Appropriate technologies for local economic development based on fisheries products in Poteran Island

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Abstract. Natural resources are no guarantee to make a rich and welfare community. With abundant coastal resources, islanders in Poteran Island have limited household welfare. More than 70% of households are poor and uneducated. In terms of production, the production chain in the island is also limited to selling raw products that are in fact making less profit for the communities. Dependency to loan shark is also one of other tragic situations, placing the fishermen in a powerless community groups. To change this current situation, making local entrepreneurship is the initial stage of developing a self-sustaining small island. The making of local entrepreneurship is integrated with the introduction of appropriate technologies. Selecting the appropriate technologies is a key step in this stage. To ensure the new technologies are appropriate, the new technologies should be tested in a serial training. The observation on the participants’ behaviour will be the basis of evaluation process by using scoring method. Through training, observation, and scoring process, the two tools (fish smoker tool and cracker slicers) are perceived as appropriate technologies for the communities. These tools that are believed can increase the economic profit for fisheries community in the island.

Keywords: Appropriate technologies, Tools, Community, Economic benefit, Local-preneurship

1. Introduction
Fisheries production has dominated the economic value in Poteran Island. In 2011, Talango District (the only district in Poteran Island) has 1,204.6 ton fisheries products with the value of IDR 12 million daily. The domination of fisheries sector can also be seen from the number of household with main occupation in fisheries for about 1,503 households. Based on the island profile in 2011, the main fisheries products are anchovy, crab, cob, snapper, cakalang, manyung, bambangan, pomfret, mullet fish, laying, squid, and grouper. Furthermore, Pamungkas et al. (2015) have specified five primary commodities in Poteran: seaweed, anchovy, crab, reef fish, and cob.

Pamungkas et al. (2014) have identified that those fisheries products can be processed for middle level products such as meatball, ice cream, nugget, jelly, crackers, powder, smoked fish, and merchandise. Some of the most excellent processed products from those fishery commodities are powder for cosmetics, rice cracker, and chips. Unfortunately, those products’ processing method in the island is not common. Pamungkas et al. (2014) identified the common practise in the island is selling raw fisheries products. The island’s most excellent processed product is a traditionally-made cracker made by limited numbers of producers.
Even worse, the common practise in the island has been hooked up to loan shark. Most of raw fisheries products are sold to the loan shark with very low prices. Therefore, the household welfare is very low. Based on Talango in Numbers (2012), the number of households with low-income category (pre welfare and welfare state category 1 household type) is 7,484 households (BPS: 2012). It is around more than 72% of the total if every household consists of four persons. In addition, the education level of islanders is low, with high percentage of un-graduated from Compulsory School (elementary school) for about 73% of the total.

Based on the production chain of five commodities, low technology usage is the main cause of low economic values. In the beginning of production chain, most fishermen rely on simple fishnet and bubu (simple fish catcher for crab). In end of the chain, most locals use simple knife and other low technologies to produce cracker. Figure 1 illustrates the most common technology used in anchovy production chain in Poteran. The green boxes are the real main production chain in Poteran and boxes in other colors are the possible production chain for anchovy products. This phenomenon does not only occur in anchovy products but also in all key fisheries products in Poteran. Consequently, the economic value of fishery sector (the primary sector in Poteran) is very low. Therefore, there is a need to optimize the economic value of fishery product to level up the islanders’ economic condition.

On the other hand, facts above have proved that Poteran Island is not a self-sustaining small island from socio-economic aspect. In relation to this, Pamungkas et al. (2014) have defined two of the five criterias of self-sustaining small island with a diverse economic sector that involves local communities in the development process. Without processing the fisheries products, the economic sector in the island is limited. Although the majority of islanders are working in fishery subsector, the unskilled workers and low education make the local communities’ involvement not optimal. Within figure 2, making local-preneurship is the first step to make a self-sustaining small island and aimed to encourage more islanders to process fishery commodities. Local-preneurship means local entreprenuers who use local resources. The communities involved in product processing will have opportunities to optimize the economic return of a commodity.

Optimizing the economic value of fisheries products can be done through the application of simple and appropriate technologies. The simplicity of technologies is important because the islanders’ education level is relatively low. Simple technology can simplify the steps, which are applied in the islanders’ daily life. Furthermore, the appropriate technology can benefit islanders because it can increase the economic value of their commodities. Then, the selection and trial process are the key steps to uncover the technology with simple and appropriate values. This paper will discuss not only from technical aspect of the technologies, but also from socio-economic aspect to determine the level of its appropriateness and simplicity. PAR (participatory action research) is selected to assess the process of finding the appropriate technologies. The interaction between researchers and community via training and workshop is highlighted in PAR research method.
Figure 1. Technology used in Anchovy Production Chain in Poeran.
2. Method

PAR is one of research methods by combining participatory research and action research (Khanlou and Peter, 2005). Lucock et al. (2007) consider participatory research encourages high involvement of researchers and participants. It also builds relation among them in an equal position. Meanwhile, Greenwood & Levin (1998) perceive action research as “systematic and orientated around analysis of data whose answers require the gathering and analysis of data and the generation of interpretations directly tested in the field of action”. Considering those definitions, we highlight PAR to have key elements such as intense interaction among researchers and participants, simulation on the ground, equal position among researchers and participants, bottom up data generation, and continuing analysis process.

In running PAR methods, seven stages from 2013 up to 2016 are implemented in Poteran case study as follows;

- **Stage 1: Choosing an Issue -What is the goal?**
  In making a self-sustaining small island for Poteran, we set a goal to create new local-preneurs in this research as the initial step in Figure 2.

- **Stage 2: Choose Participants and Identify the Research Team: Who will be involved?**
  Since the purpose is to create a local-preneurship, the main participants are the local communities from two selected villages (Talango and Padike). We asked the head of those villages to invite local communities to join this program in the first FGD. We set two main criterias of invited locals: anyone who is active in fisheries subsector and in the range of productive age. The FGD was conducted and attended by 51 local communities from both villages. From 51 local communities, 10 locals from Talango and 9 locals from Padike were actively involved for the serial trainings. All of the participation is voluntary. This way naturally selects villagers as the most prospective respondents for this research. It also reflects the purposive sampling process that highlights the relevancy of respondents to the research objectives (Maxwell, 1997).

- **Stage 3: Find funding**
  After conducting FGD, all team members confirm the research plan based on comments on FGD particularly in defining types of technologies. Afterwards, we plan our budget to implement PAR for this case. All funds come from Indonesian Directorate General of Higher Education with Sustainable Island Development Initiative (SIDI) scheme in 2016.

- **Stage 4: Methodology: How will the team collect information they need to know?**
  Qualitative method is a dominant process in this research. We review local communities’ comments, expressions, and behaviours during a series of training process. All those form of communications will be treated as sources of data (information) to evaluate the appropriateness of technologies.

- **Stage 5: Data analysis and interpretation: How will the collected information be interpreted?**
  Recording the process is the key step in producing information from serial FGD and training. From recordable materials, we select any information that constructs our conclusion on the appropriateness
of technologies. Understanding the key messages from three types of communication forms (comments, expressions, and behaviours) can justify locals’ position in the technologies selection. The locals’ position is selected via a scoring system with performance indicators for every variable (appendix A). Then, the total score is categorized into 3 groups: unappropriate technology (1-23), appropriate technology (24-46), and very appropriate technology (47-69).

- **Stage 7: Take Action: How will your team act on the results of the study?**
  Making an appropriate technology to support the development of local economy, especially fisheries products based on purposive sampling method by research team. Aside from that, trainings by using the appropriate technology will be conducted in this stage. The trainings are; production process trainings in elementary and expert level, marketing and distribution trainings in elementary and expert level, cost of goods’ determination and packaging training.

- **Stage 8: Evaluate: How will your team if your team’s action was successful?**
  After trainings, the result of training observation and participants’ opinion regarding the technology will be the important data that will be evaluated. This evaluation is to identify the appropriateness of the product, by using scoring analysis. Scoring is used because it is able to transform the qualitative data into quantitative ones. Observations are considered accurate to determine the scoring value of technology’s appropriateness because one of PAR’s principle is to know what the local communities are doing, how they interact with each other, what are their aspiration, what are the difficulties and how to interpret it in words (Stephen Kemmis and Robin McTaggart, Participatory Action Research: 271). The following is scoring by using Likert scale (Ridwan, 2009):
  - 3= Very suitable with appropriate technology’s principle
  - 2= Suitable with appropriate technology’s principle
  - 1= Not suitable with appropriate technology’s principle

Scoring guidelines is a guide to take into account aspects and criterias that are used as a framework to determine a score (Charlotte Danielson, 1997). The indicator and variable of scoring guidelines derived from literature review on the understanding of appropriate technology. Appropriate technology is a technology that can be easily absorbed by the local community culture that can add value and sustainability, so the locals are able to disengage from traditional production system (Mahlinda, 2013). Variables to valuate the appropriateness of technology are based on these literature reviews:

- **Technology**
  - Machine (Ali hanipah,2009), Accommodate human’s work (Ali hanipah,2009; Prasetyo dan Asmara, 2013), Affordable (Ali hanipah,2009; Prasetyo dan Asmara, 2013; Ricardo. 2007; Sudarmo, 2005; Almasdi, 2010), Simple (Ali hanipah,2009; Prasetyo dan Asmara, 2013; Sudarmo, 2005; Almasdi, 2010), Eco-friendly (Ali hanipah,2009; Munaf, 2008; Ricardo. 2007; Sudarmo, 2005), Save Energy (Wikipedia).

- **Appropriate**
  - Solve the problems (Ali hanipah,2009; Prasetyo dan Asmara, 2013; Sudarmo, 2005; Almasdi, 2010), Effective Technology (Munaf, 2008), Can be operated by the locals (Munaf, 2008), Suitable with the culture (Munaf, 2008; Mahlinda. 2013; Sudarmo, 2005), Convert natural resources (Munaf, 2008; Ricardo. 2007), Relatively small in size (Wikipedia; Prasetyo dan Asmara, 2013; Anonimous, 2008), Labor intensity (Wikipedia; Anonimous, 2008; Ricardo. 2007).

- **Benefit**
  - Beneficial to local communities (Ali hanipah,2009; Sudarmo, 2005), Economically beneficial (Ali hanipah,2009; Mahlinda. 2013; Sudarmo, 2005), Open new job opportunities (Munaf, 2008), Accelerate Household Industries (Munaf, 2008; Anonimous, 2008), Increase Local Communities’ Income (Munaf, 2008).

3. Result and Discussions

3.1 The Determination of Appropriate Technology

Before determining the appropriate technology to be implemented in Poteran Island, the research team chooses possible technology options that are able to solve the existing problems. Based on previous research, seaweed and reef fish are excellent potentials to be developed in Poteran Island. Hence, economic growth by developing seaweed and fishery commodities is necessary. The following are recommendations by the research team regarding appropriate technologies:
Poteran Island has an excellent potential of seaweed and reef fish commodities. However, those commodities are being sold as raw products without being processed (similar with anchovy production chain in figure 1). This caused a very minimum additional value that the fishermen get from fishery commodities. Thus, their economic status is relatively low and in some way, it generates migration from Poteran Island to big cities, especially Jakarta. Those are the root causes of Poteran Island being undeveloped and difficult to grow. Productive age population is declining and sooner or later, the island will be abandoned. Therefore, economic growth by developing seaweed and fishery commodities is necessary. To identify the strategic issues regarding the development of fisheries product, FGD with local communities were conducted.

Focus group discussion was initially done by explaining the purpose of the research in study area. The purpose of the research is to identify and apply appropriate technologies to solve the issue of the underdeveloped fisheries products in Poteran Island. Afterward, the team starts the open discussion with the community to explore strategic issues regarding the development of existing fisheries products. The following is the priority issue that has been identified by the team:

**Table 1.** FGD Result about Implementing Appropriate Technologies in Poteran Island.
| No | Types of Appropriate Technology | Raw Materials | Supporting conditions | Supporting Factors | Unsupportive Factors | Conclusions |
|----|---------------------------------|---------------|-----------------------|-------------------|---------------------|-------------|
| 1. | Fish Smoker Tool | Fish | Abundant raw material, Processing method are relatively inefficient and not eco-friendly, High market demand | Abundant fish stocks, Raw fish are sold without being processed, Unprocessed fish get spoiled easily, Smoked fish are one of the main dishes in wedding events, Fish’s charcoal-based smoking process produces a lot of smoke that could harm the health | It takes a lot of time to smoke the fish | This appropriate technology is chosen to be applied in Poteran Island. Final product: Smoked Fish |
| 2. | Seagrass Crackers Slicer | Fish | There are many seagrass crackers industries, Inefficient processing method | There are many seagrass crackers small industries, Slicing process uses knives, so the cracker’s size cannot be identical, It takes a lot of time to slice the seagrass crackers | | This appropriate technology is chosen to be applied in Poteran Island. Final product: Seagrass and fish crackers |
| 3. | Cup Sealer Packaging | A few types of raw materials | Seagrass crackers are produced in a huge amount, Inefficient processing method | Abundant seagrass crackers product, The packaging of seagrass crackers uses plastic and candle as a glue, so it isn’t quite presentable | Unstable power source | This appropriate technology is chosen to be applied in Poteran Island. Final product: Seaweed and fish meatball |
| 4. | Meat Grinder and Slicer Tool | Fish | Grinding the meat using a blender, Electrical limitations | People consider a blender as a tool to grind the meat | | This appropriate technology is chosen to be applied in Poteran Island. Final product: Seaweed and fish meatball |
The following is the process of focus group discussion in determining the appropriate technologies to be implemented in Poteran Island:

![Figure 5. FGD Process in Discussing the Chosen Appropriate Technologies.](image)

After conducting FGD with groups of islanders who process the fish in Padike and Talango village, the next step is discussing the implementation of the chosen appropriate technologies with internal team. Criteria that are used by the team to evaluate are: the importance of technology, correspondent with infrastructure’s condition, easy to be implemented by a lot of people, and give bigger added value to the consumers.

**Table 2. Recommended Appropriate Technologies Based On Research Team’s Discussion.**

| No | Raw Materials | Product | Appropriate Technologies as FGD Result | Implemented Appropriate Technologies |
|----|---------------|---------|----------------------------------------|-------------------------------------|
| 1  | Seagrass      | Crackers, Meatballs, Nugget | Seagrass crackers slicer              | Seagrass crackers slicer              |
|    |               | Syrup   | Cup sealer packaging                   |                                     |
| 2  | Fish          | Jerky (Dendeng), Crackers, Meatballs, Nugget | Fish smoker tool, fish crackers slicer, meat grinder tool | Fish smoker tool                     |

3.2 Implemented Appropriate Technologies
3.2.1 Fish Smoker Tool.

Fish smoker tool is suitable to help medium scale businesses, fishermen in coastal areas, fishermen’s villages, houses, restaurants, hotels, deserted island, disadvantaged region, and a country’s border. This tool can rapidly produce a huge amount of smoked fish, easy to use, and help to create a healthy environment. This tool can create a healthy environment because it is able to control in-and-out smoke.

Advantages
1. Reduce air pollution from traditional fish fumigation tool by preventing the smoke to spread out.
2. Trapped smokes can intensify the flavour of the fish.
3. Trapped smokes can reduce the duration of processing.

How to use
1. Prepare the fish
2. Clean the fish
3. Put the fish into fish smoker tool
4. Prepare charcoal from coconut shells
5. Burn charcoal from coconut shells
6. The process of fumigation inside the smoker tool
7. Occasionally rub seasoning on the fish
8. Lift the fish from fumigation tool
9. The results of smoked fish already finished
3.2.2 Crackers Slicers.

Crackers slicer is suitable to help medium scale businesses, fishermen in coastal areas, fishermen’s villages, to houses, restaurants, hotels, deserted island, disadvantaged regions, and country’s border. This tool can produce crackers in similar size and thickness and also in a short amount of time. Aside from that, this tool does not require electricity to operate which will make the user more active and healthier.

Advantages
1. It is small and handy.
2. It can slice crackers in similar average thickness and size.
3. The knife part can be sharpened regularly like a normal knife.

How to use
1. Put the raw materials cracker cylindrical above the main part and hold it with the left hand.
2. The right hand holding the cutting tool is moved up and down, causing cuts to the raw material crackers cylindrical.
3. The right hand moves up and down, while the left hand moves to the right to input raw materials to the cracker slicer’s blade.
4. Continue until finish

3.2.3 Conducted Trainings.
Other than creating the technologies, trainings are conducted to develop the fishery commodity’s processing method using appropriate technologies. Here are a few trainings in this activity:
• Smoked Fish Training

![Smoked Fish Training](image)

**Figure 8.** Training Process in Making Smoked Fish with the New Fish Smoker Tool.

• Seaweed Meatball Training

![Seaweed Meatball Training](image)

**Figure 9.** Training Process in Making Seaweed Meatball.
3.3 Appropriateness of Technologies’ Evaluation

The tools used to evaluate the technology during PAR are scoring method. Score 1 indicates the technology is poor, score 2 indicates the technology is below average, and score 3 indicates the technology is good, and correspondent to the principle of appropriate technology. The technology’s prototype which are given to Talango and Padike Village’s residents are crackers slicer and fish smoker tool. Those two tools are used in making smokey fish and meatball as described in figure 8 and 9. The following are scores obtained from the observation during training:

Table 3. Fish Smoker Tool Valuation.

| Aspect                  | Variable               | Indicator                                      | Rate of Response | Supporting Conditions                                      | Unsupporting Conditions         |
|-------------------------|------------------------|-----------------------------------------------|------------------|-----------------------------------------------------------|---------------------------------|
| Technology Engine       | Electric or mechanic tools | • Tools can be moved without using electricity | 3                | • Coals are required to operate this tool                 | • Produces air pollution        |
|                         | Transform/convert the energy | • Tools can convert smoke to a material that produces smoked fish as a processed product | 3                |                                                            |                                 |
|                         | Work according to the settings | • The tools work as expected. The smoking process is fast and valve cover that controls the amount of smoke inside the tool also works well. | 3                |                                                            | • It takes 10 minutes to heat up the coal |
|                         | Help human’s task       | • It does not need a lot of time and energy to fan the smoked fish. | 3                |                                                            |                                 |
| Accommodate Workforce   | Does not require much energy | • Only requires man power to lit the coal and lift the fish | 2                |                                                            |                                 |
|                         | Relatively easy         | • This tool will not be difficult to use, as it does not require certain skills to be operated | 3                |                                                            | •                                 |
| Affordable              | The price is relatively cheap | • This tool costs 15 million Rupiah each unit, which is quite expensive | 1                |                                                            |                                 |
| Simple                  | Can be duplicated       | • Does not require specific person to operate this tool | 2                | • People can create the technology by learning the work-system |                                 |
| Eco-friendly            | Does not give negative impact to the environment | • Smoke can be collected so it will not spread and pollute the environment | 3                | • Still produces smoke that pollutes the air              |                                 |
| Aspect                  | Variable                        | Indicator          | Rate of Response | Supporting Conditions                                                                 | Unsupporting Conditions                                                                 |
|------------------------|---------------------------------|--------------------|------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| Save Energy            | • Using minimum energy          | 2                  | • Fish smoking with this tool will not require motion to fan the charcoal so it will produce the smoke  | • This tool only need smoke from the burned coals to produce charcoal which will be used to smoke the fish |
|                        |                                 |                    | • Smoke that’s produced by the charcoal will be collected by this tool to quicken the smoking process. The quicker the smoking process, the lesser the needed charcoal. |                                                                                           |
| Appropriate            | Solve problem                   | 3                  | • This tool is able to process a large amount of raw fish into smoked fish in a short time. Therefore, the fish can be processed and give added value to the locals. |                                                                                           |
| Effective technology   | • Tool to generate needed goods | 3                  | • This tool can generate raw fish into processed food (smoked fish) which has a high demand in study area |                                                                                           |
|                        | • Provide end product           | 3                  | • This tool can process fish into smoked fish in a large amount yet in short time, so it will increase the productivity of the people in Poteran Island |                                                                                           |
| Can be operated by the locals | • Easy to operate | 3                  | • This tool is easy to operate |                                                                                           |
| Appropriate            | • Appropriate with the culture  | 3                  | • Based on the observations, there are no rejections from the people, yet it is very well-accepted |                                                                                           |
| Converting natural resources | • Transforming the resources | 3                  | • This tool can process fish into smoked fish in a huge amount and little time |                                                                                           |
| Relatively small       | • The size is relatively small  | 2                  | • Even though the size is quite big, this tool can be moved easily with the help of the wheels under the tool | The size of this tool is quite big                                                      |
| Benefit                | • Beneficial for the people     | 3                  | • This tool can process fish into smoked fish in a huge amount yet |                                                                                           |
little time. So, people can get the added values from smoked fish production that will gradually improve their economic and living standard.

- Benefit the distribution 3 • By processing raw fish into smoked fish, the durability of the fish is longer therefore it benefits the distribution as well as consumption.

- Benefit of the consumption 3 • By processing raw fish into smoked fish, it can gain consumer’s interest because of the various taste, more durable life, and simplify the cooking process.

Open new job opportunities
- Provide employment 3 • This tool will be operated by people, so there will be new job opportunities

Accelerating household industries
- Accelerating household industries 3 • This tool will quicken the pace of household industry because it will increase the consumption lifetime of fish

Total 63

**Table 4. The Seagrass Cracker Slicer Valuation.**

| Aspect                        | Variable      | Indicator                        | Rate of response | Supporting Conditions                                                                 | Unsupporting Conditions                                      |
|-------------------------------|---------------|----------------------------------|------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Technology                    | Machine       | Electric or mechanic tools        | 3                | • The mechanical tool can be moved with hand                                            | • Requires human power to operate                            |
|                               |               |                                  |                  | • This tool does not require electricity to operate                                   |                                                              |

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| Aspect                     | Variable                                      | Indicator                                          | Rate of response | Supporting Conditions                                                                 | Unsupporting Conditions                                                                 |
|----------------------------|-----------------------------------------------|----------------------------------------------------|-------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| Accommodate Workforce      | Does not require much energy                  | • Help human’s task                                | 3                 | • This tool helps human to slice the crackers with the exact same size and thickness  | • It requires more energy to operate this tool than using a knife                        |
|                            |                                               | • Work according to the settings                   | 2                 | • The crackers slicer works to slice the crackers according to desired thickness       | • This tool has an obstacle: bluntness of the slicer. So, the slicer is hard to slice according to desired thickness |
|                            |                                               | • Transform/convert the energy                     | 3                 | • This tool convert motion from hands to slice the crackers                            | • The slicer needs oil and sharpen using a grindstone to work according to the desired size |
| Affordable                 | The price is relatively cheap                 | • Relatively easy                                  | 3                 | • The crackers slicer is easy to use. It only requires to rotate the cutter to determine the desired thickness. After that, the handle only needs an up-and-down motion |                                                                                          |
| Simple                     | Can be duplicated                             | • Does not require specific person to operate this tool. Everyone form different education background can operate it | 2                 | • Does not require electricity, heat, nor steam that will increase the pollution. This tool will only need | • This tool costs 15 million Rupiah each unit, which is quite expensive if being compared to a knife, which costs only 20 thousand Rupiah |
| Eco-friendly               | Does not harm environment                     | • Help human’s task                                | 3                 | • This tool does not require electricity, heat, nor steam that will increase the pollution. This tool will only need | • People can make this tool themselves. They only need few trainings regarding work system of this tool |

This table summarizes the aspects, variables, indicators, and conditions of a crackers slicer. The rate of response is measured on a scale of 1 to 3, with 3 being the highest. The supporting conditions are described for each variable, highlighting the advantages and potential limitations of the tool.
| Aspect                        | Variable       | Indicator                           | Rate of response | Supporting Conditions                                                                                                           | Unsupporting Conditions                                                                 |
|------------------------------|----------------|-------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Save Energy                  |                |                                     |                  | motion and does not produce waste at all.                                                                                      | In operating this tool, a bigger movement energy are needed from the ones moving it. But this tool will make a healthier body by applying ergonomic principal |
|                             | Using minimum energy |                                    | 2                | • This tool only require motion from hands; at no cost to operate                                                             |                                                                                             |
| Appropriate                  | Solve Problem  | Solve Problem                        | 3                | • Based on observations, the cracker slicer can solve problem about cracker’s quality.                                     |                                                                                             |
| Effective technology         | Tool to generate needed goods |                                    | 3                | • This tool is able to provide crackers in the desired size                                                                   |                                                                                             |
| Can be operated by the locals | Easy to operate |                                     | 3                | • This tool is very effective to increase the quality of fish product                                                         |                                                                                             |
| Appropriate                  | Appropriate with the culture |                                    | 3                | • This tool is relatively easy to operate                                                                                      |                                                                                             |
| Converting natural resources | Transforming the resources |                                    | 3                | • Based on the observations, there are no rejections from the people, yet it is very well-accepted                           |                                                                                             |
| Relatively small             | The size is relatively small |                                    | 1                | • This tool process raw fish or seaweed into interesting products to be sold and consumed                                    |                                                                                             |
| Benefit                      | Benefit the society |                                     | 3                | • This tool is beneficial for                                                                                                 |                                                                                             |
| Aspect                        | Variable                              | Indicator                      | Rate of response | Supporting Conditions                                                                 | Unsupporting Conditions |
|------------------------------|---------------------------------------|---------------------------------|------------------|----------------------------------------------------------------------------------------|--------------------------|
| Economically beneficial      | Benefit the production                | 3                               |                  | • This tool makes the production in a standard size and thickness in a faster and easier way than previous methods. |                          |
|                              | Benefit the distribution               | 3                               |                  | • This tool benefits the distribution because the end product (cracker) has the same thickness so it will be easier to package and distribute |                          |
|                              | Benefit the consumption                | 3                               |                  | • This tool will give benefit to the consumer, because it has the same crispiness and taste |                          |
| Open new job opportunities   | Provide employment                    | 3                               |                  | • This tool will be operated by people, so there will be new job opportunities             |                          |
| Accelerating household industries | Accelerating household industries          | 3                               |                  | • This tool benefits the distribution because the end product (cracker) has the same thickness so it will be easier to package and distribute |                          |
| Total                        |                                       |                                 | 61               |                                                                                        |                          |

Based on the valuation of technology’s appropriateness, it shows that seagrass crackers slicer have a higher total rate of appropriateness compared to smoked fish tool. If it’s being grouped again, the results are:

- Technology with the value of 1-23: the technology is inappropriate
- Technology with the value of 24-24: the technology is less likely to be appropriate
- Technology with the value of 47-69: the technology is appropriate

It shows that both of the recommended prototypes are appropriate technologies. It is because the recommended technology is suitable with the local community’s aspiration, and it can solve the problem in processing the fisheries product to increase the added value, to finally achieving mutual prosperity.

4. Conclusions
Trainings that are needed by local communities in Poteran Island are the processing methods of seaweed, reef fish, and mackerel tuna commodities. Fishermen are getting lower prices for their products because the resources are being sold as raw products to retailers or, even worst, to shark loan. Hence, applying the appropriate and simple technologies to increase the added value is needed. Two technologies that are fish smoker tool and cracker slicer are introduced to the islanders. Therefore, research team starts to
make fish smoker and seagrass crackers slicer’s tools to increase fisheries’ productivity at least in intermediate level. Those two technologies applied via trainings to make smoked fish and seaweed meatball. Observation during the training process becomes main data to evaluate the appropriateness of the two technologies. Based on the scoring system on the observation outputs, we can conclude that seagrass crackers slicer and fish smoker tool technologies are appropriate technologies. The participants understand the tools easily and also express that the tools are promising in making more income in their future local economic activities.

### Appendix A

| Aspect          | Variable                          | Indicator                                                                 | Valuation Process                                                                 |
|-----------------|-----------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Technology      | Machine                           | Electric or mechanic tools ✷                                              | 1= Tools cannot be moved                                                           |
|                 |                                   | Transform/convert the energy ✷                                             | 2= Tools can be moved by using electricity                                        |
|                 |                                   | Work according to the settings ✷                                           | 3= Tools can be moved without using electricity                                    |
|                 |                                   | Help human’s task ✷                                                        | 1= The tool cannot convert the energy                                              |
|                 |                                   |                                                                           | 2= The tool is able to convert one kind of energy to another one                    |
|                 |                                   |                                                                           | 3= The tool is able to convert a kind of energy to another one                      |
| Accommodate Work| Does not require much energy ✷    |                                                                           | 1= The tool is not working                                                         |
|                 |                                   |                                                                           | 2= The tool is working but have issues in the operation                            |
|                 |                                   |                                                                           | 3= The tool is working as expected                                                 |
|                 | Relatively easy ✷                 |                                                                           | 1= The tool does not require energy and human’s power to operate the tool          |
|                 |                                   |                                                                           | 2= The tool does help human work                                                   |
|                 |                                   |                                                                           | 3= The tool helps human’s work the most                                             |
| Affordable      | The price is relatively cheap ✷   |                                                                           | 1= It requires more than two people with huge power to operate the tool            |
|                 |                                   |                                                                           | 2= It requires one person with huge power to operate the tool                      |
|                 |                                   |                                                                           | 3= The tool does not require energy and human’s power to operate the tool          |
| Simple          | Can be duplicated ✷               |                                                                           | 1= The training to operate this tool was conducted numerous times                  |
|                 |                                   |                                                                           | 2= The training of this tool’s operation was conducted once, however the participants didn’t understand how to operate it |
|                 |                                   |                                                                           | 3= In operating the tool, training is not necessarily needed                      |
| Eco-friendly    | Does not harm environment ✷       |                                                                           | 1= The price is relatively high and unaffordable for people                       |
|                 |                                   |                                                                           | 2= The price is the same as other technology in the market and affordable for people |
|                 |                                   |                                                                           | 3= The price is relatively lower than the same type in the market and affordable for people |
| Save Energy     | Using minimum energy ✷            |                                                                           | 1= It requires more than two people with huge power to operate the tool            |
|                 |                                   |                                                                           | 2= People are able to make the same technology themselves                        |
|                 |                                   |                                                                           | 3= People are able to make technology easily in a huge amount                     |
|                 |                                   |                                                                           | 4= Technology produces a large amount of pollution and endanger the environment    |
|                 |                                   |                                                                           | 5= Technology produces a small amount of pollution                                |
|                 |                                   |                                                                           | 6= Technology does not produce environmental pollution                            |
| Aspect                  | Variable                      | Indicator                      | Valuation Process                                                                 |
|------------------------|-------------------------------|-------------------------------|----------------------------------------------------------------------------------|
| Appropriate            | Solve Problem                 | Solve problem                 | • 2= It requires one person with huge power to operate the tool<br>• 3= The tool does not require energy and human’s power to operate the tool<br>• 1= Technology does not increase the productivity of fisheries’ process, and does not solve the problems in study area<br>• 2= Technology is able to increase the productivity of fisheries’ process, but does not solve the problems in study area<br>• 3= Technology is able to increase the productivity of fisheries’ process, and solve the problems in study area |
| Effective technology   | Tool to generate needed goods | Provide end product           | • 1= Technology does not produce the desired product<br>• 2= It helps to produce the desired product<br>• 3= It produces the desired product<br>• 1= Technology implementation does not improve people’s economy<br>• 2= Technology implementation is able to improve people’s economy<br>• 3= Technology implementation is able to improve people’s economy |
| Can be operated by the locals | Easy to operate              |                               | • 1= Poteran Island’s residents are not able to operate the technology<br>• 2= Only Poteran Island’s residents whom graduated from highschool or someone with higher education background able to operate the technology<br>• 3= All Poteran Island’s residents are able to operate the technology |
| Appropriate            | Appropriate with the culture  |                               | • 1= There are rejections from the local communities because it is not suitable with their culture<br>• 2= There aren’t any rejections from the local communities because it is not suitable with their culture<br>• 3= Local communities are supporting the technology’s operation |
| Converting natural resources | Transforming the resources    |                               | • 1= Cannot convert fishery resources into economically valuable products<br>• 2= Able to convert fishery resources into economically valuable products in limited amount<br>• 3= Able to convert fishery resources into economically valuable products in huge amount |
| Relatively small       | The size is relatively small  |                               | • 1= It requires a few people to move the tool with the help of other tools<br>• 2= It can be moved by a person with the help of other tools<br>• 3= It can be moved with bare hands |
| Benefit                | Beneficial for the people     | Beneficial for the society    | • 1= The technology is not beneficial for the local residents<br>• 2= The technology is beneficial for a certain group of local residents<br>• 3= The technology is beneficial for all local residents |
|                        | Economically beneficial      | Benefit the production        | • 1= Result products are getting harder to be produced<br>• 2= There are no differences before and after the technology usage<br>• 3= Result products are getting easier to be produced |
| Aspect                          | Variable              | Indicator                                                                 | Valuation Process                                                                 |
|--------------------------------|-----------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Benefit the distribution       |                       | • Benefit the distribution                                                | • 1= The product is getting more difficult to be distributed                        |
|                                |                       | • 2= There are no differences before and after the technology usage        | • 3= The product is getting easier to be distributed                               |
| Benefit of the consumption     |                       | • 1= The product is getting more difficult to be consumed by consumers    | • 2= The product does not increase consumer’s interest to consume it (relatively the same as before) |
|                                |                       | • 3= The product increases consumer’s interest to consume it               |                                                                                   |
| Open new job opportunities     | • Provide employment  | • 1= Technology’s operational is not able add job opportunities           | • 2= Technology’s operational is able to add more job opportunities                |
|                                |                       | • 3= Technology’s operational is able to open more job opportunities, as well as other supporting businesses |                                                                                  |
| Accelerating household industries | • Accelerating household industries | • 1= Technology is not able to fasten the development of household industries | • 2= Technology generates new household industries                                 |
|                                |                       | • 3= Technology generates new household industries and other supporting business |                                                                                  |

**References**

[1] Anonimous 2001 Studi Transfer Teknologi Kepada UKM. www.ristek.go.id
[2] Anonimous 2008 Appropriate Technology. Website: http://en.wikipedia.org/wiki/Appropriate Technology. Diakses pada tanggal 25 Mei 2012
[3] Dahuri R, dkk 2001 Pengelolaan Sumber Daya Wilayah Pesisir dan Lautan Secara Terpadu (Jakarta: Pradnya Paramita)
[4] Fatonah S, Afifi S 2008 Difusi Inovasi Teknologi Tepat Guna di Kalangan Wanita Pengusaha di Desa Kasongan Yogyakarta. *Jurnal Ilmu Komunikasi,* 6 42-59
[5] Kementrian Kelautan dan Perikanan 2002 *Visi, Misi, Grand Strategy dan Sasaran Strategis KKP* (Jakarta: Pusdatin, KKP)
[6] Mahlinda 2013 Pengembangan Teknologi Tepat Guna untuk Pemberdayaan Usaha Mikro Kecil dan Menengah. *Jurnal Ekonomi dan Pembangunan.* 3 10-19
[7] Prasetyo, Andjar, and Asmara A 2013 Implementasi Program Pelatihan Pemberdayaan Perempuan Berbasis Ilmu Pengetahuan dan Teknologi (Iptek). *Jurnal Ilmu Administrasi Negara.* 12 123-132
[8] Ricardo J S 2007 *Ketimpangan Kemajuan Teknologi diantara Negara Maju dan Negara Berkembang dalam Kaitan Terhadap Pertumuhan Ekonomi.* (Depok: Fakultas Ilmu Sosial dan Ilmu Politik Program Studi Ilmu Administrasi Negara Universitas Indonesia)
[9] Sudarmo S 2005 *Pestisida Nabati Pembuatan dan Pemanfaatannya* (Yogyakarta: Kanisius)
[10] Sudirman 2007 *Peranan Iptek Dalam Pembangunan Sumberdaya Kelautan Secara Berkelanjutan.* (Makassar: Fakultas Ilmu Perikanan Unhas)
[11] Soetrisno N 2009 *Proc. Conf. Pengembangan Klaster UMKM* (Surakarta)
[12] Syahza A 2010 *Teknologi Tepat Guna Dalam Rangka Pengembangan Profesi Guru.* (Pekanbaru: Workshop Pengembangan Profesi Guru 2007)
[13] Maxwell J 1997 *Designing a Qualitative Study in L Bickman & D J Rog ed Handbook of Applied Social Research Methods* (California: Sage) pp 69-100

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