 2015. Page 6.

Yulianto, K. 2003. *Observation of "Ice-ice" Disease and Phenomena of Algae Competitor Being Causes Harvest of Seaweed Culture Failure (Kappaphycus alvarezii (C) Argardh) at Pari Island, PulauSeribu in 2000 and 2001*. Proceedings of the National Marine Science and Technology Seminar.

Zatnika, A danIstini, S., 2007. *Seaweed Production and Its marketing in Indonesia*, Seafarming Workshop. Bandar Lampung.

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