BUKTI KORESPONDENSI

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Penulis : Abdul Rauf (Koresponden author), Muhammad I. Wamnebo, Muhammad H. Fattah, Harlina dan Andi Asni

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1. Bukti konfirmasi submit artikel (24 Maret 2021)

Re: AACL Bioflux Journal

From: arauf arauf (arauf_umimksr@yahoo.com)

To: ek.bioflux@gmail.com

Date: Wednesday, March 24, 2021 at 06:20 AM GMT+8

Dear Eni,
In connection with my research activities at the Ministry of Research and Technology where one of the requirements is to have an international journal, I ask for your help to be able to publish my journal before May 2021.

Thank you.

Kind regards,

Abdul Rauf

> On Sunday, March 14, 2021, 05:31:11 AM GMT+8, Eni Kovacs <ek.bioflux@gmail.com> wrote:
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> Dr. Miklos Botha unfortunately passed away unexpectedly, thus, I will be your editor and I will stay at your disposition for all the aspects concerning your manuscript.
>
> Please inform me about the status of your manuscript.
>
> Thank you.
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> Kind regards,
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Abdul Rauf, Muhammad Ikhsan Wamnebo, Hattah Fattah, Harlina, Andi Asni

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Cultivation of Seaweed using the Basic Spread System in Floating Net Cages on Salemo Island, Pangkep Regency, South Sulawesi

[1]Abdul Rauf, [2]Muhammad Ikhsan Wamnebo, [2]Muhammad Hattah Fattah, [2]Harlina Harlina, [3]Andi Asni

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Corresponding author :: arauf_umimksr@yahoo.com

Abstract. Seaweed has a large enough potential to be developed, especially in small islands. So far, cultivation activities carried out by seaweed farmers generally use stretch ropes so that they have high operational costs. One of the cultivation technology innovations that can be developed with an operational cost that is quite cheap and easy to operate is seaweed cultivation using floating net cages with a basic stocking system. The purpose of this study was to design a tool / media for seaweed cultivation in the form of marine cage with a bottom stocking system and to analyze the absolute growth rate based on the depth of placement of the cages (30.50 and 70 cm). The method used in this study is the cultivation of seaweed with a bottom stocking system at different depths of floating net cages (KJA). This study uses a comparative analysis approach, which compares the results of seaweed production based on different marine cage depths. The results showed that the highest seaweed production was at a depth of 50 cm above sea level, followed by 70 cm and the lowest was at a depth of 30 cm. The results of this study are expected to contribute to increased production and income for seaweed farmers, especially in Pangkep Regency.
Keywords: seaweed, bottom stocking, floating net cages.

Introduction. Pangkep Regency is one of the districts in South Sulawesi Province which has a coastal area with a coastline of about 49.71 Km and has a total of 145 islands (Pangkep District in Figures, 2017) with various coastal geomorphological variations, starting from hilly areas. to the sloping beach. Salemo Island is one of the islands located in Liukang Tupabbiring District, north of which has the potential of marine resources that are potential enough to be developed, namely seaweed cultivation. One type of seaweed that is commonly cultivated by people in this area is Eucheuma cottonii (Kappaphycus alvarezii) (Anggadiredja, et al., 2006). This species is widely cultivated because the production technology is relatively cheap and easy and post-harvest handling is relatively easy and simple (Meiyana, et al., 2001). Besides that, the seeds are also sufficiently available so that they are easy to obtain (Dahuri, 2001; Dahuri, 2003). Apart from being an industrial raw material, this type of seaweed can also be processed into food (Restiana, et al., 2009; Ghufran, 2010; Sulisetijono, 2009) which can be consumed directly. Seaweed cultivation in Pangkep Regency has encountered many obstacles, which have resulted in reduced yields. Constraints commonly experienced by cultivators in this area include the lack of understanding of cultivators about the correct cultivation techniques, the quality of the product is still not being considered and the most dominant is the problem of price, where the price is determined by the buyer or collector. In addition, the handling of seaweed pests is not appropriate so that pests can spread and attack the entire production area, ice-ice disease, weather, changes or decreases in the quality of the cultivation environment (Effendi, 2003), and low quality of human resources. One of the most important factors is the right cultivation method, namely efficiency in space, free from pests such as baronang fish and those that are broken due to waves and currents (Hutabarat and Evans, 2008; Syamsiah. 2007; Wijayanto, et al., 2011.). One method that can be used is to use floating net cages (KJA) media. The seaweed cultivation method referred to in this study is focused on the use of marine cage cultivation media using the off-bottom method as a modification of the Eucheuma cottonii seaweed cultivation methods recommended by the Directorate General of Fisheries, including: off-bottom method, floating method (raft) , the long line method (Directorate General of Aquaculture, 2005). This study aims to design a tool / media for cultivating seaweed in the form of a marine cage with a basic stocking system, and to analyze the absolute growth rate of seaweed in the marine cage based on cage depth (30.50 and 70 cm). The results of this study are expected to provide information in the development of Eucheuma cottonii seaweed cultivation in Salemo Island waters, Pangkep Regency.

Material and method. The method used in this research is the seaweed cultivation method with the basic stocking system. The research was carried out around Salemo Island (Figure 1).

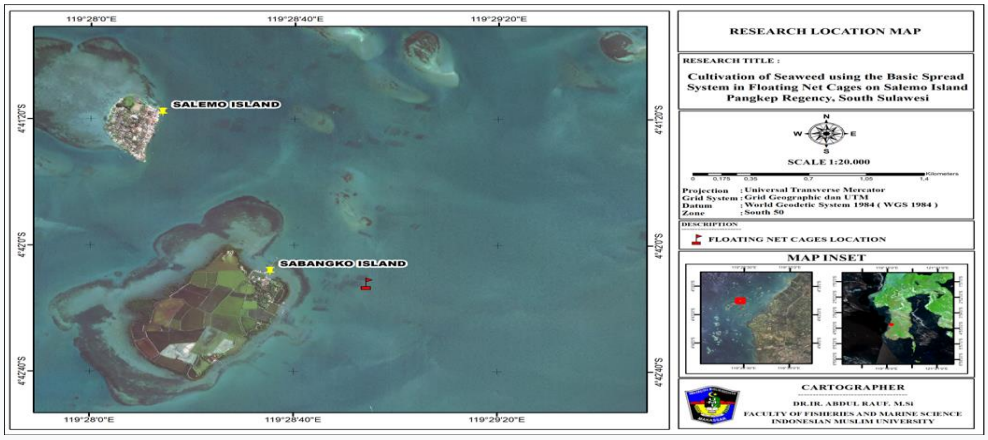

Figure 1. Map of the Research Location

Conducting this research using stages arranged in a diagram as shown in Figure 2 below.

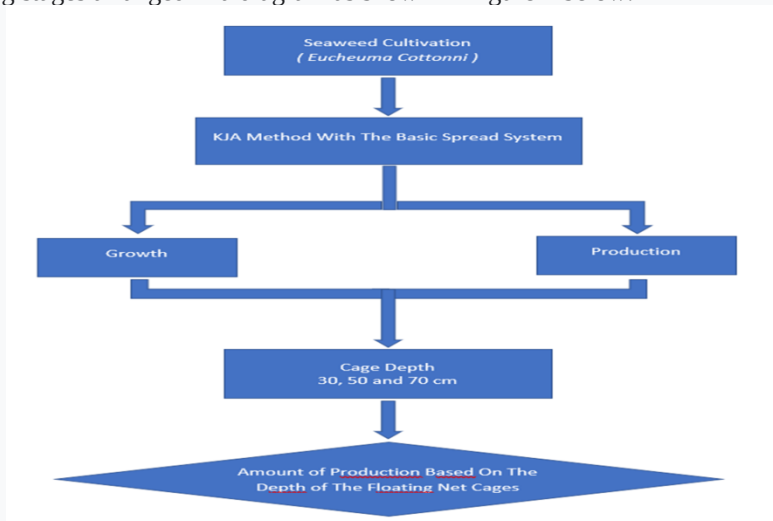

Figure 2. Flowchart of research on seaweed cultivation on Salemo Island

Research procedure

1. Designing tools / media for seaweed cultivation in the form of floating cages. The tools used were made of stainless steel measuring 2x2 mm with a length of 3 m and a width of 3 m and a height of 30 cm, 50 cm and 70 cm respectively. The finished cage frame is wrapped in trawl no.12, using a float made from a 4 ”paralon pipe attached around the KJA. Furthermore, it is operated at sea using a stake (weight replacement) with a weighted rope at a depth of 7-10 m, as shown in Figure 3.

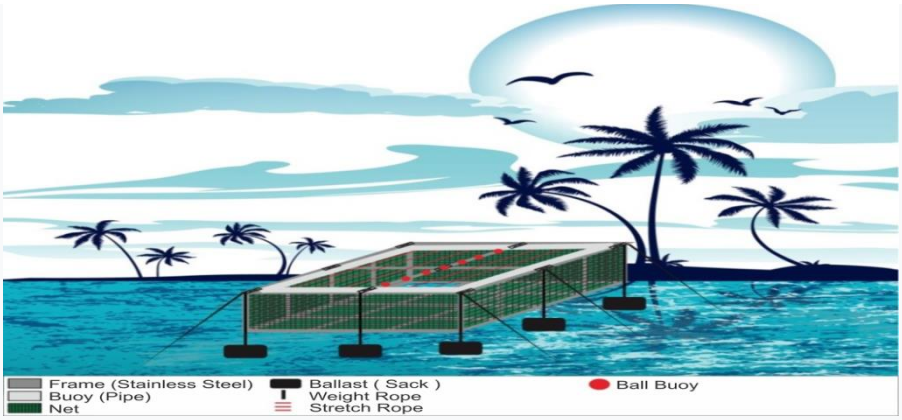

Figure 3. Model of marine seaweed cultivation with the basic stocking system

2. Spread the seaweed seeds in the floating net cages by first weighing the initial weight of 50 kg, weighing the weight of the

seaweed is carried out at harvest time at the age of 45 days.
3. Seaweed production is determined by calculating the initial weight and final weight values for each cage (treatment).

Data analysis

a. Absolute Growth Rate

The absolute growth rate is calculated using the formula from Pongarrang, et.all (2013):

G = Wt - Wo

Information :

G = Absolute Growth (kg)

Wt = weight of seaweed seeds at the end of the study (kg)

Wo = weight of seaweed seeds at the beginning of the study (kg)

2. Seaweed Production

Seaweed production is calculated based on the results of the final weighing (after being maintained for 45 days) in each cage. The effect of cage depth (30, 50 and 70 cm) on seaweed production is calculated based on the amount of production obtained for each.

Results

1. Seaweed cultivation in KJA

Seaweed is generally harvested after the age of 40 - 45 days (Harun, et al., 2013; with the consideration that at that age it has a high degree of porosity (Restiana, et al., 2009; Sulisetijono, 2009) or in accordance with market demand. The results obtained from the three cage sizes after weighing can be seen in Table 1 and Figure 4.

Table 1. Measurement results of the average weight (kg) of seaweed kept in floating net cages for 45 days.

No. KJT	X-Coord	Y-Coord	Hasil Pengukuran (kg)		
			Awal	Akhir	Tinggi Keramba
1	119° 28' 56,018" E	04° 42' 11.470" S	50	249	30 cm
2	119° 28' 56,087" E	04° 42' 11.745" S	50	316	50 cm
3	119° 28' 55,916" E	04° 42' 11.736" S	50	273	70 cmt

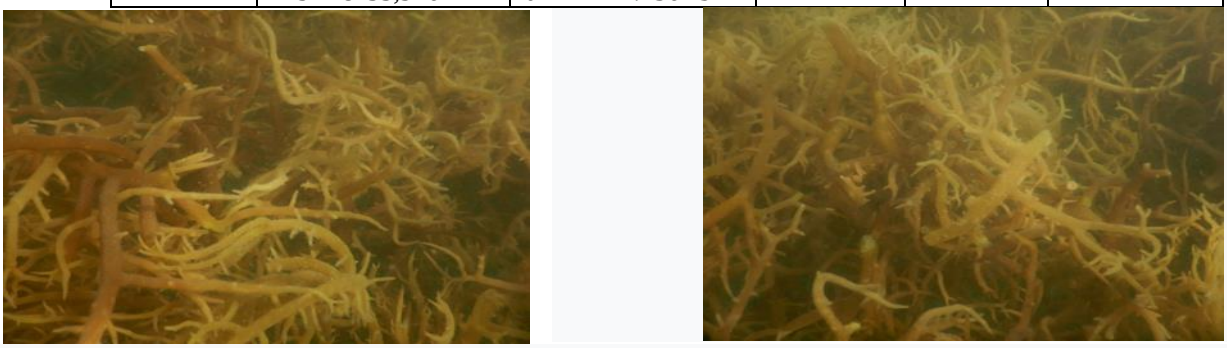

Figure 4. Seaweed Production that is maintained in KJA

2. Absolute Growth Rate

Based on the results of weighing the final weight of seaweed that is maintained for approximately 45 days, the results of weighing the seaweed in floating net cages are placed at different depths, namely 30 cm, 50 cm and 70 cm, each weighing 249 kg, 316 kg. and 273 kg (Table 2).

Table 2.The measurement results of the average weight (kg) of seaweed reared in the marine cage for 45

No. KJT	X-Coord	Y-Coord	Hasil Pengukuran (kg)			
			Awal	Akhir	Pertumbuhan Mutlak	Tinggi Keramba
1	119° 28' 56,018" E	04° 42' 11.470" S	50	249	199	30 cm
2	119° 28' 56,087" E	04° 42' 11.745" S	50	316	266	50 cm
3	119° 28' 55,916" E	04° 42' 11.736" S	50	273	223	70 cm

The results of the growth analysis showed that the best absolute growth rate occurred in floating net cages with a height of 50 cm with a production yield of 266 kg, while the lowest was found in floating cages with a height of 30 cm with a yield of 199 kg.

From Table 2, it can be seen that there is a difference in final weight between the three treatments where the lowest seaweed production is in cages with a depth of 30 cm, this is presumably because it gets a higher temperature from sunlight compared to

those with a depth of 50 cm and 70 cm (Pongarrang, et al. , 2013). whereas cages with a depth of 50 cm have a higher production, presumably because the temperature has decreased and is optimal, while in cages with a depth of 70 cm the production is lower than 50 cm it is suspected that the penetration of sunlight has started to decrease due to high sedimentation (turbidity) at the research location.

Discussion. The results of seaweed production in floating net cages are placed at different depths, namely 30 cm, 50 cm and 70 cm, each with a weight of 249 kg, 316 kg and 273 kg. The best absolute growth rate was obtained for floating net cages with a height of 50 cm with a yield of 266 kg, while the lowest was obtained for cages with a height of 30 cm with a yield of 199 kg.

Conclusion.

1. Tools or media for cultivating seaweed with the KJA method with the basic stocking system is very good for use in seaweed cultivation
2. The absolute growth rate of seaweed in the marine cage with maintenance time of 45 days, the best production is obtained in floating net cages with a depth of 50 cm as much as 266 kg from the initial weight of 50 kg.

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2. Bukti revisi awal (5 April 2021)

Re: Major revision

From: arauf arauf (arauf_umimksr@yahoo.com)

To: ek.bioflux@gmail.com

Date: Monday, April 5, 2021 at 11:43 AM GMT+8

Dear Eni
I send the corrections to the manuscript in the hope that it can be published as soon as possible. Thank you for your help

Kind regards,

Abdul Rauf

> On Thursday, March 25, 2021, 05:04:06 PM GMT+8, Eni Kovacs <ek.bioflux@gmail.com> wrote:
>
> Dear Dr. Rauf,
>
> Regarding your manuscript submitted to AACL Bioflux Journal, the editorial team has some requests prior to acceptance (please see the attachment).
>
> **Please note**: Always operate corrections/additions (or deletions) in the manuscript we are sending you, by **highlighting with a bright color** (for an easy identification). We never work on the manuscript you send back, just identify the corrections and operate them on our document (to avoid any undesirable accidental operations like changed page set up, otherwise the editors have to start all the work from the beginning, and we cannot ask them to re-check every manuscript word by word to identify unmarked modifications).
>
> Thank you for understanding!
>
> --
> Kind regards,
> Editor AACL Bioflux
> Eniko Kovacs

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Cultivation of seaweed using the basic stocking system in floating net cages on Salemo Island, Pangkep Regency, South Sulawesi, Indonesia

[1]Abdul Rauf, [2]Muhammad I. Wamnebo, [2] Muhammad H. Fattah, [2]Harlina Harlina, [3]Andi Asni

[1] Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Muslim University of Indonesia; [2] Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Indonesian Muslim University; [3] Department of Fisheries Resources Utilization, Faculty of Fisheries and Marine Sciences, Muslim University of Indonesia. Corresponding author: A. Rauf, arauf_umimksr@yahoo.com

Abstract. Seaweed has a large enough potential to be developed, especially in small islands. So far, cultivation activities carried out by seaweed farmers generally use stretch ropes so that they have high operational costs. One of the cultivation technology innovations that can be developed with an operational cost that is quite cheap and easy to operate is seaweed cultivation using floating net cages with a basic stocking system. The purpose of this study was to design a tool / media for seaweed cultivation in the form of marine cage with a bottom stocking system and to analyze the absolute growth rate based on the height of the cages (30, 50 and 70 cm). The method used in this study is the cultivation of seaweed with a bottom stocking system for different heights of the floating net cages (KJA). This study uses a comparative analysis approach of the results of seaweed production, based on different marine cage heights. The results showed that the highest seaweed production was at a depth of 50 cm , followed by 70 cm and the lowest was at a depth of 30 cm. The results of this study are expected to contribute to an increased production and income for seaweed farmers, especially in Pangkep Regency.
Key Words: seaweed, bottom stocking, floating net cages.

Introduction. Milkfish Pangkep Regency is one of the districts in South Sulawesi Province which has a coastal area with a coastline of about 49.71 Km and has a total of 145 islands (Rauf et al 2019) with various coastal geomorphological variations, ranging from hilly areas to sloping beaches. Salemo Island is one of the islands located in Liukang Tupabbiring District, the north of which having the sufficient marine resources with development potential, such as the seaweed cultivation. One type of seaweed that is commonly cultivated by people in this area is *Eucheuma cottonii* (*Kappaphycus alvarezii*) (Anggadiredja et al 2006). This species is widely cultivated because the production technology is relatively cheap and easy, and the post-harvest handling is relatively simple (Meiyana et al 2001). Besides that, the seeds are also available in sufficient quantities (Dahuri 2001; Dahuri 2003). Apart from being an industrial raw material, this type of seaweed can also be processed into food (Restiana & Diana 2009; Ghufran 2010; Sulisetijono, 2009) which can be consumed directly. Seaweed cultivation in Pangkep Regency has encountered many obstacles, which have resulted in reduced yields. Constraints commonly experienced by cultivators in this area include the lack of understanding concerning the correct cultivation techniques and the product quality maintenance but the dominant issue remains the price, which is determined by the buyer or collector. In addition, the handling of seaweed pests is not appropriate. These can stocking and attack the entire production area, which is already vulnerable to ice-ice disease, weather changes or decreases in the quality of the cultivation environment (Effendi 2003), but also conditioned by the quality of human resources. One of the most important factors is the right cultivation method, depending on the spatial efficiency and the protection against from the pests, the predators (such as baronang fish) and the waves and currents (Hutabarat & Evans 2008; Syamsiah 2007; Wijayanto et al 2011). One of the best seaweed cultivation methods is to use floating net cages (KJA) media. This study referred to the marine cages cultivation media using the off-bottom method, as a modification of the *Eucheuma cottonii* seaweed cultivation recommendations of the Directorate General of Fisheries, including the off-bottom, floating (raft) and long line methods (Directorate General of Aquaculture 2005). This study aims to design a tool/ media for cultivating seaweed in the form of a marine cage with a basic stocking system, and to analyze the seaweed absolute growth rate, based on the cage depth (30, 50 and 70 cm). The results of this study are expected to provide informations on the development of *Eucheuma cottonii* seaweed cultivation in Salemo Island waters, Pangkep Regency.

Material and Method. The method used in this research is the seaweed cultivation method, with the basic stocking system. The research was carried out around Salemo Island in Juli 2019 (Figure 1).

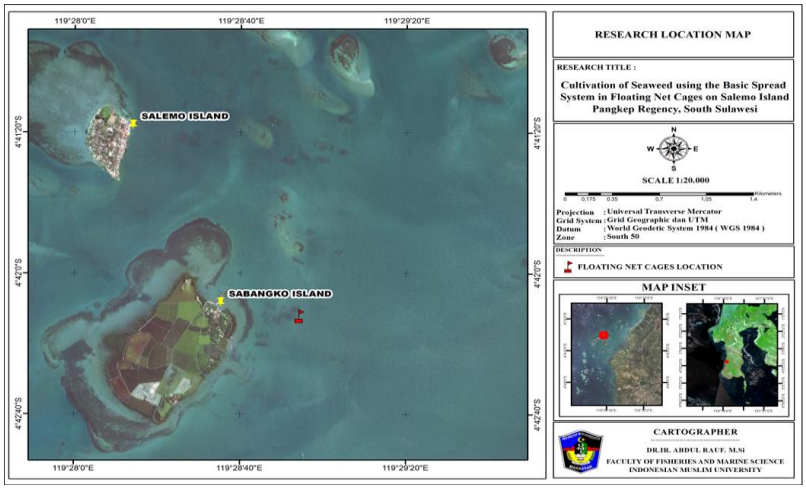

Figure 1. Map of the research location.

This research was conducted according to the stages described in the Figure 2 diagram.

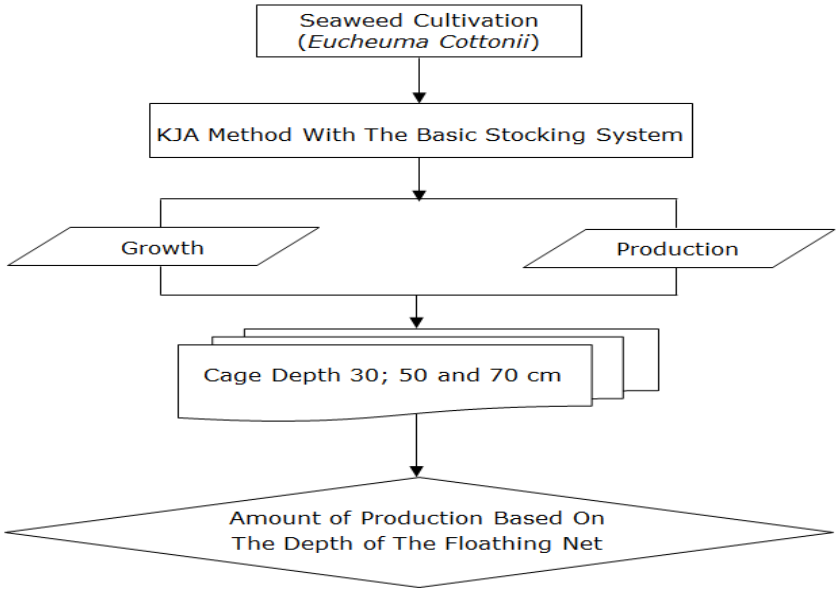

Figure 2. Flowchart of the research on seaweed cultivation on Salemo Island.

Research procedure. This research was conducted with the following procedures:
1.Designing tools / media for seaweed cultivation in the form of floating cages. The tools made of stainless steel profiles measuring 2x2x2 cm, had a length of 3 m, a width of 3 m and a depth of 30 cm, 50 cm and 70 cm, respectively. The finished cage frame is wrapped in trawl no.12, using a float made from a 4" paralon pipe attached around the KJA. Furthermore, it is operated at sea using a stake (weight replacement) with a weighted rope, at a depth of 7-10 m, as shown in Figure 3.
2. Spreading the seaweed seeds in the floating net cages, after weighing the initial quantity of 50 kg, which was carried out at harvest time, at the age of 45 days.
3. Determining the seaweed production by calculating the initial weight and final weight values for each cage (treatment).

Data analysis

Absolute growth rate. The absolute growth rate is calculated using the formula from Pongarrang et al (2013):

$$G = Wt - Wo$$

Where:
G - Absolute growth (kg);
Wt - weight of seaweed seeds at the end of the study (kg);
Wo - weight of seaweed seeds at the beginning of the study (kg).

Seaweed production. The seaweed production is calculated based on the results of the final weighing (after being maintained for 45 days) in each cage. The effect of cage depth (30, 50 and 70 cm) on the seaweed production is calculated based on the amount of production obtained for each cage variant.

Results

Seaweed cultivation in KJA. Seaweed is generally harvested after the age of 40-45 days (Harun et al 2013), considering their high degree of porosity (Restiana et al 2009; Sulisetijono 2009), in accordance with the market demand. The results obtained from the three cage sizes after weighing can be seen in Table 1 and Figure 3.

Table 1. Measurement results of the average weight (kg) of seaweed kept in floating net cages for 45 days

No. KJT	*X-Coord*	*Y-Coord*	*Measurement results (kg)*		
			Early	*End*	*Depth*
1	119° 28' 56,018" E	04° 42' 11.470" S	50	249	30 cm
2	119° 28' 56,087" E	04° 42' 11.745" S	50	316	50 cm
3	119° 28' 55,916" E	04° 42' 11.736" S	50	273	70 cm

Figure 3. Seaweed production that is maintained in KJA.

Absolute growth rate. The weighing of the final quantity of seaweed, after being maintained for 45 days in floating net cages placed at different depths, namely 30 cm, 50 cm and 70 cm, resulted in 249 kg, 316 kg and 273 kg, respectively (Table 2).

Table 2 The measurement results of the average weight (kg) of seaweed reared in the marine cage for 45 days

No. KJT	*X-Coord*	*Y-Coord*	*Measurement results (kg)*			
			Early	*End*	*Absolute Growth*	*Depth*
1	119° 28' 56,018" E	04° 42' 11.470" S	50	249	199	30 cm
2	119° 28' 56,087" E	04° 42' 11.745" S	50	316	266	50 cm
3	119° 28' 55,916" E	04° 42' 11.736" S	50	273	223	70 cm

The results of the growth analysis showed that the best absolute growth rate occurred in floating net cages with a height of 50 cm and a yield of 266 kg, while the lowest was found in floating cages with a height of 30 cm and a yield of 199 kg.

Discussion

From Table 2, it can be seen that there is a difference of final weights between the three treatments, where the lowest seaweed production was found in cages with a height of 30 cm, presumably

due to a higher temperature from the sunlight, compared to those with a height of 50 cm and 70 cm (Pongarrang et al 2013). Cages with a height of 50 cm had a higher production, presumably because the temperature has decreased and is optimal, while in cages with a height of 70 cm, the production is lower than in the 50 cm variants, probably because the penetration of sunlight has started to decrease due to a high sedimentation (turbidity) at the research location (Susilowati et al 2012).

Conclusions. It was demonstrated by the experimental method of the present study that tools or media for cultivating seaweed with the KJA method and a basic stocking system are appropriate for use in seaweed cultivation. The best absolute growth rate and yelds of seaweed in marine floating cages, with a maintenance time of 45 days, were observed in cages with a height of 50 cm, where as much as 266 kg were produced from an initial weight of 50 kg.

Conflict of interest. The authors declare no conflict of interest.

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*** Google image.2019.http: //googleimage.com/ accesed on December 5, 2019 at 20.00 WIB

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3. Bukti revisi kedua (12 April 2021)

Re: Revision

From: arauf arauf (arauf_umimksr@yahoo.com)

To: ek.bioflux@gmail.com

Date: Monday, April 12, 2021 at 11:30 PM GMT+8

Dear Eni
I send back the corrected manuscript for publication in Volume 14 issue 2. Thanks

Kind regards,

Abdul Rauf

> On Sunday, April 11, 2021, 03:46:48 AM GMT+8, Eni Kovacs <ek.bioflux@gmail.com> wrote:
>
> Dear Dr. Rauf,
>
> Please find the manuscript attached and make all the necessary adjustments.
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>
> **Please note**: Always operate corrections/additions (or deletions) in the manuscript we are sending you, by **highlighting with a bright color** (for an easy identification). We never work on the manuscript you send back, just identify the corrections and operate them on our document (to avoid any undesirable accidental operations like changed page set up, otherwise the editors have to start all the work from the beginning, and we cannot ask them to re-check every manuscript word by word to identify unmarked modifications).
>
> Thank you for your cooperation.
>
> Kind regards,
> Editor AACL Bioflux
> Eniko Kovacs

Rauf_seaweed floating net cages_final Ok.doc
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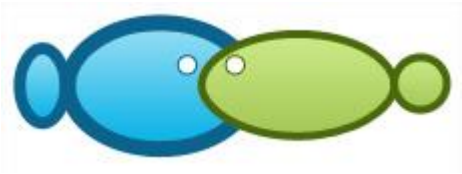

Cultivation of seaweed using the basic stocking system in floating net cages on Salemo Island, Pangkep Regency, South Sulawesi, Indonesia

[1]Abdul Rauf, [2]Muhammad I. Wamnebo, [2] Muhammad H. Fattah, [2]Harlina Harlina, [3]Andi Asni

[1] Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Muslim University of Indonesia; [2] Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Indonesian Muslim University; [3] Department of Fisheries Resources Utilization, Faculty of Fisheries and Marine Sciences, Muslim University of Indonesia. Corresponding author: A. Rauf, arauf_umimksr@yahoo.com

Abstract. Seaweed has a large enough potential to be developed, especially in small islands. So far, cultivation activities carried out by seaweed farmers generally use stretch ropes so that they have high operational costs. One of the cultivation technology innovations that can be developed with an operational cost that is quite cheap and easy to operate is seaweed cultivation using floating net cages with a basic stocking system. The purpose of this study was to design a tool/media for seaweed cultivation in the form of marine cage with a bottom stocking system and to analyze the absolute growth rate based on the height of the cages (30, 50 and 70 cm). The method used in this study is the cultivation of seaweed with a bottom stocking system for different heights of the floating net cages (KJA). This study uses a comparative analysis approach of the results of seaweed production, based on different marine cage heights. The results showed that the highest seaweed production was at a depth of 50 cm, followed by 70 cm and the lowest was at a depth of 30 cm. The results of this study are expected to contribute to an increased production and income for seaweed farmers, especially in Pangkep Regency.
Key Words: seaweed, bottom stocking, floating net cages.

Introduction. Milkfish Pangkep Regency is one of the districts in South Sulawesi Province which has a coastal area with a coastline of about 49.71 Km and has a total of 145 islands (Rauf et al 2018) with various coastal geomorphological variations, ranging from hilly areas to sloping beaches. Salemo Island is one of the islands located in Liukang Tupabbiring District, the north of which having the sufficient marine resources with development potential, such as the seaweed cultivation. One type of seaweed that is commonly cultivated by people in this area is *Eucheuma cottonii* (*Kappaphycus alvarezii*) (Anggadiredja et al 2006). This species is widely cultivated because the production technology is relatively cheap and easy, and the post-harvest handling is relatively simple (Meiyana et al 2001). Besides that, the seeds are also available in sufficient quantities (Dahuri 2001; Dahuri 2003). Apart from being an industrial raw material, this type of seaweed can also be processed into food (Restiana & Diana 2009; Ghufran 2010; Sulisetijono 2009) which can be consumed directly. Seaweed cultivation in Pangkep Regency has encountered many obstacles, which have resulted in reduced yields. Constraints commonly experienced by cultivators in this area include the lack of understanding concerning the correct cultivation techniques and the product quality maintenance, but the dominant issue remains the price, which is determined by the buyer or collector. In addition, the handling of seaweed pests is not appropriate. These can spread and attack the entire production area, which is already vulnerable to ice-ice disease, weather changes or decreases in the quality of the cultivation environment (Effendi 2003), but also conditioned by the quality of human resources. One of the most important factors is the right cultivation method, depending on the spatial efficiency and the protection against from the pests, the predators (such as baronang fish) and the waves and currents (Hutabarat & Evans 2008; Syamsiah 2007; Wijayanto et al 2011.). One of the best seaweed cultivation methods is to use floating net cages (KJA) media. This study referred to the marine cages cultivation media using the off-bottom method, as a modification of the *Eucheuma cottonii* seaweed cultivation recommendations of the Directorate General of Fisheries, including the off-bottom, floating (raft) and long line methods (Directorate General of Aquaculture 2005). This study aims to design a tool / media for cultivating seaweed in the form of a marine cage with a basic stocking system and to analyze the seaweed absolute growth rate, based on the cage depth (30, 50 and 70 cm). The results of this study are

expected to provide informations on the development of *Eucheuma cottonii* seaweed cultivation in Salemo Island waters, Pangkep Regency.

Material and Method. The method used in this research is the seaweed cultivation method, with the basic stocking system. The research was carried out around Salemo Island in July 2019 (Figure 1).

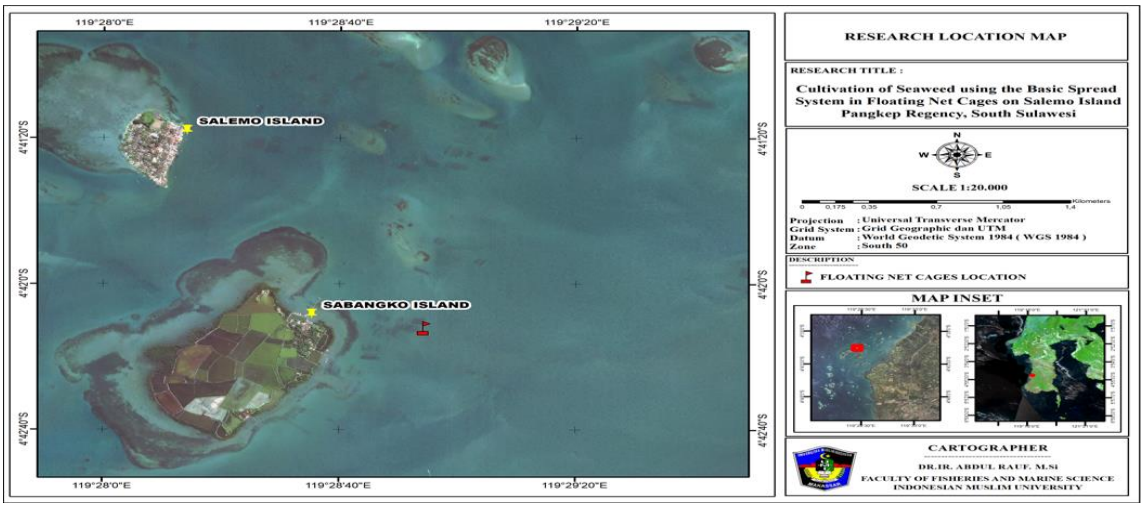

Figure 1. Map of the research location.

The present research was conducted according to the stages described in the Figure 2 diagram.

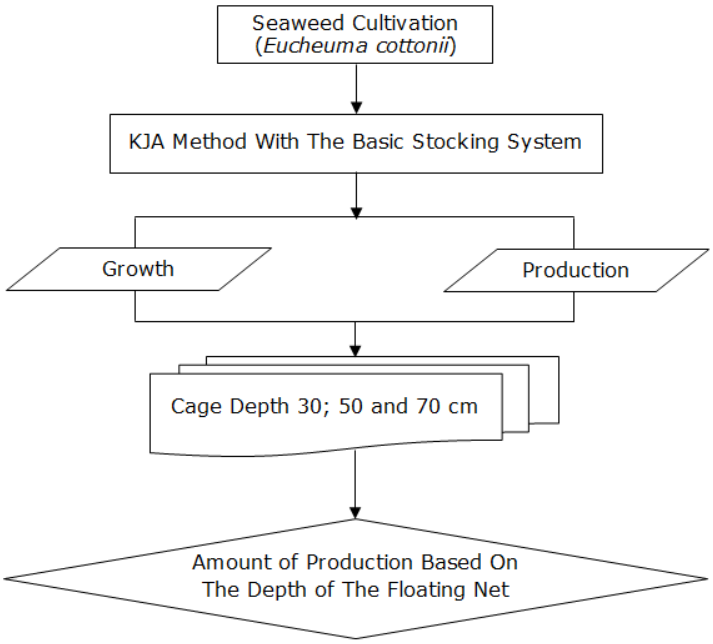

Fig on Salemo Island.

Research procedure. The present research was conducted with the following procedures:

1. Designing tools/media for seaweed cultivation in the form of floating cages. The tools, made of stainless steel profiles measuring 2 x 2 x 2 cm, had a length of 3 m, a width of 3 m and a depth of 30, 50 and 70 cm, respectively. The finished cage frame was wrapped in trawl no. 12, using a float made from a 4" paralon pipe attached around the KJA. Furthermore, it was operated at sea using a stake (weight replacement) with a weighted rope, at a depth of 7-10 m.
2. Spreading the seaweed seeds in the floating net cages, after weighing the initial quantity of 50 kg, which was carried out at harvest time, at the age of 45 days.
3. Determining the seaweed production by calculating the initial weight and final weight values for each cage (treatment).

Data analysis

Absolute growth rate. The absolute growth rate is calculated using the formula from Pongarrang et al (2013):

$$G = Wt - Wo$$

Where:
G - Absolute growth (kg);
Wt - weight of seaweed seeds at the end of the study (kg);
Wo - weight of seaweed seeds at the beginning of the study (kg).

Seaweed production. The seaweed production is calculated based on the results of the final weighing (after being maintained for 45 days) in each cage. The effect of cage depth (30, 50 and 70 cm) on the seaweed production is calculated based on the amount of production obtained for each cage variant.

Results

Seaweed cultivation in KJA. Seaweed is generally harvested after the age of 40-45 days (Harun et al 2013), considering their high degree of porosity (Restiana et al 2009; Sulisetijono 2009), in accordance with the market demand. The results obtained from the three cage sizes after weighing can be seen in Table 1 and Figure 3.

Table 1
Measurement results of the average weight (kg) of seaweed kept in floating net cages for 45 days

No. KJT	*X-Coord*	*Y-Coord*	*Measurement results (kg)*		
			first	*End*	*Depth*
1	119° 28' 56,018" E	04° 42' 11.470" S	50	249	30 cm
2	119° 28' 56,087" E	04° 42' 11.745" S	50	316	50 cm
3	119° 28' 55,916" E	04° 42' 11.736" S	50	273	70 cm

Figure 3. Seaweed production that is maintained in KJA. (Source: Photo Rauf, 2019)

Absolute growth rate. The weighing of the final quantity of seaweed, after being maintained for 45 days in floating net cages placed at different depths, namely 30, 50 and 70 cm, resulted in 249 kg, 316 kg and 273 kg, respectively (Table 2).

Table 2
The measurement results of the average weight (kg) of seaweed reared in the marine cage for 45 days

No. KJT	*X-Coord*	*Y-Coord*	*Measurement results (kg)*			
			First	*End*	*Absolute growth*	*Depth*
1	119° 28' 56,018" E	04° 42' 11.470" S	50	249	199	30 cm
2	119° 28' 56,087" E	04° 42' 11.745" S	50	316	266	50 cm
3	119° 28' 55,916" E	04° 42' 11.736" S	50	273	223	70 cm

The results of the growth analysis showed that the best absolute growth rate occurred in floating net cages

with a height of 50 cm and a yield of 266 kg, while the lowest was found in floating cages with a height of 30 cm and a yield of 199 kg.

Discussion

From Table 2 it can be seen that there is a difference of final weights between the three treatments, where the lowest seaweed production was found in cages with a height of 30 cm, presumably due to a higher temperature from the sunlight, compared to those with a height of 50 and 70 cm (Pongarrang et al 2013). Cages with a height of 50 cm had a higher production, presumably because the temperature has decreased and is optimal, while in cages with a height of 70 cm, the production is lower than in the 50 cm variants, probably because the penetration of sunlight has started to decrease due to a high sedimentation (turbidity) at the research location. The very high light intensity actually inhibits the photosynthesis process (photoinhibition), while the too low intensity becomes a barrier for the photosynthetic process that occurs in seaweed (Sunarto, 2008). Kune (2007) stated that an important factor affecting the growth rate of seaweed is that the difference in light intensity received by seaweed at different depths will affect the stretch of new cell walls which hardly changes when the expansion of seaweed growth is inhibited by light.

Conclusions. It was demonstrated by the experimental method of the present study that tools or media for cultivating seaweed with the KJA method and a basic stocking system are appropriate for use in seaweed cultivation. The best absolute growth rate and yelds of seaweed in marine floating cages, with a maintenance time of 45 days, were observed in cages with a height of 50 cm, where as much as 266 kg were produced from an initial weight of 50 kg.

Conflict of interest. The authors declare no conflict of interest.

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How to cite this article:
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4. **Bukti draft final (18 April 2021)**

Re: Final draft

From: arauf arauf (arauf_umimksr@yahoo.com)

To: ek.bioflux@gmail.com

Date: Sunday, April 18, 2021 at 12:57 PM GMT+8

I have read and reviewed this article carefully and fixed 2 comments in the reference section with all authors. Finally, we agreed to be signed for publication.

Best Regards

Abdul Rauf

> On Sunday, April 18, 2021, 02:38:21 AM GMT+8, Eni Kovacs <ek.bioflux@gmail.com> wrote:
>
> Dear Dr. Rauf,
>
> Could you please check the final form of the article attached, some adjustments were operated. Also, there are 2 comments in the References section, please address them.
>
> If you have any final observations and instructions prior to the article publishing, please inform us, any changes should be clearly highlighted. Change requests cannot be considered after publishing the material.
>
> If all the authors agree with the final form of the article, could you please send us your acceptance for publishing, signed by all the authors.
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> --
> Kind regards,
> Editor AACL Bioflux
> Eniko Kovacs

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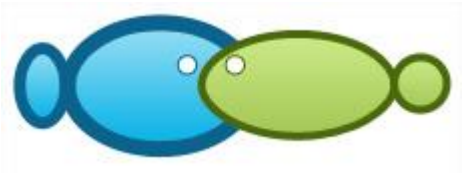

Cultivation of seaweed using the basic stocking system in floating net cages on Salemo Island, Pangkep Regency, South Sulawesi, Indonesia

[1]Abdul Rauf, [2]Muhammad I. Wamnebo, [2] Muhammad H. Fattah, [2]Harlina Harlina, [3]Andi Asni

[1] Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Muslim University of Indonesia; [2] Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Indonesian Muslim University; [3] Department of Fisheries Resources Utilization, Faculty of Fisheries and Marine Sciences, Muslim University of Indonesia. Corresponding author: A. Rauf, arauf_umimksr@yahoo.com

Abstract. Seaweed has a large enough potential to be developed, especially in small islands. So far, cultivation activities carried out by seaweed farmers generally use stretch ropes so that they have high operational costs. One of the cultivation technology innovations that can be developed with an operational cost that is quite cheap and easy to operate is seaweed cultivation using floating net cages with a basic stocking system. The purpose of this study was to design a tool/media for seaweed cultivation in the form of marine cage with a bottom stocking system and to analyze the absolute growth rate based on the height of the cages (30, 50 and 70 cm). The method used in this study is the cultivation of seaweed with a bottom stocking system for different heights of the floating net cages (KJA). This study uses a comparative analysis approach of the results of seaweed production, based on different marine cage heights. The results showed that the highest seaweed production was at a depth of 50 cm, followed by 70 cm and the lowest was at a depth of 30 cm. The results of this study are expected to contribute to an increased production and income for seaweed farmers, especially in Pangkep Regency.
Key Words: seaweed, bottom stocking, floating net cages.

Introduction. Pangkep Regency is one of the districts in South Sulawesi Province which has a coastal area with a coastline of about 49.71 km and has a total of 145 islands (Rauf et al 2019) with various coastal geomorphological variations, ranging from hilly areas to sloping beaches. Salemo Island is one of the islands located in Liukang Tupabbiring District, the north of which having the sufficient marine resources with development potential, such as the seaweed cultivation. One type of seaweed that is commonly cultivated by people in this area is *Eucheuma cottonii* (*Kappaphycus alvarezii*) (Anggadiredja et al 2006). This species is widely cultivated because the production technology is relatively cheap and easy, and the post-harvest handling is relatively simple (Meiyana et al 2001). Besides that, the seeds are also available in sufficient quantities (Dahuri 2001; Dahuri 2003). Apart from being an industrial raw material, this type of seaweed can also be processed into food (Restiana & Diana 2009; Ghufran 2010; Sulisetijono 2009) which can be consumed directly. Seaweed cultivation in Pangkep Regency has encountered many obstacles, which have resulted in reduced yields. Constraints commonly experienced by cultivators in this area include the lack of understanding concerning the correct cultivation techniques and the product quality maintenance, but the dominant issue remains the price, which is determined by the buyer or collector. In addition, the handling of seaweed pests is not appropriate. These can spread and attack the entire production area, which is already vulnerable to ice-ice disease, weather changes or decreases in the quality of the cultivation environment (Effendi 2003), but also conditioned by the quality of human resources. One of the most important factors is the right cultivation method, depending on the spatial efficiency and the protection against from the pests, the predators (such as baronang fish) and the waves and currents (Hutabarat & Evans 2008; Syamsiah 2007; Wijayanto et al 2011.). One of the best seaweed cultivation methods is to use floating net cages (KJA) media. The study refers to the marine cages cultivation media using the off-bottom method, as a modification of the *Eucheuma cottonii* seaweed cultivation recommendations of the Directorate General of Fisheries, including the off-bottom, floating (raft) and long line methods (Directorate General of Aquaculture 2005). This study aimed to design a tool/media for cultivating seaweed in the form of a marine cage with a basic stocking system and to analyze the seaweed absolute growth rate, based on the cage depth (30, 50 and 70 cm). The results of this study are

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Material and Method. The method used in this research is the seaweed cultivation method, with the basic stocking system. The research was carried out around Salemo Island in July 2019 (Figure 1).

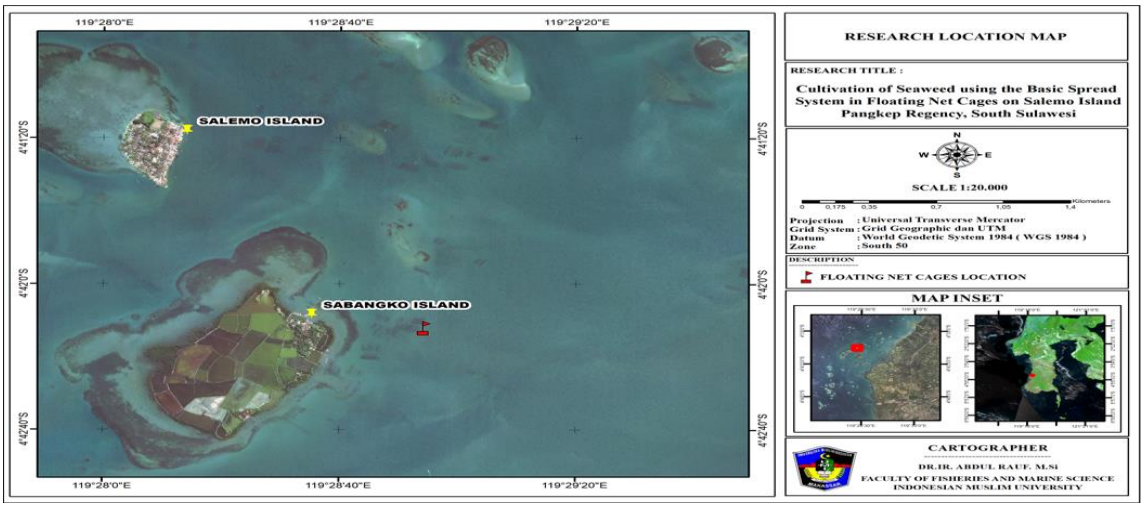

Figure 1. Map of the research location.

The present research was conducted according to the stages described in the Figure 2 diagram.

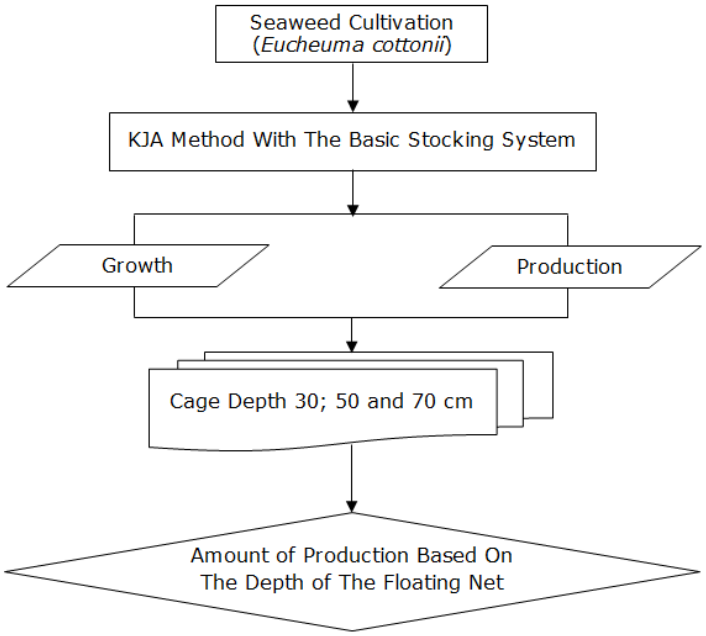

Fig ı on Salemo Island.

Research procedure. The present research was conducted using the following procedures:

1. Designing tools/media for seaweed cultivation in the form of floating cages. The tools, made of stainless steel profiles measuring 2 x 2 x 2 cm, had a length of 3 m, a width of 3 m and a depth of 30, 50 and 70 cm, respectively. The finished cage frame was wrapped in trawl no. 12, using a float made from a 4" paralon pipe attached around the KJA. Furthermore, it was operated at sea using a stake (weight replacement) with a weighted rope, at a depth of 7-10 m.
2. Spreading the seaweed seeds in the floating net cages, after weighing the initial quantity of 50 kg, which was carried out at harvest time, at the age of 45 days.
3. Determining the seaweed production by calculating the initial weight and final weight values for each cage (treatment).

Data analysis

Absolute growth rate. The absolute growth rate is calculated using the formula from Pongarrang et al (2013):

$$G = Wt - Wo$$

Where:
G - Absolute growth (kg);
Wt - weight of seaweed seeds at the end of the study (kg);
Wo - weight of seaweed seeds at the beginning of the study (kg).

Seaweed production. The seaweed production is calculated based on the results of the final weighing (after being maintained for 45 days) in each cage. The effect of cage depth (30, 50 and 70 cm) on the seaweed production is calculated based on the amount of production obtained for each cage variant.

Results

Seaweed cultivation in KJA. Seaweed is generally harvested after the age of 40-45 days (Harun et al 2013), considering their high degree of porosity (Restiana et al 2009; Sulisetijono 2009), in accordance with the market demand. The results obtained from the three cage sizes after weighing can be seen in Table 1 and Figure 4.

Table 1
Measurement results of the average weight (kg) of seaweed kept in floating net cages for 45 days

X-Coord	*Y-Coord*	*Measurement results (kg)*		
		First	*End*	*Depth*
119° 28' 56,018" E	04° 42' 11.470" S	50	249	30 cm
119° 28' 56,087" E	04° 42' 11.745" S	50	316	50 cm
119° 28' 55,916" E	04° 42' 11.736" S	50	273	70 cm

Figure 4. Seaweed production that is maintained in KJA (original).

Absolute growth rate. The weighing of the final quantity of seaweed, after being maintained for 45 days in floating net cages placed at different depths, namely 30, 50 and 70 cm, resulted in 249 kg, 316 kg and 273 kg, respectively (Table 2).

Table 2
The measurement results of the average weight (kg) of seaweed reared in the marine cage for 45 days

X-Coord	*Y-Coord*	*Measurement results (kg)*			
		First	*End*	*Absolute growth*	*Depth*
119° 28' 56,018" E	04° 42' 11.470" S	50	249	199	30 cm
119° 28' 56,087" E	04° 42' 11.745" S	50	316	266	50 cm
119° 28' 55,916" E	04° 42' 11.736" S	50	273	223	70 cm

The results of the growth analysis showed that the best absolute growth rate occurred in floating net cages with a height of 50 cm and a yield of 266 kg, while the lowest was found in floating cages with a height of 30 cm and a yield of 199 kg.

Discussion

From Table 2 it can be seen that there is a difference of final weights between the three treatments, where the lowest seaweed production was found in cages with a height of 30 cm, presumably due to a higher temperature from the sunlight, compared to those with a height of 50 and 70 cm (Pongarrang et al 2013). Cages with a height of 50 cm had a higher production, presumably because the temperature has decreased and is optimal, while in cages with a height of 70 cm, the production is lower than in the 50 cm variants, probably because the penetration of sunlight has started to decrease due to a high sedimentation (turbidity) at the research location. The very high light intensity actually inhibits the photosynthesis process (photoinhibition), while the too low intensity becomes a barrier for the photosynthetic process that occurs in seaweed (Sunarto 2008). Kune (2007) stated that an important factor affecting the growth rate of seaweed is that the difference in light intensity received by seaweed at different depths will affect the stretch of new cell walls which hardly changes when the expansion of seaweed growth is inhibited by light.

Conclusions. It was demonstrated by the experimental method of the present study that tools or media for cultivating seaweed with the KJA method and a basic stocking system are appropriate for use in seaweed cultivation. The best absolute growth rate and yelds of seaweed in marine floating cages, with a maintenance time of 45 days, were observed in cages with a height of 50 cm, where as much as 266 kg were produced from an initial weight of 50 kg.

Conflict of interest. The authors declare no conflict of interest.

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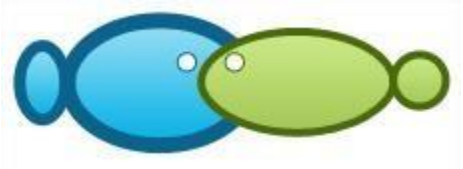

Cultivation of seaweed using the basic stocking system in floating net cages on Salemo Island, Pangkep Regency, South Sulawesi, Indonesia

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Abstract. Seaweed has a large enough potential to be developed, especially in small islands. So far, cultivation activities carried out by seaweed farmers generally use stretch ropes so that they have high operational costs. One of the cultivation technology innovations that can be developed with an operational cost that is quite cheap and easy to operate is seaweed cultivation using floating net cages with a basic stocking system. The purpose of this study was to design a tool/media for seaweed cultivation in the form of marine cage with a bottom stocking system and to analyze the absolute growth rate based on the height of the cages (30, 50 and 70 cm). The method used in this study is the cultivation of seaweed with a bottom stocking system for different heights of the floating net cages (KJA). This study uses a comparative analysis approach of the results of seaweed production, based on different marine cage heights. The results showed that the highest seaweed production was at a depth of 50 cm, followed by 70 cm and the lowest was at a depth of 30 cm. The results of this study are expected to contribute to an increased production and income for seaweed farmers, especially in Pangkep Regency.
Key Words: marine cage, bottom stocking system, absolute growth rate, seaweed production.

Introduction. Pangkep Regency is one of the districts in South Sulawesi Province which has a coastal area with a coastline of about 49.71 km and has a total of 145 islands (Rauf et al 2019) with various coastal geomorphological variations, ranging from hilly areas to sloping beaches. Salemo Island is one of the islands located in Liukang Tupabbiring District, the north of which having the sufficient marine resources with development potential, such as the seaweed cultivation. One type of seaweed that is commonly cultivated by people in this area is *Eucheuma cottonii* (*Kappaphycus alvarezii*) (Anggadiredja et al 2006). This species is widely cultivated because the production technology is relatively cheap and easy, and the post-harvest handling is relatively simple (Meiyana et al 2001). Besides that, the seeds are also available in sufficient quantities (Dahuri 2001; Dahuri 2003). Apart from being an industrial raw material, this type of seaweed can also be processed into food (Restiana & Diana 2009; Ghufran 2010; Sulisetijono 2009) which can be consumed directly.

Seaweed cultivation in Pangkep Regency has encountered many obstacles, which have resulted in reduced yields. Constraints commonly experienced by cultivators in this area include the lack of understanding concerning the correct cultivation techniques and the product quality maintenance, but the dominant issue remains the price, which is determined by the buyer or collector. In addition, the handling of seaweed pests is not appropriate. These can spread and attack the entire production area, which is already vulnerable to ice-ice disease, weather changes or decreases in the quality of the cultivation environment (Effendi 2003), but also conditioned by the quality of human resources. One of the most important factors is the right cultivation method, depending

on the spatial efficiency and the protection against from the pests, the predators (such as baronang fish) and the waves and currents (Hutabarat & Evans 2008; Syamsiah 2007; Wijayanto et al 2011). One of the best seaweed cultivation methods is to use floating net cages (KJA) media. The study refers to the marine cages cultivation media using the off-bottom method, as a modification of the *E. cottonii* seaweed cultivation recommendations of the Directorate General of Fisheries, including the off-bottom, floating (raft) and long line methods (Directorate General of Aquaculture 2005).

The present study aimed to design a tool/media for cultivating seaweed in the form of a marine cage with a basic stocking system and to analyze the seaweed absolute growth rate, based on the cage depth (30, 50 and 70 cm). The results of this study are expected to provide information on the development of *E. cottonii* seaweed cultivation in Salemo Island waters, Pangkep Regency.

Material and Method. The method used in this research is the seaweed cultivation method, with the basic stocking system. The research was carried out around Salemo Island in July 2019 (Figure 1).

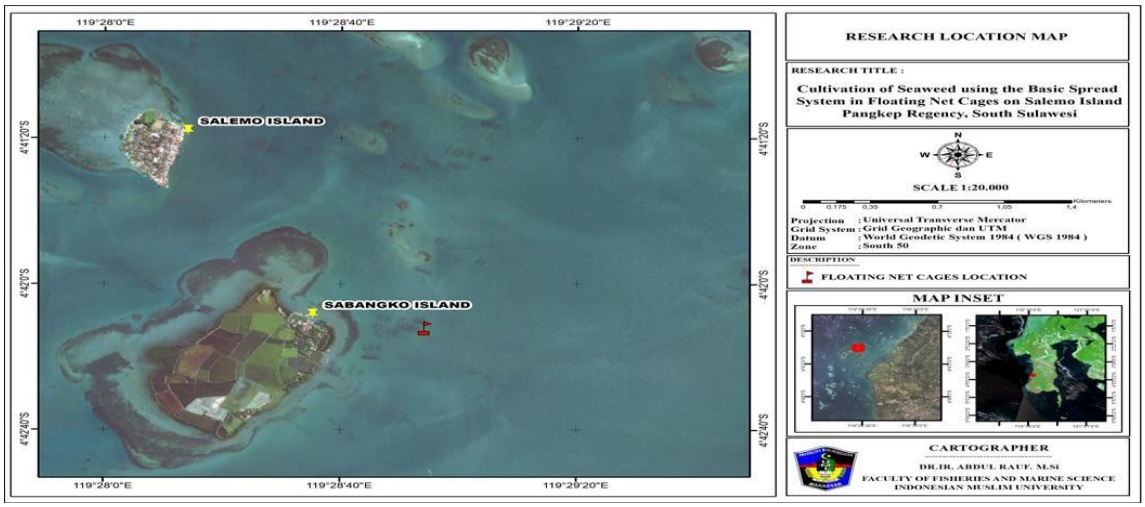

Figure 1. Map of the research location.

The present research was conducted according to the stages described in the bellow diagram (Figure 2).

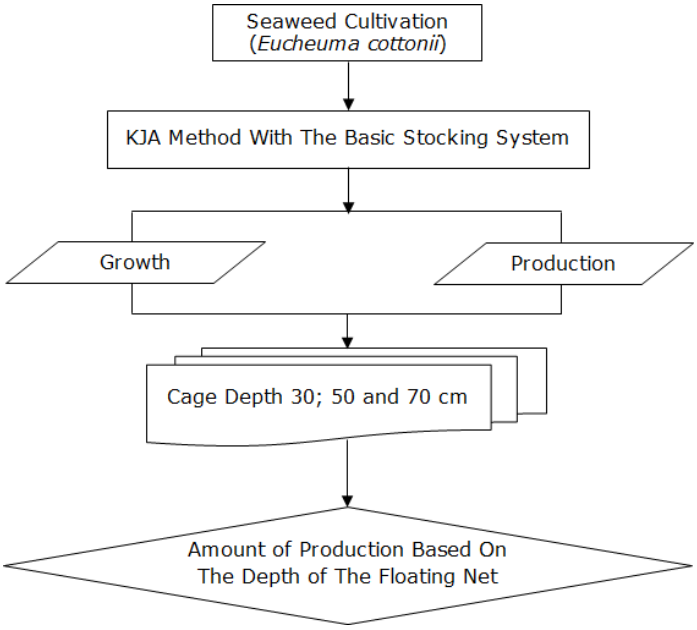

Figure 2. Flowchart of the research on *Eucheuma cottonii* cultivation on Salemo Island.

Research procedure. The present research was conducted using the following procedure:
1. Designing tools/media for seaweed cultivation in the form of floating cages. The tools, made of stainless steel profiles measuring 2 x 2 x 2 cm, had a length of 3 m, a width of 3 m and a depth of 30, 50 and 70 cm, respectively. The finished cage frame was wrapped in trawl no. 12, using a float made from a 4" paralon pipe attached around the KJA. Furthermore, it was operated at sea using a stake (weight replacement) with a weighted rope, at a depth of 7-10 m.
2. Spreading the seaweed seeds in the floating net cages, after weighing the initial quantity of 50 kg, was carried out at harvest time, at 45 days.
3. Determining the seaweed production by calculating the initial weight and final weight values for each cage (treatment).

Data analysis
Absolute growth rate. The absolute growth rate was calculated using the formula Pongarrang et al (2013):

$$G = Wt - Wo$$

Where:
G - absolute growth (kg);
Wt - weight of seaweed seeds at the end of the study (kg);
Wo - weight of seaweed seeds at the beginning of the study (kg).

Seaweed production. The seaweed production was calculated based on the results of the final weighing (after being maintained for 45 days) in each cage. The effect of cage depth (30, 50 and 70 cm) on the seaweed production was calculated based on the amount of production obtained for each cage variant.

Results

Seaweed cultivation in KJA. Seaweed is generally harvested after the age of 40-45 days (Harun et al 2013), considering its high degree of porosity (Restiana et al 2009; Sulisetijono 2009), in accordance with the market demand. The results obtained from the three cage sizes after weighing can be seen in Table 1 and Figure 4.

Table 1
Measurement results of the average weight (kg) of *Eucheuma cottonii* kept in floating net cages for 45 days

X-Coordinates	*Y-Coordinates*	*Measurement results (kg)*		
		Beginning	*End*	*Depth (cm)*
119° 28' 56.018" E	04° 42' 11.470" S	50	249	30
119° 28' 56.087" E	04° 42' 11.745" S	50	316	50
119° 28' 55.916" E	04° 42' 11.736" S	50	273	70

Figure 4. *Eucheuma cottonii* production maintained in KJA (original).

Absolute growth rate. The weighing of the final quantity of *E. cottonii*, after being maintained for 45 days in floating net cages placed at different depths, namely 30, 50 and 70 cm, resulted in 249, 316 and 273 kg, respectively (Table 2).

Table 2

The measurement results of the average weight (kg) of *Eucheuma cottonii* reared in the marine cage for 45 days

X-Coordinates	*Y-Coordinates*	*Measurement results (kg)*			
		Beginning	*End*	*Absolute growth*	*Depth (cm)*
119° 28' 56.018" E	04° 42' 11.470" S	50	249	199	30
119° 28' 56.087" E	04° 42' 11.745" S	50	316	266	50
119° 28' 55.916" E	04° 42' 11.736" S	50	273	223	70

The results of the growth analysis showed that the best absolute growth rate occurred in floating net cages with a height of 50 cm and a yield of 266 kg, while the lowest was found in floating cages with a height of 30 cm and a yield of 199 kg.

Discussion

From Table 2 it can be seen that there was a difference of final weights between the three treatments, where the lowest *E. cottonii* production was found in cages with a height of 30 cm, presumably due to a higher temperature from the sunlight, compared to those with a height of 50 and 70 cm (Pongarrang et al 2013). Cages with a height of 50 cm had a higher production, presumably because the temperature decreased and was optimal, while in cages with a height of 70 cm, the production was lower than in the 50 cm variants, probably because the penetration of sunlight has started to decrease due to a high sedimentation (turbidity) at the research location. The very high light intensity actually inhibits the photosynthesis process (photoinhibition), while the too low intensity becomes a barrier for the photosynthetic process that occurs in seaweed (Sunarto 2008). Kune (2007) stated that an important factor affecting the growth rate of seaweed is that the difference in light intensity received by seaweed at different depths will affect the stretch of new cell walls which hardly changes when the expansion of seaweed growth is inhibited by light.

Conclusions. It was demonstrated by the experimental method of the present study that tools or media for cultivating *E. cottonii* with the KJA method and a basic stocking system are appropriate for use in seaweed cultivation. The best absolute growth rate and yields of *E. cottonii* in marine floating cages, with a maintenance time of 45 days, were observed in cages with a height of 50 cm, where as much as 266 kg were produced from an initial weight of 50 kg.

Conflict of interest. The authors declare no conflict of interest.

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