Business Analysis of Intensive Fish Farming with Aquaponic Systemusing Probiotic and Biofertilizer from *Gracilaria* sp. Seaweed Waste

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ABSTRACT---- ***The aim of the research is to transfer knowledge about enrichment product of probiotic and biofertilizer and analysis of technology engineering of Gracilaria sp. waste as probiotic and biofertilizer in intensive fish farming with aquaponic system. The business analysis showed the optimization of technology engineering of seaweed waste processing in intensive fish farming with aquaponic system. The survival rate of fish with enrichment product of probiotic and biofertilizer was recorded at 83.3% while the survival rate of fish without enrichment product of probiotic and biofertilizer only reached 66.7%. The technology engineering of seaweed waste as probiotic and biofertilizer could save water usage up to 20 times from originally 400 m^3/10 months into 20 m^3/10 months. However, there was no differences in the amount of harvested water spinach which was 25 kg/cycle. Finally, this system showed better values of cash flow, R / C ratio, payback period and break-even points compared to those in aquaponic system without enrichment product of probiotic and biofertilizer from Gracilaria sp.seaweed waste.***

Keywords---- enrichment product, probiotic, biofertilizer, *Gracilaria* sp. waste, aquaponic

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1. INTRODUCTION

Being located in tropical region, Indonesia has the advantage in seaweed production. If it is used properly and with the support from the government support, seaweed can be an alternative for gaining high income for the country. Based on datafrom 1999 to 2006 by FAO, Indonesia has become the world's second exporter after China with the total of export volume of 360.577 tonnes. The increased seaweed export volume of Indonesian indicatesthat Indonesia gains a better position in world trade.Seaweeds are marine organisms that have specific environmental requirements in order to live and grow well. The more similar the area of cultivation to the aquatic conditions, the better the growth and the yields (Aslan, 1998; Effendi, 2000).

Harvesting seaweed is carried out by leaving some part of the seaweed tore-grow. Usually, the base and the tip of the thallusare removed to be used as seed. For seaweed cultivated withdispersal method, harvesting is carried outby moving the plant ashore. While for seaweed planted with long line method, harvesting is carried out by removing seaweed from the rope and then moving it ashore. Seaweed is then sorted by separating old thallusand youngthallus. Young thallusis returned to the pond to be replanted. Once harvested, seaweed is washed to remove dirts and sorted to separate unwanted seaweed.

The yields of seaweed that do not meet the quality for trade namely seaweed with many branches and are dense, no patches, no peeling, bright colors and more than 45 days old, will be accommodated in the landfill. Solid waste producedfrom seaweed cultivationis usually allowed to accumulate in the landfill. Although not dangerous, the waste potentially cause problems, especially if the landfill is not able to accommodate waste production. The production of organic fertilizer made from seaweed waste can also be a prospective business. The amount of agricultural potential in Indonesia is a large market for organic fertilizer products (Saputra, 2011).

The use of seaweed as the raw material of organic fertilizer in Indonesia has not been widely used although the production is highly potential as Indonesia has a variety of seaweed estimated to be as many as 555 species (Anggadireja *et al*., 2006). Among them are *Sargassum* sp. and *Gracilaria* sp. Seaweed is known to contain many micronutrients such as iron, boron, calcium, copper, chlorine, potassium, magnesium, and manganese. It also contains plant growth regulator

(PGR) such as auxin, cytokinin, giberilin, abisat acid, ethylene, phosphorus, sulfur and zinc. Basmal (2011) also revealed the results of the analysis which indicated that seaweed contained 1.00% of nitrogen, 0.05% of phosphorus, 10.00% of potassium, 1.20% of calcium, 0.80% of magnesium, 3.70% of sulfur, 5 ppm of copper, 1200 ppm of iron, 12 ppm of manganese, 100 ppm of zinc, 80 ppm of boron, 50-55% of organic compounds, and 45-50% of ash content. PGR in seaweed is widely available in the stem (thallus).

Aquaponic technology is basically divided into two, namely fishfarming as the main cultivation and plant cultivation. Inaquaponic technology, the water that has been used is used for fertilizing the soil for another farm (eg. vegetables). Although planting vegetables is a side business, it has an important role in supporting the success of the basic business, fish farming, since part of the plants serves as water filter that provides a medium for a good fish growth. Given thefilter, the toxin often produced from fish farming in the form of ammonia can be reduced by the plant up to 90% of existing level so that the water is still worth reused as a medium in fish farming (Nugroho and Sutrisno, 2008).

Nitrification bacteria transform fish waste into nutrients that can be utilized by plant. Then, the plant serves as a filter of vegetation that parses the toxic substance into a substance that is not harmful to fish and the supply of oxygen to the water used to raise fish. This cycle is a mutually beneficial cycle (Pramono, 2011).

2. MATERIAL AND METHOD

Preparing Research Equipment

Equipment used in the study are washed with detergent and rinsed with clean water, then washed again with 12 ppm of chlorine, then washed with clean water and dried in the sun. Each container is placed on a shelf where the position is in accordance with the study design.

Preparing Seaweed

Gracilaria sp. used are the waste of seaweed harvest from aquaculture ponds or seaweed manufacturer. Then, the process of making fertilizer is undertaken by cutting the seaweed into small pieces and depressing themin order to take the juice. Then, the seaweed waste liquid is analyzed in the laboratory to determine the concentration levels of N and P.

Determination of N-Total isperformedthrough semi modified micro-Kjeldahl, i.e. by weighing 10 mL of solution and putting it into a 100 mL measuring flask anddiluting it with distilled water to the limit. 10 mL of the solution formed is taken and putinto a 500 mL Kjeldahl flask and added with 10 ml of H_2SO_4(93-98% N-free). 5 g of a mixture of Na_2SO_4-HgO (20:1) is also added for a catalyst. The sample then is boiled until it is clear and the boiling process is continued for 30 min.After the sample is cool, the processis followed by washing the walls in theKjeldahl flask using distilled water and boiling it again for 30 min. Once it is cool, 140 mL of distilled water is added as well as 35 mL of a solution of NaOH-$Na_2S_2O_3$and zinc granules. The process is followed by distillation in which 100mL of distillate is collected in an Erlenmeyer containing 25 mL of a saturated solution of boric acid and a few drops of blue methylene indicators. In the next step, thesolution obtained is titrated with 0.02 HCl and the N total of the sample is calculated. N Total mg / mL = [(mL HCl x N HCl) / mL of sample solution] x 14.008 x f; where f is the dilution factor.

Determination of P is carried out by weighing 2 g of sample and putting it intoa beaker and adding 7.5 mL of Mg-nitrate solution. The solution is then heated on top of an electric heater at 180°C until it becomesthick. Then, the sample is moved into a muffle at 300°C until no black residue. Furthermore, the sample is chilled and addedwith 15 mL of concentrated HCl and diluted with distilled water. The sample is then moved into a 250mL measuring flask and diluted to the limit. The next step is taking 100 mL of the sample solution resulted and moving it into a 250 mL beaker. Concentrated NH_4OH is added to the sample until sediment is resulted and then the sample is dissolved again by adding concentrated HNO_3 until the solution turns clear. The process is followed by adding 15 g of ammonium-nitrate to the sample and heatingit using a water heater until the temperature reaches 65°C and adding 70 ml of molybdate solution andsettling itfor 60 min. The next step is examiningthe sedimentation by taking 5 mL of supernatant and adding 5 mL of molybdate solution. It is then stirred until no more sediment formed. As the sedimentation is completed, it is necessary to filter out and wash it with distilled water. Furthermore the sediment is resolvedusing filter paper with the addition of NH_4OH (1:1) and hot water until the filter paper becomes clean. The volume of filtrate and the product ofrecent washing should not be more than 100 mL. The filtrate and the product of recent washing with concentrated HCl are then neutralized and it is then settled and added with 15 mL of magnesia mixture from the burette with a speed of 1 drop per second while shaking it. After being settled for 15 min, 12 mL of concentrated NH_4OH is added and then it is settled for 2 h. Supernatant is then poured through ash-free filter paper and the sediment is washed in the beaker with dilute ammonia until it is chloride free. The next step is drying the sedimentation and filter paper in a crucible which has been turned on to obtain a white residue. It is then chilled in exycator. The residue is then weighed as $Mg_2P_2O_7$. Weight of P_2O_5 iscalculated by the formula of the weight of P_2O_5(g in 100 mL of solution) = 0.6377 x weight of $Mg_2P_2O_7$ (g).

Fermented Seaweed Waste Technology

Fluid resulted from the process of preparing seaweed is fermented using culture dominated by fermentation bacteria *Lactobacillus* sp. Fermentation is the conversion of organic matter into another form with the help of microbe (Judoamijoyo, 2003). Microbe performs fermentation by converting complex organic materials into simpler organic materials. Based on the results of the preliminary test, the composition of bacteria is *Lactobacillus* 8.7 x10^5CFU/mL. This process begins by performing the waste of*Gracilaria* sp. in amount of 500 g each with a solution of fermentation bacteria *Lactobacillus* sp. as much as 5 mL and then stirred evenly. The liquid is then put into a sealed container and fermented for 1 week. This is in accordance with the opinion of Inckle*et al.* (2005) who explains that the fermentation period is between one to two weeks. Fermentation period is adjusted to the desired treatment. Laboratory analysisis performed after the fermentation process to determine levels of N and P.

Aquaponic System Planting Media

Planting media used in this study is combined with intensive aquaculture with aquaponicsystem (Thimen*et al.* 2005; Kohar *et al.*2004). Fertilizer made from seaweed liquid waste resulted from the fermentation is put in each reservoir.

Cat Fish (Clarias batrachus) Biomass Weight Calculation

Biomass is the total weight of a population at a certain period and is expressed inweight unit (Gideon *et al.*2007). Cat fish*(Clarias batrachus)*is measured regarding its body length and body weight and then placed in an aquarium with a density of intensive cat fish aquaculture. The fish is acclimatized and not fed for two days before given treatment. The feed to be used in this study is commercial feed. The amount of feed for each treatment is as much as 3% of the average body weight of fish weighed using analytical balance (SNI 01-6141-1999).

Preparing Aquatic Plants

The method applied refers to recommendation of Prasad *et al.* (2008) with modifications. Aquatic plants usedarelocal watercress with 25 cm stem length and 1 cm shoots which then placed in a container that had been prepared. Next, the reservoir containing fermentation product will flow according to the force of gravity towards the aquarium below. The water flow is then pumped towards the reservoir. Recirculation of the water flow will rotate until the study ends. At the end of the study, the length and width of leaves, stems, roots, number of leaves and the body length and body weight of the fish as well as the changes that occur are measured.

Fish Survival Rate

Survival rate is the percentage of fish that live in acultivation period (Suyanto, 2002). Effendie (1997) states that fish survival rate can be calculated by the formula:

$$SR = Nt / No \times 100\%$$

Description: SR: survival rate (%); Nt: Number of fish at the end of the test; No.: Number of fish at the beginning of the test

Aquatic Plant Growth

Growth is associated with changes in number, size or cells level dimension, organas well as individual that can be measured by the measurement of weight and length (Hidayat 1985). Leaf length is measured weekly by inverting leaf then measuring its lengthfrom the media top surface to the longest leaf using a ruler. Leaf width is measured weeklyusing a ruler to measure from the media top surface to the bottom surface. The stem length is measured weekly using a ruler to measure from the media top surface to the bottom surface. Stem length growth can be calculated using the following formula: stem absolute growth = final stem length–initial stem length. Root length is measured weekly using a ruler to measure from the media top surface to the bottom surface. Root length growth can be calculated using the following formula: Root absolute growth = final root length–initial root length.

Identifying the Type and Number of Probiotic Bacteria

Probiotic bacterial isolates in culture on gelatin GYP (Glucose-Yeast extract-Peptone) isolation media with the composition of 10 g of glucose, 10 g of yeast extract, 5 g of peptone, 2 g of beef extract, 1.4 g of Na-asetat.$3H_2O$, 5 mL of salt solution (0.1 g of $MgSO_4.7H_2O$, 0.1 g of $MNSO_4.4H_2O$, 0.1 g of $FeSO_4$.$7H_2O$; 0.1 g of NaCl; 50 mL of distilled water), 0.5 g of tween 80, 20 g of gelatin, 1 L of water. Once it is sterilized,0.75 mg of $CaCO_3$/mL of media is added. The selection of *Lactobacillus* sp. is performed by analyzing its amount committed towards isolates with the excellence character of tolerance to low pH. Tolerance to low pH testing is performed by replacing the isolates growth resulted from the enrichment of seaweed waste fermentation media with a broth MRS media whose pH is set to reach 2.5. Media turbidity is measured using a spectrophotometer at a wavelength of 600 nm, after the incubation for 0, 24, 24 and 72 h.

Technology Dissemination and Marketing Distribution of the Product

From the study conducted with products from the research "Empowering Coastal Communitiesthrough Technology Engineering of Seaweed Waste as Enrichment Product of Probiotic and Biofertilizer in Intensive Fish Farming with Aquaponic System", technology dissemination to coastal communities (fishermen and traditional fish farmers) in Keputih and Kenjeran Surabaya was carried out.

Technology dissemination would becarried out in packages, namely (1) the production process of enrichment productof probiotic and biofertilizer as well as technology applications in the field and (2) the marketing distribution of enrichment product of probiotic and biofertilizer.The production process of enrichment product of probiotic and biofertilizer as well as technology applications in the field wascarried outthroughcounselling, demonstration of the package of technology and testing by participantsas well as monitoring and evaluation of the results of the technology dissemination.Participants were also given information regarding the marketing distribution of enrichment product of probiotic biofertilizer as well as training to perform business analysis of enrichment product of probiotic and biofertilizer.

Counseling on dissemination of the production process of enrichment product of probiotic and biofertilizer

Determining and grouping of fishermen and traditional fish farmers were carried out based on level of education / knowledge / skills in business diversification. Counseling was prioritizedfor the region with numbers of respondents who activelyaccepting the transfer of technology and skills to produce enrichment product of probiotic and biofertilizer. Monitoring and evaluation were carried out at each stage of technology dissemination.

Technology Applications in the Field

Integrated aquaponic farming between fish and aquatic plant utilizing the enrichment product of probiotic and biofertilizer from engineered technology of seaweed waste is established.Target of testing were the survival and growth rate of fish and aquatic plant, the efficiency in aquaponic cultivation withNutrient Film Technique and Floating Raftsystems, the potentiality of the products stored in packing as well as applications in the field.Monitoring and evaluation were carried out at each stage of technology dissemination.

Marketing Distribution ofEnrichment Product ofProbiotic and Biofertilizer

Enrichment product of probiotic and biofertilizer produced from the engineered technology of seaweed waste was tested on stakeholders to establish a marketing distribution synergistic with efforts to increase the production of fish and aquatic plants and capabilities in entrepreneurship of fishermen and traditional fish farmers as a form of alternative business diversification.Monitoring and evaluation were carried out ateach stage of technology dissemination.

Business Analysis

Participantscould perform analysis and calculation of investment costs, operational costs, variable costs, income, Revenue Cost Ration (R/C Ratio), Payback Period (PP), and Break Event Point (BEP).Monitoring and evaluation were carried out at each stage of technology dissemination.

3. RESULTS AND DISCUSSION

Implementation of the results of research empowering coastal communities through technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic systemwas strongly associated with the Anti Poverty Program in the field of fisheries as well as the pioneering in the development of the Center of Agribusiness for SuperiorCommodities in the field of fisheries carried out by the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia and the Department of Fisheries and Marine at provincial and district level.

The innovation of the results of the research empowering coastal communities through technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system also involved coastal communities or fishermen with the aim of providing an alternative economic empowerment when it is not fishing seasonandthe environment does not allow them to go to sea, as well as efforts to diversify their business through fish farming with aquaponic systems and seaweed waste utilization as enrichment product of probiotic and biofertilizer.Likewise, the role performed by universities to carry out one of the points of ThreeServices ofCollegein which education, research and community service should bebalanced so as to contribute significantly to the development of complete Indonesian human.

Alamsjah (2013) also reported that the Consortium of Marine Partners as part of a group of researchers and practitioners in the field of marine and fisheries in Indonesia examined the importance of improving the human resource capacity of coastal communities and communities in small islands. Coastal communities and communities in small islands are unique executant of natural resources utilization. Theyutilize natural resources supported by the human resource capacity.

Human resource capacity in this area is likely to be lower than other areas such as down town. The capacity is influenced by the culture of origin, remote location, inadequate access to technology, as well as minimal access to education compared to the other areas. The low human resource capacity of coastal communities affects, either directly or indirectly,the utilization of natural resources. Natural resources which are not well managed by adequate human resources results in not maximal utilization, mishandled and even damage to the natural resources.

Human resource's behavior and capacity are reflected in three parameters, namely the attitude of the community, the level of knowledge and skill levels. Strategies that can be performed to improve the human resource capacity among others are (1) sustainable counseling, (2) training of appropriate technologies, (3) basic education, (4) giving examples, (5) workshops, (6) internship to industrial institution.

From these activities, all components be it the government, association of fishery and marine, universities and stakeholders with their resources are expected to contribute to improving knowledge, skills and awareness of coastal communities in an effort to reduce and prevent damage to the ecosystem, for the sake of the sustainability of the utilization and preservation of resources and services in coastal areas.Comprehensive research on mapping the condition of the human resource capacity of coastal communities that have the potential as a driver of human resource capacity building as well as to provide information and assistance related to innovation of activities that are capable of providing human resource capacitybuilding in the field of marine and fisheries is required.

Socio-economic conditions of coastal communities tend to be lower than that ofcommunities in other areas. This condition is mainly due to the low human resource capacity, limited access to capital sources, technology, information and market as well as lack of public participation in decision making related to the management of coastal resources. Building strong and prosperous coastal communities through developing small-scale productive economy that requires skills, technology, access to capital, etc and is supportedwith behavioral change is part of efforts to improve the socio-economic conditions and increase the cultural role of coastal communities. The communities need training on the management of small scale industry in terms of business management, financial management, marketing management as well as human resource management. Briefing on the management of research-based industry is the basic strategy to provide new innovations and to receive and carry out a more effective management of natural resources as an alternative for increasing income. Further strategies are implemented by providing access to information technology as a tool to improve and expand the capacity of the industry such as market expansion, providinginformation about the development of industry that follows the market trend. Creating and building solidarity and collective action of the communities are efforts to build an economy that supports the sustainability of natural resources and the environment, social welfare and justice through the establishment of joint venture or business group through cooperative.

Implementation of the strategy requires the involvement of many parties, utilization and integration with the coastal community empowerment programs, development of innovative products and services of marine and fisheries which are environmentally friendly. Expertise, facilities, results of research and the development of applied technology owned by the Consortium of Marine Partners need to be utilized to support these efforts in line with the development of fisheries and marine program. Until now, the management of resources and coastal environment has not been properly carried out, resulting in extensive damage to the preservation of resources and the coastal environment. Recovery efforts to conserve natural resources through conserving marine ecosystems by providing counseling and appeal to fishermen about the dangers ofillegal fishing as well as providing solution and alternative for environmentally friendly fishing methods are priority that must be performed, along with the handling of waste that pollutes marine ecosystems. Similarly,fish seeding activity is carried out in an effort to conserve and balancethe marine ecosystems. This activity can be carried out by children of early agesas an effort to introduce marine ecosystems and foster a sense of concern for the balance in the marine environment. Other activities that can also be a priority are counseling and mentoring cultivation with floating net that is environmentally friendly because the impact of cultivation with floating net are found to contribute to the pollution in reservoirs and aquatic areas in which aquaculture with floating net is carried out.These activities arecarried out as an effort to conserve coastal and marine ecosystems. The farming activities in coastal and marine areas are expected not to lead to environmental pollution or increase in the burden of environmental pollution. Intensive fish farming with aquaponic system is also a breakthrough in an effort to diversify business in fishery which can be carried out by coastal communities.

Another activityas part of prevention and restoration of damage to the coastal environment isto increase the intensity of understanding and awareness programs for coastal communities in dealing with disasters and adaptation to climate change. Through sustainabledisaster mitigation program, it is expected to form agents of disaster mitigation simulator in any coastal areas, so as to facilitate the communities in understanding disaster mitigation. The efforts of cleaning beach also becomes the most important part to foster the love of coast and ocean, especially the one performed by the younger generation. Counseling and training programs as well as all field activities should be based on research studies that have been conducted so that the activities give a more tangible impact on prevention to the damage and recovery of resources and coastal environment.

The results of research empowering coastal communities through technology engineering of seaweed waste seaweed as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system in the 3rd year are expected to provide motivation for the coastal communities to diversify its business as well as a better understanding of performingfish farming with aquaponic system by utilizing seaweed waste as enrichment media of probiotic and biofertilizer. The results of the interviews and the initial and final evaluation of the respondents show the following characteristics:

Table 1. Distribution of the age of respondents of coastal communities in the research of engineering technology of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system

Age group (year)	Number of respondent	Percentage (%)
25-34	17	34
35-44	11	22
45-54	12	24
55-64	10	20
Total	50	100

Age of respondents vary widely, suggesting that the empowerment of coastal communities through engineering technology of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system attracted the communities and was able to be developed by a diverse age range of respondents. Fish farming system with aquaponic model is very advantageous because it gives double results at the time of harvesting in the form of fish and vegetables as well as seaweed waste utilization which is relatively easy to implement as an effort of economic empowerment of the coastal communities. It is also due to a good understanding of related products it produces as well as marketing opportunities that allow it to be carried out by the respondents.

Table 2. Level of education of respondents of coastal communities in the research of engineering technology of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system

Level of education	Number of respondent	Percentage (%)
Primary School	10	20
Secondary School	13	26
High School	24	48
Bachelor Degree	3	6
Total	50	100

The level of education of respondents of coastal communities in the research of engineering technology of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system which also vary suggests that the technology of fish farming with aquaponicsystem was applicable. Moreover, most of the respondents were graduated from high school, making the acceptance of the understanding of engineering technology of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system easier.

Table 3. Percentage of respondents who attended training on engineering technology of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system

Activity	Number of respondent	Percentage (%)
Ever attended training	0	0
Never attended training	50	100
Total	50	100

The data suggest that all respondents had never attended training on technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system so that a more intensive understanding of the technology dissemination and its utilizationfor the respondents was required. Respondents needed time and practice to understand the procedure of engineering technology of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system. They also needed funds to start the business diversification as they originally depended on fishing to become coastal communities capable of conducting business diversification through technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system.

Table 4. Percentage of increase in capability, skills and interest of the respondents after the training on technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system

Activity	Percentage (%)	
	Capability and skills	Interest to develop
Before training	7.55	50.50
After training	55.50	100
Increase	47.95	49.50

The increased capacity and skills of the respondents were followed by the increase in number of respondents who wish to develop business in the future. Prospective market opportunities and access to marketing of the yields encouraged respondents to improve their capability and skills as well as theirinterest in applying the results of the research of technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system.

Table 5. Response of participants after the training on technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system

Response	Yes	Fair	Less	No
Improving knowledge	96% (48 participants)	4% (2 participants)	0%	0%
Improving skills	94% (47 participants)	6% (3 participants)	0%	0%
Improving self-reliance	90% (45 participants)	6% (3 participants)	4% (2 participants)	0%
Increasing income	60% (30 participants)	18% (9 participants)	12% (6 participants)	10% (5 participants)

People believe that coastal communities (especially fishermen) is a group of people who occupy a region with income level below the poverty threshold. Luqman *et al.* (1999) states that the status of natural resources greatly affects performance in exploring and exploiting the fishery resources. On the other hand, the level of knowledge and technology also contribute to what extent the existing potential can be utilized. The next process is to formulate a common policy between the municipal authorities, universities and stakeholders with a mentoring program (e.g. funded by the budget of revenues and expenditures) so as to create entrepreneurs and new jobs, while increasing the income of coastal communities.

Evaluation was carried out at every stage of the processing procedure of the product starting from selection of raw materials up to the stage prior to the promotion and distribution of the product. Determination of evaluation criteria still referred to product that is hygienic and worth selling, starting with the selection of quality materials and controlled processing procedure. The implementation program of technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system was expected to empower coastal communities with low socio-economic level to make innovation in economy empowerment and improve knowledge and skills in engineering technology of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system. Furthermore, the benchmarks of the success of the activities can be assessed from the dissemination of the application of engineering technology in the form of the participants' ability to perform seaweed waste processing as enrichment product of probiotic and biofertilizir, optimization of intensive fish farming with aquaponic system, handling of harvested products in the form of fish and vegetables as well as the marketing of the products.

The comparison between the percentage of increase in capability, skills and interest of the respondents to develop technology engineering of seaweed waste as enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system and the response from the respondents before and after training suggestes that the touch of technological innovation provides inspiration for the improvement of the products produced from intensive fish farming with aquaponic system. This is in line with the statement of Luqman *et al.* (1999) that the higher the chance to receive new innovation, the greater the willingness to improve business.

Responses from the participants were highly positive and showing enormous curiosity. This is shown by the liveliness of the participants in the process of discussion carried out with two-way communication method so that the role of the communities (participants) was the same as the executor (presenters), namely providing input in the form of experience. Pariticipants' enormous curiosity was shown by the numbers of questions proposed by the participants, particularly on the management of appropiate and good intensive fish farming with aquaponic system of aquaponics and the technology of seaweed waste treatment as enrichment product of probiotic and biofertilizer, as well as the prospect of marketing the products. The capability of coastal communities in obtaining optimum results from aquaponic products was embodied in the success in establishing a marketing network for fish and vegetables produced in the surrounding regions. Buyers enthusiastically came directly to the coastal communities as the producer of fish and vegetables as the products were cheaper and fresher.

Business analysis of the comparison between the utilization of seaweed waste as the media of enrichment product of probiotic and biofertilizer in intensive fish farming with aquaponic system and intensive fish farming with aquaponic system without the addition of probiotic and biofertilizer is as follow:

Table 6. Differences in business analysis of intensive fish farming with aquaponic system with utilization of seaweed waste as enrichment product of probiotic and biofertilizer

No.	Business analysis of intensive fish farming with aquaponic system	Without probiotic and biofertilizer	With probiotic and biofertilizer
1.	Investment costs	Rp. 5,382,500,-	Rp. 5,825,000,-
2.	Operating costs	Rp.30,702,000,-	Rp.30,042,000,-
3.	Total Expenditure	Rp.36,084,500,-	Rp.35,424,500,-
4.	Total Income	Rp.75,250,000,-	Rp.94,000,000,-
5.	Total Profit	Rp.39,165,000,-	Rp.58,575,500,-
6.	Cash Flow	Rp.44,548,000,-	Rp.63,958,000,-
7.	R / C Ratio	2.09	2.65
8.	Payback Period	0.81 (9.7 months)	0.55(6.7 months)
9.	BEP (price)	Rp.7,216.9,- / kg	Rp.5,667.9,- / kg
10.	BEP (production)	2,405.6 kg	2,361.6 kg

Differences in the business analysis also suggest the optimization of the utilization of technology engineering of seaweed waste processing in intensive fish farming with aquaponic system, where the survival rate (SR) of fish was recorded at 83.3% while the SR of fish without enrichment product of probiotic and biofertilizer only reached 66.7%. Similarly, The utilization of technology engineering of seaweed waste processing as enrichment product of probiotic and biofertilizer could save up to 20 times in water usage from 400 m^3/10 months into 20 m^3/10 months, in which 10 months is a period of effective farming in a year with the calculation of 5 harvest cycles / year. However, there were no differences in the amount of vegetable crops such as water spinach between intensive fish farming with aquaponic system with enrichment product of probiotic and biofertilizer and the one without enrichment product of probiotic and biofertilizer in which the amount of the crops was 25 kg / cycle.

Lacheta (2010), Blidariu and Grozea (2011) and Dunn (2012) state that the benefits obtained from using aquaponics properly will give a higher growth rate resulting in better fish, consistency of plant growth in the aquaponic system, conservation in water and land usage in fish and plants farming significantly, relatively to prevent the emergence of diseases in fish and plants with optimal nitrification and denitrification processes in the media of fish and plants farming. Alamsjah (2014) also repoted that the plant became a substance capable of being biological filter so that it is able to eliminate the poison substances appear and guarantee to supply oxygen is more assured in the aquaponic process. The involvement of microbial bacteria also able to produce enzymes that help the process of breaking down complex compounds into simpler compounds that can eventually become an organic element which is easily absorbed by the fish as well as plants with better. Pramono (2011) mentions that the cycle developed in the aquaponic provide mutually beneficial effects (mutualism symbiosis) between the fish and the plants cultivated simultaneously.Tyson *et al.* (2004, 2007, 2008a, b) also mentioned that the integration of hydroponics with aquaculture system into aquaponic cultivation system can balance the pH levels in plants, fish and bacterial nitrification. Specifically, Roosta and Ghorbani (2011) do comparison hydroponic and aquaponic cultivation system with related growth rate, oil and mineral deposits.Alamsjah (2013) has been making a research relevant relation integration waste seaweed *Gracilaria* sp., *Lactobacillus* sp. and phytoplankton of *Chlorella* sp. collaborated in order to support the process of aquaponic until it able to analyze the amount of bacteria of *Lactobacillus* sp. in the process of fermentation to the media various waste seaweed, the difference of growth in plants water, and the average growth of long narrow leaves, wide leaves, long stems and roots as well as the growing number of leaves of aquatic plants. Growth analysis of fish associated with specific growth rate, the absolute long growth of fish, domination of plankton and the quality of water for the aquaponic system executed.

Aquaponic system is a form of synergy or bio integrationthat correlates aquaculture patterns using the principle of recirculation with hydroponic plants/vegetables production (Diver,2006). Aquaponic technology is also an alternative of aquaculture with hydroponic plants/vegetables using the principle of time and space saving cultivation and utilization of nutrients from feed and fish metabolism residue. Plants also serve as a filter of vegetation that decomposes the toxins into harmless substances to fish and increased supply of oxygen in the water is used to conserve the fish. This cycle will lead tomutual beneficial cycle (Pramono 2011). Ahmad *et al.* (2007) also states that aquaponic technology is proven as capable of successfully producing fish optimally witha limitedspace and water resources. In this case, aquaponic technology designed is attempted as an alternative to coastal community empowerment considering space and water use efficiency, the combination of aquacultureand plants/vegetables cultivation systems, easy, inexpensive and environmentally friendly aquaculture applications because it uses seaweed waste which is abundant and scattered in coastal areas.

4. CONCLUSION

The Disseminate process of making seaweed waste technology engineering to the enrichment of probiotics and biofertilizer developed by community fisherman groups that would give alternative technological innovation of aquaponic system and economic empowerment significantly.Response, enthusiastic and liveliness from coastal communities in diversify aquaponic products using seaweed waste was very high. Interestingly, the target groups of coastal communities in obtaining optimum results of the aquaponic can create fish and vegetable market.

Technical assistances and monitoring the implementation of the program have to be continues to be developed and didesiminasikan widely and sustainable by the relevant agencies, especially assistance by Ministry of Marine and Fisheries, Republic of Indonesia and stakeholders related.Interlacing cooperation with a partner industry and marketing networks need to facilitated by the relevant agencies so that target groups the coastal communities more optimistic and professional in developing a product produced.

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