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Sea ecology increase family economic revenues

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ABSTRACT

The marine ecology of Maluku has the potential for fertility to be used to increase people's incomes. One of the marine ecologies of interest is seaweed, which is the largest part of marine plants and as one of the potential commodities to be developed, but in reality there has been no serious concern from coastal communities to take advantage of this ecological environment. This study aims to measure the yield of seaweed that can increase the family's economic income. Approach Financial analysis uses a seaweed business analysis that reviews the characteristics of the economy in Ambon City. The calculation results show that the first crops of the farmers have covered the capital from investment and operational costs. If in one period (1 year) there are 7 times of harvest, then the cultivators get a return on capital at the first harvest and six next harvest is profit. Marine ecology is not only a land of seaweed that can provide growth but increase people's income in Ambon City. The next researchers are suggested to examine the extraction of seaweed that can increase farmer income.

Key words : *Marine ecology, Income, Familyeconomy*

Introduction

The world's seaweed industry has provided a wide range of products to meet human needs both directly and indirectly. The contribution given from the seaweed industry is estimated at 100 million USD per year (Bixler & Pors, 2011; FAO 2013). The largest stock of seaweed is in Europe and Latin America. For example Chile and Norway contributing seaweed yields of 51, 3% and 19.2% (FAO, 2014). Until now seaweeds in the Asian region have not been properly managed to increase the country's economic income (Rebours *et al.*, 2014). Developed countries such as Europe and Latin America have used natural resources in the form of seaweed to improve their country's economy. For example Portugal in developing seaweed requires a very comprehensive assessment so as to improve their country's economy, while Norway and Canada have developed and implemented sustainable and planned coastal management in exploiting the seaweed resources. Other countries such as Peru, Chile, and Brazil build on the role of sustainable and planned seaweed in improving the country's economy (Rebours *et al.*, 2014). All this information has become an input material to be used in increasing the community's income from seaweed cultivation.

Other information also mentioned that, interest in seaweed become increasingly important e.g. in the United States, Russia, and North America (van den Burg, *et al.*, 2016). This is because seaweed can be

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used as raw material for various product, for example as food of children who have high selling value (Bixler & Porse, 2011), animal food (Wilding *et al*., 2006; Soler-Vila *et al*., 2009, Rust *et al*., 2011; Mesnildrey *et al*., 2012; Bikker *et al*., 2013), as chemicals (Wal *et al*., 2013; Wei *et al*., 2013) or bioenergy (Sustainable Energy Ireland, 2009; Eyes *et al*., 2010). So that seaweed contributes greatly to the economic improvement in Russia, the United States and North America (Luning and Pang, 2003; Kraan, 2013).

Based on thosepotentialites, one of the largest marine ecologies in Asia is in Indonesia. The data obtained states that in one year can export abroad amounted to 159,075 tons with total revenues of 157,587 USD (Ministry of Marine Affairs & Fisheries, 2014). Maluku is one of the provinces that has the biggest contributionof seaweed. It has a vast sea and thousands of islands with seaweed as the potential of marine natural resources. Seaweed production in Maluku in 2009 amounted to 3,126 tons and increased to 7,350 tons in the next year continuously. However, the increase in production has not provided significant returns to local revenues and the economic community in Maluku (Picaulima *et al*., 2016). The current marine potential is expected to be managed by farmers and entrepreneurs as well as existing stakeholders to foster regional economic growth (Vredegoor and Pennink, 2013). Seaweed has a very important role in supporting biodiversity and ecological functions in marine ecosystems (Bracken and Williams, 2013). Other information mentioned that the production of seaweed in 2016 in Maluku Province amounted to 600.8 tons with a production value of Rp. 1.658.875.000, - with the frequency of planting six times (Department of Marine and Fisheries, 2016).

In Indonesia there are four types of seaweed that are of high economic value as an export commodity and also consumed domestically namely *Eucheuma sp, Glascillaria sp, Gelidium sp, Sargassum sp,* and *Hypnea sp* (Sukiman *et al*., 2014; Mulyati and Geldermann, 2017; Artini *et al*., 2017). Types of *Eucheumacottoni* and *Eucheumanspinosum* are red algae species that are widely cultivated and exported abroad (Mulyati and Geldermann, 2016). This is due to the great pikokoloid benefits of carrageenan, relatively easy and inexpensive cultivation techniques. *Eucheumacottoni* is a grass the red sea (Rhodophyta), which is rich in photosynthetic pigments and other accessories pigments, chlorophyll, α-carotene, β-carotene, fichobilin, neozantin, and zeanthin (Luning, 1990).

The distribution area of seaweed in Maluku, especially in the city of Ambon, which is rich in marine resources, is still faced with various obstacles. The obstacles are the lack of awareness of the community to take advantage of marine ecology as a seaweed planting ground. Some farmers still require a large cost in the management of seaweed. Then, the technology used is still relatively simple and the lack of information about business development and market opportunities. It is also still lack of government contribution from the funding side and experts in facilitating seaweed farmers in developing existing business (Zamroni *et al*., 2011; Picaulima *et al*., 2016).

Based on interviews with seaweed farmers in Ambon City, the cultivated grass lifespan is 30 days. Selection of seaweed harvest age is 30 days and cannot be harvested at 45 days. The reason is the seaweed harvested 45 days cannot be harvested anymore because it is detached from the rope.It has a lot of clumps and heavy. It has become a habit to do during the process of seaweed cultivation in the area. While, at the seaweed farming location Waiheru Village has a 45 days harvest age. Age of harvest in the seaweed cultivation area is different in each region so that the test results are also different.

Family income in Ambon City is seen from the society's effort is still relatively low, while the marine ecology, which is the cultivation of seaweed, has not evenly reached. So far, seaweed has been extensively researched in large measure in improving the country's economy using modern technology (Rebours *et al*., 2014; van den Burg *et al*., 2016), but no traditional, comprehensive study has been linked to seaweed in increasing the family's economic income. It encourages researchers to examine more about the increase in family income from seaweed production. This study aims to measure the yield of seaweed that can increase people's income as a scientific reference for seaweed farmers in improving the family economy.

Literature Review

Marine Ecology Environment

Mutually affecting in a living system, it is very possible in seaweed organisms with the environment to grow, so it takes many supporters for the sustainability of an ecosystem. Marine ecological

environment that affects the growth of seaweed that is, 1) Temperature, where one important part in affecting the life of seaweed, reproduction, photosynthesis and respiration. 2) Current velocity is a flowing motion, water mass can be caused by wind blowing, seawater density difference and long wavy tides of open sea. The ideal current velocity is between 15-50 cm / sec. 3). The depth of good waters for seaweed cultivation of *Eucheumacottonii* is 0.3-0.6 m at the lowest tidal for the locations of the fastest current and for the basic off method, while 2-15 m for the floating raft method, longline method), and the path system. This condition is to avoid seaweed from drought and optimize sun exposure and 4) Basis of waters, where the waters are based on coarse sand and rough sand, are well regarded for the cultivation of *Eucheu macottonii*. Such a watershed condition is an indication of good water movement. The basic types of waters can be used as indicators of sea water movement (Abowei and Ezekiel, 2013).

Red Seaweed (Eucheuma cottonii)

Eucheu macottonii is one type of red seaweed (*Rhodophyceae*) and changed its name to *Kappaphycusalvarezii* because the resulting carrageenans include kappa-carrageen fractions, which are commonly found in the Philippines, Indonesia and East Africa (Chan *et al.*, 2013). Red grass is found mostly on coastal and brackish water (John *et al.*, 2001). Therefore, this type of taxonomy is called Kappaphycusalvarezii the name of the region 'cottonii' is generally better known and commonly used in the world of national and international trade. Eucheumacottoniibanya in export by 80% (Directorate General of Aquaculture Department of Marine and Fisheries, 2004). It is widely found in tropical regions such as Indonesia, which is very potential for cultivation (Munoz *et al.*, 2004). The classification of Eucheumacottonii can be shown as follows.

Kingdom	:	Plantae
Divisi	:	Rhodophyceae
Ordo	:	Gigartinales
Famili	:	Solieracea
Genus	:	*Eucheuma*
Species	:	*Eucheumaalvarezii*
Kappaphycus	:	*alvarezii*(doty)

The physical characteristic of Eucheumacottonii is to have a cylindrical thallus, slippery surface, and cartilogeneus. The state of color is not always fixed, sometimes green, yellow, gray or red. Color changes often occur only because of environmental factors. Thalli sightings vary from simple to complex form. The thorns on the long pointed thallus, rather rarely and uncoiled around the thallus. Branching in different directions with the main trunks out close together to the basal area (base). Grows attached to the substrate with a disc-shaped adhesive. The first and second branches grow by forming lush clumps with special characteristics leading to the arrival of sunlight. Not only found in Philippines and Indonesia, Eucheumacottoniiis found in Sabah North Malaysia. A marine plant has a dense structure, about 50m high, which is where it grows on coral reefs and shallow lagoons. E. cottonii is a potential source of various compounds such as natabati food sources, vitamin C, á-tocopherol, minerals, fatty acids and proteins (Matanjun*et al.*, 2009; Jimenez *et al.*, 2010). The distribution of red seaweed in Indonesia can be shown in Figure 2.

Source 2016: Personal Documentation

Fig. 1. Seaweed Eucheumacottonii.

= Seaweed distribution
Eucheuma cottonii
= Waiheru, Ambon City

Family Economic Income

Poverty is a complex social phenomenon that can not be underestimated. Related to that, many factors that influence the occurrence of poverty such as inadequate human resources, increasingly narrow jobs, family members are so many, lack of social services and lack of availability of information in that area (Arsyad & Kawamura, 2009). One way to get out of poverty is to encourage the production of seaweed farmers on the coast (Irmayani *et al.*, 2015). The reason farmers choose seaweed cultivation because the government through the relevant agencies have started to contribute to livelihoods and services to farmers, then seaweed farming in its management requires a cost that is not large enough and the pro-

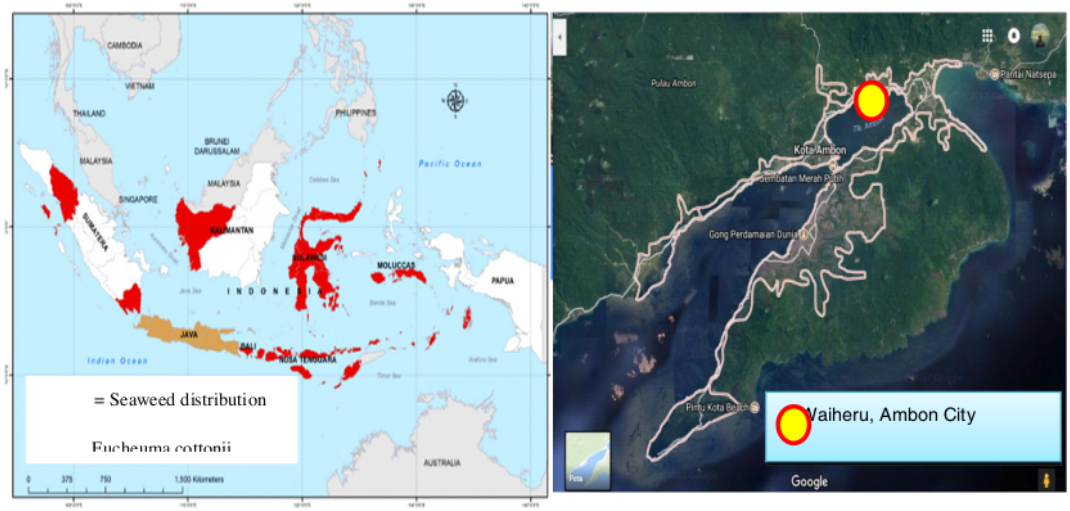

Fig 2. Location of seaweed distribution in Indonesia, One of them Waiheru Village, Ambon City, Maluku-Indonesia, Mulyati & Geldermann, 2017.

duction of seaweed at the time of harvest more so that profitable farmers so that improving the family economy (Zamroni and Yamao, 2011). Seaweed cultivation is often promoted as an advantageous alternative to coastal communities in Southeast Asia (Hill *et al.*, 2011) whereby by improving communication patterns of seaweed farmers and extension workers to improve the development of seaweed farming (Ekasari *et al.*, 2013).

Method

This research was conducted in the coastal area of Waiheru Village, Ambon City, with total area of coastal business of 1 km^2, The sample of research was conducted on seaweed farmer. Technique of taking data with cluster sampling. To obtain more in-depth data then do interviews, observationof the seaweed farmers. The method used is financial analysis or income with approach analysis Revenue Cost Ratio (R / C), Break Event Point, ROI, economic profitability analysis (Kordi, 2011). Against 6 groups of seaweed farmers in Ambon City.

Results

Grass Cultivation Business Analysis for Business Revenue earned.

Based on the survey results, the average wet seaweed harvest for each clump weighing 1250 g / grass. So, the total of of wet seaweed harvest is 4,000 kgfrom the results of a survey of seaweed harvested, 1 kg of wet dried dry results 700 g or 0.7 kg with dry price Rp.14.000. From the survey results, seaweed cultivation for one harvest get Rp.39.200.00, - obtained from 2,800 kg of dried seaweed multiplied by Rp.14.000, the price per kilogram selling dried seaweed. Based on these results, for the first harvest farmers have covered capital from investment and operational costs for one harvest with a time of 45-50 days. If in one period (1 year) there are 7 times harvest, then the cultivator will get Rp. 274.400.000, - obtained from Rp. 39.200.00, - and multiplied by 7 times the harvest for one period (1 year).

Analysis of Revenue Cost Ratio (R / C).

The revenue cost ratio analysis shows the benefits or profits obtained from seaweed farming activities during one production period or one year of production or 7 times of production. The result of revenue cost ratio (R / C) analysis depends on revenue (total revenue / TR) and expenses (total cost / TC), the result is as follows:

$$\frac{R}{C} = \frac{TR}{TC} = \frac{274.400.000}{26.495.000} = 10{,}36$$

Based on the calculation of Revenue Cost Ratio (R / C) analysis, the value (R / C) for the sale of dried

seaweed is 10.36. Criteria Revenue Cost Ratio (R / C) obtained R / C> 1, so it can be interpreted that seaweed business for the sale of seeds is profitable.

1. Break Event Point Analysis

The BEP shows an annual production figure (period) to be achieved to get a breakeven point (not profit and no loss), or in other words a break-even state is a condition where the acceptance of seaweed (TR) equals the cost incurred (TC) or TR = TC. The results of BEP calculation as follows:

$$BEP_{(kg)} = \frac{Cost\ Total}{Cost\ per\ Unit} = \frac{26.495.000}{14.000} = 1.892{,}5\ kg$$

Acquisition of BEP (kg) above, the breakeven point achieved when seaweed cultivation produces seaweed seeds as much as 182.5 kg.

2. Return on Investment Analysis

To analyze *Return on Investment*,it needs to know operating profit as follows:

Operating Profit = 274.400.000– 26.495.000 = Rp.247.905.000,-

So Return on Investment is

$$ROI = \frac{\text{Operating Profit}}{\text{Capital of production}} = \frac{247.905.000}{26.495.000} = 9{,}36\%$$

Based on the comparison of profit and capital of production, obtained ROI value of 9.36%. It means that the amount of profits obtained compared with the amount of cost for the business is "good", meaning that every capital of Rp.100 in profit gain of Rp 9.36.

3. Economic Profitability Analysis

To analyze the economic profitability, it is necessary to know the operational profit obtained from TR minus the operational cost so that:

Operating Profit= Rp.247.905.00– Rp.9.000.000 = Rp.238.905.000,-

So economic profitability as follows:

$$\text{Economic profitability} = \frac{Operating\ Profit}{TC} = \frac{238.905.000}{26.495.000} = 9{,}02\%$$

Economic profitability earnings aboveshows 9.02%> 9% as result then it can be said feasible for business.

The problem faced is the price of seaweed that continues to decline or seem to be played by big capital entrepreneurs. Therefore, the local government is expected to facilitate the farmers in anticipating this price. Given this seaweed is a material or a durable commodity then it should not be immediately on sale.

Discussion

Based on comprehensive results concerning the analysis of added value from seaweed processing, the researcher suggests the results of research teams concerning seaweed cultivation that has been done in 2014. The method used seaweed farmers in the city of Ambon the Long Line method, with a long rope length of 200 m. The average of planting area for long line method is 15 x 200 m / unit. In each unit, there are 4 taliris with a length of 200 m with a distance between taliris 5 m intended to not be related between taliris current or wave. At the end of each unit is anchored from a large rock and buoys from a used aqua bottle over taliris.

The required seedlings per field / unit (15 x 200 m) are 320 kg for 3,200 clumps, where there are 4 taliris and 1 taliris there are 800 clumps with a distance of 25 cm between the clumps, and each clump planted seeds weighing 100 gr. The sale price of dried seaweed Rp.14.000 / kg. Based on the survey results, the average wet seaweed harvest for each clump weighing 1250 gr / clump. So for a total of 4,000 kg of wet seaweed harvest. From the results of a survey of seaweed harvested 1 kg of wet dried dry results 700 g or 0.7 kg with dry price Rp.14.000.

Based on the test results, seaweed cultivation business for once harvest get Rp.39.200.00, -did from 2800 kg of dried seaweed multiplied by Rp.14.000, - price per kilogram selling dried seaweed. Based on these results, for the first harvest farmers have covered capital from investment and operational costs for one harvest with a time of 45-50 days. If in one period (1 year) there are 7 times harvest, then the cultivator will get Rp. 274,400,000, - obtained from Rp.39.200.00, - multiplied by 7 times the harvest for one period (1 year).

The results showed the marine ecological environment that has temperature, velocity, salinity, pH, brightness, water base, depth of nitrate and phosphate waters greatly contribute or influence on the growth of ecology of seaweed.It can provide benefits for people real and fast. It can be proved by the first cultivated seaweed yield, which can return the capital / investment of the farmers so that the next harvest has created a large income for farmers / seaweed farmers, thus seaweed crop yields an advan-

tage for farmers in increase revenue. The results are not much different from the previous research on the northern hemisphere coast informed that seaweed cultivation can provide 300% of profits so it can contribute greatly to the country and the family economy of seaweed farmers (van den Burg, 2016).

The results of this study support the concept that all business results in the second harvest season and so on in a year into seaweed farmer income. This income is able to improve family welfare. In this study, there are many limitations in assessing the empirical results in depth.It is caused there is no study linking seaweed cultivation that is traditional with family income. Most research on seaweed is universally handled with the help of advanced machinery and technology and extracts of seaweed that can add value to the industrial economy. For that, an effective way to tackle coastal poverty depends on how people can take advantage of an ecological environment that has the potential to increase the family's economic income.

Conclusion

Based on the results of research and discussion it can be concluded that marine ecology containing temperature, current velocity, salinity, pH, brightness has the potential to provide fertility in seaweed plants by seaweed farmers and seaweed yields multiple benefits so that the welfare of seaweed farmers'family can be fulfilled. Therefore, it can be recommended that the cultivation of seaweed can improve the family economy in coastal areas. Therefore, serious attention is needed from the community to utilize the existing natural potency to improve the family economy. This study can also be a reference for further research to assess the benefit of seaweed extraction that can boost family income.

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