
**IDENTIFYING POTENTIALS OF PROCESSED MARINE PRODUCTS
AND MARINE BASED INDUSTRY AS STRATEGY TO EMPOWER
LOCAL COMMUNITY IN COASTAL REGION OF SUMBAWA,
INDONESIA**

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Abstract

The purpose of this study is to identify which processed marine products have more potentials to be developed as marine based industry in Sumbawa's coastal region. The identified product would be chosen to create empowerment program in the coastal region of Sumbawa. Analytical Hierarchy Process (AHP) is used as tool of analysis in identifying the potentials of those processed marine products. Respondents in this study consist of experts that are responsible to develop criteria of potentials as well as to weight such criteria. On the other hand, the common respondents that are selected from the local coastal society members of Sumbawa are needed to identify alternatives of processed marine products as well as to weight the alternatives for each criteria. The result of the study indicates that the Cooked Crab Product is considered to have highest potentials to be developed as marine based industry in Sumbawa's coastal region. Therefore, the empowerment program that is going to be implemented in Sumbawa should focus on developing the cooked crab product as marine based industry.

Keywords: processed marine products; potentials, empowerment; marine based industry; Analytical Hierarchy Process (AHP)

Introduction

In the global landscape, economic outputs that measured by Gross National Product (GNP) density are concentrated in the seacoast and sea-navigable waterways (Sachs et al., 2001). It is caused by the ability of coastal area to connect different regions and develop economic networks among regions as well as attract people to live along the coast. However, in many coastal zones of the world, poverty exist as major face of the areas, especially in countries that have low level of economic diversity in their coastal regions while their coastal communities mostly depend their lives in natural marine products that provided by nature. Some studies have revealed that phenomenon as described by Lawson et al.(2012) in Ghana; Adnan et al.(2020) in Bangladesh; and Sunandi et al.(2019) in Indonesia.

The poverty of coastal societies in Indonesia has been discussed in many perspectives. Nirzalin (2019) revealed that despite of the statistical fact that Indonesia is one of the largest exporters of fish worldwide, 34% of Indonesian fishermen live in poverty. Cahyagi & Gurning (2018) suggested that the fishermen poverty in Indonesia is multidimensional which mostly caused by the low ability of fishermen in financial management, lack of fishing technologies, unsustainable practice of fishing, and low level of further processing activities. On the other hand, Rukin (2018) concluded that the poverty condition of the coastal society was caused by the inability of the society to grab business opportunities and the lack of rural infrastructures as well as the unavailability of guidance and empowerment program from government agencies.

Due to the complexity of poverty phenomenon in the coastal regions of Indonesia, it is important to use the empowerment approach in order to tackle such problem. As described by Nirzalin (2019) in her study in Aceh, empowerment program has had a significant impact on improving the prosperity of Aceh's coastal society. Empowerment is a term to describe activities that aimed to make the beneficiaries to have more power in solving their own problem such as poverty by motivating, encouraging, and raise awareness about their own potentials. Supanto & Astuti (2019) conducted empowerment program in southern part of East Java Province by identifying potencies of the region that can be optimized to boost the prosperity of local people. Another example of empowerment activity was conducted by Madihah & Wardani (2018) by facilitating integration of social finance (crowd-funding) with communities that involve in ecotourism maritime based economy in order to promote sustainable socio-economic development in Yogyakarta. All of those empowerment activities were successful in reducing poverty in the region that the programs were implemented.

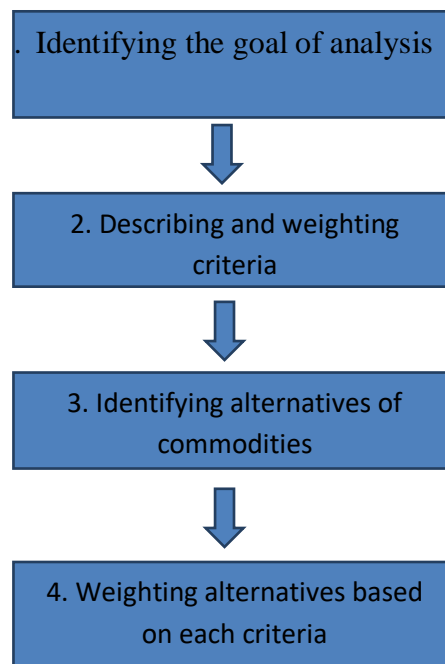
As one of many regions in Indonesia that has large amount of people living in coastal area, Sumbawa Regency needs to implement the empowerment approach in order to solve the region poverty condition. Improving quality of life for societies is the main purpose of all empowerment programs. These quality of life are measured mostly by economic indicators such as income, employment, and other social indicators such as environmentally sustainable and promote gender equality. Therefore, the empowerment program that is needed to implement in the coastal region of Sumbawa should be able to cover both social and economic aspects. In order to do so, identifying the region potencies are substantially needed. Since the coastal regions of Sumbawa are rich in marine products, the empowerment program should focus on increasing the value added of the marine products to increase the coastal inhabitant wellbeing. On the other words, the marine products that are obtained by fishermen in Sumbawa must be processed to create added values for the products (developing marine products based industry).

Developing an industry based community empowerment for the coastal society of Sumbawa would need to consider wide range of aspects, started from scientific aspects that suggested by previous studies and local aspects that exist in Sumbawa's coastal society. The alternatives of industry that are going to be developed must be based on local marine products that have been commonly produced by local fishermen. This study aims to investigate the potencies of local processed marine commodities that can be scaled up and processed as community based industry.

Method

The potencies of local marine commodities in coastal region of Sumbawa that will be developed as marine based industry have been measured using Analytical Hierarchy Process (AHP) in this study. Data were obtained using various approaches such as Focus Group Discussion (FGD) with local society, deep interviews with specific actors, direct questionnaires to be filled by society members, and systematic observations. Respondents in this research are divided in to two categories; expert respondents and common respondents. Experts respondents were chosen using purposive sampling in which the respondents came from academicians, local government high officials, Non-Government Organization (NGO) and public figures that are familiar with the topic. Meanwhile, the common respondents were chosen using stratified random sampling, focusing on the coastal society of Sumbawa in the Samota region. There were 15 experts and 100 society members chosen as respondents in this research.

There are several steps in AHP that has to be conducted in sequence as described as follows:



Picture 1. Sequence step and hierarchy in AHP procedure

The first step in AHP is identifying the goal of the study. In this research the goal is to identify which processed marine products that can be used to develop marine based industry in order to empower the coastal society of Sumbawa. Furthermore, criteria that are used in this research were developed from Action for Enterprise (AFE) concept that combined with the result of FGD among experts. AFE (2007) developed criteria in supporting poor people to develop business by promoting market based solution for SMSE and industry competitiveness. The criteria that had been chosen are:

1. Market demand
2. Level of market growth
3. Job Creation
4. Income generating capacity
5. Government Policies support
6. Environmental sustainability
7. Gender equality
8. Availability of technology
9. Social Capital
10. Sectoral linkage

On the other hand, list of alternatives for marine products were obtained from the local coastal society of Sumbawa through an intensive FGD among them. Finally, the process of weighting the criteria and alternatives in this research are using AHP OS (AHP Online System) combined with manual data analysis using Microsoft Excel.

Results and Discussions

In order to develop community based industry for Sumbawa's processed marine products, some aspects must be carefully considered. Such aspects are represented by criteria that are analysed in this research. The criteria that are used in this research inspired by AFE combined with some local social aspects that decided through FGD among experts in social and economic development. The criteria that had been developed by AFE (2007) was originally part of steps that are required to make a value chain design for Micro, Small and Medium Enterprises (MSME) in order to tackle poverty. Those criteria are developed and modified in this research to make it more relevant with the purpose of this study. The chosen criteria were then weighted to describe which criteria is to be prioritized in designing marine based industry as a strategy to conduct empowerment programs in Sumbawa's coastal society.

Level of Importance and Priority Rank of Criteria

Weighting process of the chosen criteria is developed from the perception of expert respondents. Using the AHP procedures, the following table shows the pair-wise matrix of the chosen criteria:

Table 1. Pair-wise matrix of Criteria To Identify Potentials of Processed Marine Products in Sumbawa’s Coastal Region

	Market Demand	Market Growth	Job Creation	Generate Income	Policies Support	Environment sustainability	Gender equality	Technology	Social Capital	Sectoral Linkage
Market Demand	1	4.00	2.00	2.00	1.00	2.00	3.00	2.00	2.00	2.00
Market Growth	0.25	1	2.00	2.00	1.00	2.00	4.00	2.00	2.00	3.00
Job Creation	0.50	0.50	1	2.00	2.00	2.00	4.00	2.00	3.00	3.00
Generate Income	0.50	0.50	0.50	1	2.00	2.00	4.00	3.00	3.00	4.00
Policies Support	1.00	1.00	0.50	0.50	1	3.00	4.00	3.00	4.00	4.00
Environment sustainability	0.50	0.50	0.50	0.50	0.33	1	4.00	2.00	3.00	2.00
Gender equality	0.33	0.25	0.25	0.25	0.25	0.25	1	3.00	2.00	2.00
Technology	0.50	0.50	0.50	0.33	0.33	0.5	0.33	1	4.00	3.00
Social Capital	0.50	0.50	0.33	0.33	0.25	0.33	0.5	0.25	1	2.00
Sectoral Linkage	0.50	0.33	0.33	0.25	0.25	0.50	0.50	0.33	0.50	1
TOTAL	5.58	9.08	7.91	9.16	8.41	13.58	25.33	18.58	24.5	26

Source: processed primary data

In order to identify the weight and eigenvector mean of each criteria, the matrix needs to be normalized by dividing the value of each column with the total value of columns in every criteria. Furthermore, the Eigen Vector Mean (EVM) is resulted by summarizing the total amount of normalized values in every line which then divided with the number of criteria (this study is using 10 criteria). The described process resulting the following normalized table:

Table 2. Normalized Values of Criteria’s Pair-Wise Matrix and The Eigenvector Mean (EVM) Value of Each Criteria

	Market Demand	Market Growth	Job Creation	Generate Income	Policies Support	Environment sustainability	Gender equality	Technology	Social Capital	Sectoral Linkage	EVM
Market Demand	0.1792	0.4405	0.2528	0.2183	0.1189	0.1473	0.1184	0.1076	0.0816	0.0769	17.8%
Market Growth	0.0448	0.1101	0.2528	0.2183	0.1189	0.1473	0.1579	0.1076	0.0816	0.1154	13.8%
Job Creation	0.0896	0.0551	0.1264	0.2183	0.2378	0.1473	0.1579	0.1076	0.1224	0.1154	13.9%
Generate Income	0.0896	0.0551	0.0632	0.1092	0.2378	0.1473	0.1579	0.1615	0.1224	0.1538	1.0%
Policies Support	0.1792	0.1101	0.0632	0.0546	0.1189	0.2209	0.1579	0.1615	0.1633	0.1538	13.7%
Environment sustainability	0.0896	0.0551	0.0632	0.0546	0.0392	0.0736	0.1579	0.1076	0.1224	0.0769	8.5%
Gender equality	0.0591	0.0275	0.0316	0.0273	0.0297	0.0184	0.0395	0.1615	0.0816	0.0769	5.4%
Technology	0.0896	0.0551	0.0632	0.0360	0.0392	0.0368	0.0130	0.0538	0.1633	0.1154	6.3%
Social Capital	0.0896	0.0551	0.0417	0.0360	0.0297	0.0243	0.0197	0.0135	0.0408	0.0769	4.1%
Sectoral Linkage	0.0896	0.0363	0.0417	0.0273	0.0297	0.0368	0.0197	0.0178	0.0204	0.0385	3.5%

Source: processed primary data

The EVM value in the table indicates the level of importance as well as the priority rank of each criteria as the result of this AHP process. Therefore, the level of importance and the priority rank of respective criteria is described in the following table:

Table 3. The Level of Importance and Priority Rank of Each Criteria

Criteria	Level of Importance	Rank
Market Demand	17.8%	1
Market Growth	13.8%	3
Job Creation	13.9%	2
Generate Income	13.0%	5
Policies Support	13.7%	4
Environment Sustainability	8.5%	6
Gender Equality	5.4%	8
Technology	6.3%	7
Social Capital	4.1%	9
Sectoral Linkage	3.5%	10

Source: processed primary data

The table shows that the availability of market demand is the most important criteria in deciding which processed marine products should be developed as marine based industry in Sumbawa’s coastal region. Furthermore, the ability of the industry to create jobs, enhance market growth, have support of policies and regulation, and the possibility of the industry to increase the income of people are relatively equally important. This result supports the conclusion that has been made by Khoza et al (2019) which stated that the distance to market and low level of demand were main obstacles for people in rural South Africa to participate in agro-processing industry.

AHP procedure requires the test of consistency to make sure that the result of analysis is consistent and trusted as well as to make sure that the process was conducted correctly and the data obtained was valid. The result of this AHP process would only be considered as valid and correct if its value of Consistency Ratio (CR) is equal or less than 10%. The CR value is measured using the following equations:

$$CR = \frac{\text{Consistency Index (CI)}}{\text{Ratio Index (RI)}}$$

$$CI = \frac{\lambda \text{ maximum} - n}{n - 1}$$

The value of RI is given by Saaty (2004). Its value depends on the number of elements included in the analyses. The value of RI for various amount of criteria are as follows:

Table 4. Ratio Index (RI) For Every Amount of Criteria or Alternatives in AHP Procedures

Amount of Criteria / Alternatives	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI value	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.54	1.56	1.57	1.58

Source: Saaty (2004)

λ maximum is resulted from the total value of multiplied *total value of column* and the *EVM value* of all criteria.

$$\begin{aligned} \lambda \text{ maximum} &= (\text{total value of column for Criteria A} \times \text{EVM value of Criteria A}) + \dots + \\ &\quad (\text{total value of column for Criteria n} \times \text{EVM value of Criteria n}) \\ &= (5.58 \times 0.178) + (9.08 \times 0.138) + (7.91 \times 0.139) + (9.16 \times 0.130) + (8.41 \times 0.137) + \\ &\quad (13.58 \times 0.085) + (25.33 \times 0.054) + (18.58 \times 0.063) + (24.5 \times 0.041) + (26 \times 0.035) \\ &= 11.3 \end{aligned}$$

$$\begin{aligned} CI &= \frac{11.3 - 10}{10 - 1} \\ &= 0.14 \end{aligned}$$

$$\begin{aligned} CR &= \frac{0.14}{1.49} \\ &= 0.097 \end{aligned}$$

The CR value for criteria in this study is 0.097 which is less than 10% (0.1). Therefore, it is clear that the data obtained in this study (for weighting criteria) and its analysis results are consistent, valid, and trusted.

The main purpose of this study is to identify what processed marine products should be used to develop coastal community based industry as a strategy to empower people in the coastal region of Sumbawa. Therefore, after identifying the criteria that based on the perception of experts, identifying the alternatives of marine products that have been traditionally processed by the coastal society of Sumbawa is needed. This process of identifying the processed marine products as alternatives of developing marine processing industry in Sumbawa was conducted using FGD and deep interviews. The alternatives of processed marine products in coastal region of Sumbawa that resulted in this study are as follows:

1. Traditional fried shredded fish (Abon)
2. Fish crackers
3. Fish dumpling (empek-empek)
4. Fish for Animal feed
5. Fermented local shrimp paste (masin)
6. Advanced shrimp paste (terasi)
7. Cooked Crab product

Those products have been traditionally produced by local inhabitant in the coastal region of Sumbawa. Most of the products are produced as a household scale industry which targeted local market and have low scale of capital. Therefore, these small scale industry was unable to improve their business capacity as well as unable to increase local people prosperity significantly. These household industry are needed to be scaled up in order to create wider impact on the local coastal people wellbeing. External supports in terms of capital, business coaching, policy support, and human resources development are highly important in strengthening the rural based industry (Astiti et al., 2014). Moreover, the empowerment program that will take place to support the development of marine based industry in the region should focus on the most important products that will be decided based on the perception of local people about the possibility of the products to fulfill 10 criteria that have been previously weighted. Using the same tool of analysis, the following discussion describes the priority rank of those processed marine products in every given criteria.

Priority Rank of Products in the Criteria of Market Demand

Market demand is one of the most important criteria that has to be carefully consider in creating business development plan. Without proper and sustainable demand, a business would not be able to survive. The following matrix indicates the perception of local coastal society of Sumbawa related to the market demand capacity of every marine processed product:

Table 5. Pair-Wise Matrix For Alternatives of Processed Marine Products in the Criteria of Market Demand

	Shredded Fish	Fish Cracker	Fish Dumpling	Animal Feed	Fermented Shrimp Paste	Advanced Shrimp Paste	Cooked Crab
Shredded Fish	1	0.33	0.33	1.00	0.33	0.33	0.25
Fish Cracker	3.00	1	0.50	2.00	1.00	0.50	0.50
Fish Dumpling	3.00	2.00	1	2.00	0.50	0.50	0.33
Animal Feed	1.00	0.50	0.50	1	0.33	0.33	0.20
Fermented Shrimp Paste	3.00	1.00	2.00	3.00	1	1.00	0.33
Advanced Shrimp Paste	3.00	2.00	2.00	3.00	1.00	1	0.33
Cooked crab	4.00	2.00	3.00	5.00	3.00	3.00	1

Source: processed primary data

The above matrix resulting Eigenvector (EVM) value for each criteria as indicated below:

Table 6. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Market Demand

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	5.2%	7
Fish crackers	11.7%	5
Fish dumpling (empek-empek)	12.3%	4
Fish for Animal feed	5.5%	6
Fermented local shrimp paste (masin)	15.4%	3
Advanced shrimp paste (terasi)	17.0%	2
Cooked Crab product	32.9%	1
Consistency Ratio (CR)	3.3%	

Source: processed primary data

The table shows that among all of those identified processed marine products in the coastal region of Sumbawa, the cooked crab is considered to have highest market demand by 32.9% followed by the advanced shrimp paste and the fermented local shrimp paste that have 17.0% and 15.4% market demand respectively. The other products have significantly lower level of market demand. The Consistency Ratio (CR) for this AHP procedure is 3.3% which is much lower than 10%. Therefore the result of this analysis is valid and consistent.

Priority Rank of Products in the Criteria of Market Growth

Market growth indicates the possible sustainability of demand and the development trend of products. The higher trend of market growth is a sign that the product would be able to access wider market and increase the business capacity of the product. The following matrix table shows the perception of the coastal society of Sumbawa related to the possible growth of market for local marine processing products:

Table 7. Pair-Wise Matrix For Alternatives of Processed Marine Products in Market Growth Criteria

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	0.33	0.33	1.00	0.33	0.33	0.20
Fish Cracker	3.00	1	0.50	2.00	0.50	0.50	0.25
Fish Dumpling	3.00	2.00	1	2.00	0.50	0.50	0.33
Animal Feed	1.00	0.50	0.50	1	0.25	0.33	0.17
Fermented shrimp paste	3.00	2.00	2.00	4.00	1	0.50	0.25
Advanced shrimp paste	3.00	2.00	2.00	3.00	2.00	1	0.33
Cooked crab	5.00	4.00	3.00	6.00	4.00	3.00	1

Source: processed primary data

The EVM value that resulted from the above matrix is described in the following table:

Table 8. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Market Growth

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	4.8%	7
Fish crackers	8.9%	5
Fish dumpling (empek-empek)	11.3%	4
Fish for Animal feed	4.9%	6
Fermented local shrimp paste (masin)	14.8%	3
Advanced shrimp paste (terasi)	17.8%	2
Cooked Crab product	37.6%	1
Consistency Ratio (CR)	3.3%	

Source: processed primary data

The best market growth of Sumbawa’s marine processing products is the cooked crab product by 37.6%. The growing market for this product is encouraged by the ability of the product to reach national market. While the other products are sold for local consumption in Sumbawa, the cooked crab is exported to some Java cities to be exported again to other countries. Esteves & Rua (2015) explained that the growth of export demand for any product does not depend on the

growth of domestic demand. In many cases, the market growth of products are mainly supported by foreign demand. The export demand for cooked crab product of Sumbawa is increased overtime which caused the consistent rise of the product's price. Moreover, the high growth of market for this product increases the scarcity of crab in coastal Sumbawa.

Priority Rank of Products in the Criteria of Job Creation

A study conducted by Nurjihadi & Firdaus (2021) revealed that the best way of reducing unemployment rate in Sumbawa are providing loan for small businesses to grow and conducting comprehensive empowerment program for jobless society. The ability of an industry to create jobs is substantially important to be considered in making plan for empowerment program. The activity of empowerment that have higher possibility of creating jobs should be prioritized to conduct, not only to increase the participation of the society members in the empowerment program, but also to increase the income of the society members. Among all of the marine processing products that are currently taking place in coastal region of Sumbawa, the following matrix that resulted from the perception of Sumbawa's coastal society would create the EVM value of each product that indicates which product is more likely to create more jobs:

Table 9. Pair-Wise Matrix For Alternatives of Processed Marine Products in the Criteria of Job Creation

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	0.25	0.50	1.00	0.33	0.33	0.33
Fish Cracker	4.00	1	0.50	2.00	1.00	0.50	0.33
Fish Dumpling	2.00	2.00	1	2.00	1.00	0.50	0.33
Animal Feed	1.00	0.50	0.50	1	0.33	0.33	0.20
Fermented shrimp paste	3.00	1.00	1.00	3.00	1	0.50	0.25
Advanced shrimp paste	3.00	2.00	2.00	3.00	2.00	1	0.25
Cooked crab	3.00	3.00	3.00	5.00	4.00	4.00	1

Source: processed primary data

The EVM value for each product in the criteria of job creation is as follows:

Table 10. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Job Creation

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	5.7%	6
Fish crackers	11.3%	5
Fish dumpling (empek-empek)	12.1%	3
Fish for Animal feed	5.4%	7
Fermented local shrimp paste (masin)	11.7%	4
Advanced shrimp paste (terasi)	17.6%	2
Cooked Crab product	36.3%	1
Consistency Ratio (CR)	4.7%	

Source: processed primary data

The cooked crab product is considered by the local coastal society of Sumbawa to have the best possibility in creating jobs for local people. The process of creating jobs in this cooked crab product is not only lies on the processing activities, but also in the crab fishing process that requires more efforts and manpower than the other marine products. Developing this business in the higher scale would be able to substantially increase job opportunities for local coastal society.

Priority Rank of Products in the Criteria of Income Generating Capacity

Increasing the income of beneficiaries is one of the main purposes in conducting empowerment program. Therefore, identifying the ability of empowerment activities to generate income for the society is vital. Using AHP as tool of analysis, the following matrix table shows the perception of local coastal society of Sumbawa on the ability of processed marine products to generate income for the society:

Table 11. Pair-Wise Matrix For Alternatives of Processed Marine Products in the Criteria of Income Generating Capacity

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	0.33	0.50	1.00	0.33	0.50	0.25
Fish Cracker	3.00	1	0.50	2.00	0.50	0.50	0.25
Fish Dumpling	2.00	2.00	1	2.00	1.00	0.50	0.25
Animal Feed	1.00	0.50	0.50	1	0.25	0.33	0.20
Fermented shrimp paste	3.00	2.00	1.00	4.00	1	0.50	0.33
Advanced shrimp paste	2.00	2.00	2.00	3.00	2.00	1	0.33
Cooked crab	4.00	4.00	4.00	5.00	3.00	3.00	1

Source: processed primary data

The matrix produced the following EVM value that indicates the priority and rank of products in generating income for society.

Table 12. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Income Generating Capacity

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	5.8%	6
Fish crackers	9.3%	5
Fish dumpling (empek-empek)	11.6%	4
Fish for Animal feed	5.2%	7
Fermented local shrimp paste (masin)	14.2%	3
Advanced shrimp paste (terasi)	17.5%	2
Cooked Crab product	36.6%	1
Consistency Ratio (CR)	3.6%	

Source: processed primary data

The cooked crab product is believed to have the highest possibility of generating income for the society in coastal region of Sumbawa. Respondents level of confidence in such product reach 36.6% which is much higher than the other products. In the people perspective, cooked crab product is able to create more income compares to the other products because net profit value that created by the cooked crab product is significantly higher. The value of Consistency Ratio that reach 3.6% indicates that the respondents perception on such issue is quite similar and consistent.

Priority Rank of Products in the Criteria of The Availability of Policies Support

Government support through regulation and development program is necessary to enhance the development of an industry. This support includes the easiness of getting business permit, fiscal support (tax allowance), infrastructure support, skill development training, and other relevant supports. The following matrix table summarizes the perception of Sumbawa’s coastal society on processed marine products that gain policies supports from the government:

Table 13. Pair-Wise Matrix For Alternatives of Processed Marine Products in the Criteria of Policies Support

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	0.33	1.00	1.00	0.33	0.33	0.33
Fish Cracker	3.00	1	0.50	2.00	0.50	0.50	0.33
Fish Dumpling	1.00	2.00	1	2.00	0.50	0.50	0.33
Animal Feed	1.00	0.50	0.50	1	0.33	0.33	0.25
Fermented shrimp paste	3.00	2.00	2.00	3.00	1	0.50	0.33
Advanced shrimp paste	3.00	2.00	2.00	3.00	2.00	1	0.33
Cooked crab	3.00	3.00	3.00	4.00	3.00	3.00	1

Source: processed primary data

The following table describes the EVM value of the processed marine products based on the above matrix table:

Table 14. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Policies Support

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	6.6%	6
Fish crackers	10.2%	5
Fish dumpling (empek-empek)	10.5%	4
Fish for Animal feed	5.7%	7
Fermented local shrimp paste (masin)	15.5%	3
Advanced shrimp paste (terasi)	18.9%	2
Cooked Crab product	32.7%	1
Consistency Ratio (CR)	4.5%	

Source: processed primary data

The EVM value of the processed marine products indicates that government policies supports are mostly in favour of the cooked crab product. As an export based product, it is highly acceptable if the government prioritized the cooked crab product above other products that mostly lies on local market. The development of export based products would able to increase the trade balance among regions that would have positive impact on increasing the regional Gross Domestic Product (regional GDP / PDRB) which is one of the government important performance indicators.

Priority Rank of Products in the Criteria of Environmental Sustainability

Sustainable development is currently discussed as the mainstream perspective on economic development. The issue of global warming and climate changes forced countries to take control of environmental damages caused by development activities. Therefore, the future development plan should pay high attention on this issue, including in developing plan to empower rural coastal society of Sumbawa. The following matrix table describes the perception of Sumbawa’s coastal society on which processed marine products have better environmental sustainability:

Table 15. Pair-Wise Matrix For Alternatives of Processed Marine Products in the Criteria of Environmental Sustainability

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	1.00	0.33	1.00	0.50	0.50	0.50
Fish Cracker	1.00	1	1.00	0.50	1.00	1.00	1.00
Fish Dumpling	3.00	1.00	1	2.00	1.00	1.00	0.17
Animal Feed	1.00	2.00	0.50	1	0.50	0.50	0.50
Fermented shrimp paste	2.00	1.00	1.00	2.00	1	0.50	1.00
Advanced shrimp paste	2.00	1.00	1.00	2.00	2.00	1	1.00
Cooked crab	2.00	1.00	6.00	2.00	1.00	1.00	1

Source: processed primary data

The matrix produced the following EVM value for each product that indicates which product is more sustainable:

Table 16. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Environmental Sustainability

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	8.2%	7
Fish crackers	12.3%	5
Fish dumpling (empek-empek)	13.8%	4
Fish for Animal feed	10.1%	6
Fermented local shrimp paste (masin)	14.2%	3
Advanced shrimp paste (terasi)	17.2%	2
Cooked Crab product	24.3%	1
Consistency Ratio (CR)	8.8%	

Source: processed primary data

The table reveals that in the perception of local coastal society of Sumbawa, the most sustainable processed marine products in their region is the cooked crab product. This perception is mostly influenced by the amount of wastes that produced during the production of those processed marine products. The cooked crab product is considered to have the lowest level of wastes during its production compares to the other processed marine products that are currently produced in their region.

Priority Rank of Products in the Criteria of Gender Equality

Gender equality is one of the current important issue in economic and social studies. The involvement of women in economy has widely discussed in academic articles across the world. Elomäki (2015) suggested that gender equality contributes significantly in enhancing economic growth in Europe. Moreover, it is also proven that the contribution of gender equality in economic growth in Europe promotes the idea of gender equality to be more grounded and accepted by more people across the globe.

In many part of the world, women are usually facing gender discrimination in social and economic activities. Therefore, every effort of empowerment in the society should consider gender equality as its main requirement. Many studies have revealed that involving women in empowerment activities are crucial to determine the success of such program as strongly proven by Astiti et al (2014); Pakkanna et al (2020); Mirsardoo et al (2015); and Supanto & Astuti (2019). In order to develop marine based industry in the coastal region of Sumbawa, this issue is also needed to be carefully consider. Based on the perception of the local coastal society of Sumbawa, the following table shows which processed marine product requires gender equality on its process:

Table 17. Pair-Wise Matrix For Alternatives of Processed Marine Products in the Criteria of Gender Equality

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	0.33	0.50	0.50	0.33	0.33	0.25
Fish Cracker	3.00	1	1.00	1.00	0.50	0.50	0.33
Fish Dumpling	2.00	1.00	1	1.00	0.33	0.50	0.33
Animal Feed	2.00	1.00	1.00	1	0.50	0.50	0.50
Fermented shrimp paste	3.00	2.00	3.00	2.00	1	0.50	0.33
Advanced shrimp paste	3.00	2.00	2.00	2.00	2.00	1	0.33
Cooked crab	4.00	3.00	3.00	2.00	3.00	3.00	1

Source: processed primary data

The products that enhance more equal opportunities of any gender is determined by the following EVM value of each product:

Table 18. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Gender Equality

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	5.1%	7
Fish crackers	9.9%	5
Fish dumpling (empek-empek)	8.8%	6
Fish for Animal feed	9.9%	4
Fermented local shrimp paste (masin)	16.1%	3
Advanced shrimp paste (terasi)	18.4%	2
Cooked Crab product	31.8%	1
Consistency Ratio (CR)	3.4%	

Source: processed primary data

The above EVM values indicate that the most gender biased industry that currently taking place in the coastal region of Sumbawa is the production of the traditional fried shredded fish. The production of such processed marine product is mostly in favour of female workers. Meanwhile, the processed marine product that provide equal opportunity to any gender is the cooked crab product. The role of men and women are needed to produce such product.

Priority Rank of Products in the Criteria of Technology

Developing a marine based industry requires technologies and human resources that could operate such technologies. Therefore, before deciding which product is to be developed in an empowerment program, it is important to identify whether the required technology and people who operate it are available. Using AHP as tool of analysis and people’s perception as data sources, the following matrix table determines which product is better in term of the availability of technology and the availability of human resource to operate the technology in order to produce the processed marine products:

Table 19. Pair-Wise Matrix for Alternatives of Processed Marine Products in the Criteria of Technology

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	0.5	0.25	1.00	0.33	0.25	0.33
Fish Cracker	2.00	1	1.00	1.00	0.50	0.50	2.00
Fish Dumpling	4.00	1.00	1	0.50	1.00	0.50	0.50
Animal Feed	1.00	1.00	2.00	1	0.33	0.33	0.33
Fermented shrimp paste	3.00	2.00	1.00	3.00	1	0.50	0.50
Advanced shrimp paste	4.00	2.00	2.00	3.00	2.00	1	0.50
Cooked crab	3.00	0.50	2.00	3.00	2.00	2.00	1

Source: processed primary data

The EVM value of each product that resulted from the above matrix is described in the following table:

Table 20. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Technology

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	5.5%	7
Fish crackers	14.1%	4
Fish dumpling (empek-empek)	11.7%	5
Fish for Animal feed	9.3%	6
Fermented local shrimp paste (masin)	15.8%	3
Advanced shrimp paste (terasi)	21.4%	2
Cooked Crab product	22.2%	1
Consistency Ratio (CR)	9.1%	

Source: processed primary data

Based on the perception of local people, the technology that are currently available in the coastal society of Sumbawa are relatively in the same level for all processed marine products. However, products that considered to have most proper technology in the region is the cooked crab product and the advanced shrimp paste. Both of the products shared relatively the same portion of EVM values by 22.2% and 21.4% respectively.

Priority Rank of Products in the Criteria of Social Capital

The deep requirement for economic development is the trust among people (Dasgupta, 2011). Moreover, Francois & Zabochnik (2005) explained that trustworthiness performs when individuals fulfill their promises despite the action would not benefit them. Developing trust among people requires interpersonal network which is called social capital. If those interpersonal network directed to the right sphere, it would have substantial effect on enhancing economic growth, otherwise it could be the reason of economic recession.

In this research, social capital is defined as social cohesion and social supports on developing marine based industry in the coastal region of Sumbawa. Moreover, social capital is also defined as the suitability of products with local wisdoms and cultures. It is important to consider such factors in developing marine based industry in coastal region of Sumbawa. Developing products that are socially unsuitable because of cultures or religious reasons would be contra-productive. Therefore, identifying products that have strong social supports is important in creating empowerment program plan. The following matrix table indicates people perception on which products are considered as socially supportive:

Table 21. Pair-Wise Matrix For Alternatives of Processed Marine Products in the Criteria of Social Capital

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	0.33	0.50	1.00	0.50	0.33	0.25
Fish Cracker	3.00	1	0.50	2.00	0.50	0.50	0.33
Fish Dumpling	2.00	2.00	1	2.00	1.00	0.50	0.33
Animal Feed	1.00	0.50	0.50	1	0.33	0.33	0.25
Fermented shrimp paste	2.00	2.00	1.00	3.00	1	0.50	0.25
Advanced shrimp paste	3.00	2.00	2.00	3.00	2.00	1	0.33
Cooked crab	4.00	3.00	3.00	4.00	4.00	3.00	1

Source: processed primary data

The EVM values that resulted from the above matrix are as follows:

Table 22. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Social Capital

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	5.8%	6
Fish crackers	10.0%	5
Fish dumpling (empek-empek)	12.2%	4
Fish for Animal feed	5.8%	7
Fermented local shrimp paste (masin)	12.6%	3
Advanced shrimp paste (terasi)	18.5%	2
Cooked Crab product	35.0%	1
Consistency Ratio (CR)	3.2%	

Source: processed primary data

Social support for developing marine based products in the coastal region of Sumbawa is mostly for cooked crab product. It is because the product is originally come from local tradition. Crab has been considered as superior product by the local communities for a very long time due to its scarcity and high value. Crab was a favourite meal for local aristocrats and royal families. This cultural background make it gain strong social support to be developed as marine based industry. Meanwhile, most of the other products are not originally came from Sumbawa. They were brought to Sumbawa by travellers from other regions of Indonesia.

Priority Rank of Products in the Criteria of Sectoral Linkage

The ability of industry to link with other sectors is considered as one of main indicators in enhancing economic development. Therefore, marine based industry that is going to be developed in the coastal region of Sumbawa should have high linkage with other sectors, both forward and backward linkages. Based on the perception of local people in coastal region of Sumbawa, the following matrix table indicates the ability of each processed marine product in encouraging other economic sectors:

Table 23. Pair-Wise Matrix For Alternatives of Processed Marine Products in the Criteria of Sectoral Linkage

	Shredded fish	Fish Cracker	Fish Dumpling	Animal Feed	fermented shrimp paste	advanced shrimp paste	Cooked crab
Shredded fish	1	0.33	0.50	1.00	0.50	0.50	0.33
Fish Cracker	3.00	1	0.50	2.00	0.50	0.50	0.33
Fish Dumpling	2.00	2.00	1	2.00	1.00	1.00	0.33
Animal Feed	1.00	0.50	0.50	1	0.33	0.33	1.00
Fermented shrimp paste	2.00	2.00	1.00	3.00	1	1.00	0.25
Advanced shrimp paste	2.00	2.00	2.00	3.00	1.00	1	0.33
Cooked crab	3.00	3.00	3.00	1.00	4.00	3.00	1

Source: processed primary data

The following table shows the EVM values of each product that indicates how much the products linked with other economic sectors:

Table 24. The EVM Value of Each Alternatives of Processed Marine Products and its Priority Rank in the Criteria of Sectoral Linkage

	Priority (EVM)	Rank
Traditional fried shredded fish (Abon)	6.6%	7
Fish crackers	10.4%	5
Fish dumpling (empek-empek)	13.8%	4
Fish for Animal feed	8.9%	6
Fermented local shrimp paste (masin)	14.6%	3
Advanced shrimp paste (terasi)	14.9%	2
Cooked Crab product	30.7%	1
Consistency Ratio (CR)	8.3%	

Source: processed primary data

Cooked crab product is considered by local people of Sumbawa’s coastal region to have high linkage with other sectors, especially in forward linkage. It is because the cooked crab is sold to produce other products such as high quality food in restaurants and hotels that could increase tourism industry.

Priority Rank of Products for the Combined Criteria

After identifying the priority and rank of every processed marine product in coastal region of Sumbawa for every criteria, the priority and rank of those processed marine products in the combined criteria must be measured. This process is conducted using the following equation:

$$Y = [(X1 \times y1) + \dots + (X1 \times yn)] + \dots + [(Xn \times y1) + \dots + (Xn \times yn)]$$

in which:

Y = Total EVM value of each processed marine product

X1 = EVM value of product 1 in criteria 1

y1 = EVM value of criteria 1

yn = EVM value for criteria n

Xn = EVM value of product n in criteria n

The following table indicates the total value of EVM for combined criteria that determines the priority and rank of every processed marine product in Sumbawa’s coastal region:

Table 25. Total EVM Value for Each Alternatives of Processed Marine Products For All Combined Criteria

Processed Marine Products	Criteria										Total EVM
	1	2	3	4	5	6	7	8	9	10	
	0.178	0.138	0.139	0.13	0.137	0.085	0.054	0.063	0.041	0.035	
Traditional fried shredded fish (Abon)	0.052	0.048	0.057	0.058	0.066	0.082	0.051	0.055	0.058	0.066	0.058
Fish crackers	0.117	0.089	0.113	0.093	0.102	0.123	0.099	0.141	0.1	0.104	0.107
Fish dumpling (empek-empek)	0.123	0.113	0.121	0.116	0.105	0.138	0.088	0.117	0.122	0.138	0.117
Fish for Animal feed	0.055	0.049	0.054	0.052	0.057	0.101	0.099	0.093	0.058	0.089	0.064
Fermented local shrimp paste (masin)	0.154	0.148	0.117	0.142	0.155	0.142	0.161	0.158	0.126	0.146	0.145
Advanced shrimp paste (terasi)	0.17	0.178	0.176	0.175	0.189	0.172	0.184	0.214	0.185	0.149	0.179
Cooked Crab product	0.329	0.376	0.363	0.363	0.327	0.243	0.318	0.222	0.35	0.307	0.330
TOTAL	1	1	1	1	1	1	1	1	1	1	1

Source: processed primary data

Based on the total value of EVM for every processed marine product, the following table indicates the rank and priority level of each product:

Table 26. Rank and Priority Percentage of Each Alternative of Processed Marine Products in Sumbawa’s Coastal Region

Rank	Processed Marine Products	Priority Percentage
1	Cooked Crab product	33%
2	Advanced shrimp paste (terasi)	17.9%
3	Fermented local shrimp paste (masin)	14.5%
4	Fish dumpling (empek-empek)	11.7%
5	Fish crackers	10.7%
6	Fish for Animal feed	6.4%
7	Traditional fried shredded fish (Abon)	5.8%

Source: processed primary data

Overall, the cooked crab product is considered to have a highest potential to be developed as an advance industry in the coastal region of Sumbawa. Therefore, the empowerment program that will be implemented in the coastal region of Sumbawa should focus on developing cooked crab as a marine based industry.

Conclusion

Developing marine based industry as a strategy to empower local coastal people of Sumbawa should consider some criteria that were developed by AFE (2007). Experts respondents in this research suggested that the most valuable criteria among them are market demand, followed by job creation capacity, having consistent market growth, and income generating capability. However, the other criteria are also considered important despite they have much lower value of eigenvector. Furthermore, using all of those criteria, it is clear that the most potential processed marine product to be developed as marine based industry in the coastal region of Sumbawa is the Cooked Crab product.

The result of this study has a significant implication for the society itself and also for the government and other stakeholders that are concern on developing marine based industry in Sumbawa. Such industry should focus to develop the cooked crab product that has been identified in this research since it has much better prospect of market demand, job creation capacity, and other important criteria. Therefore, the product has better opportunity of success if it is developed as marine based industry in Sumbawa compare to the other alternatives of processed marine products.

Nevertheless, the results of this research were obtained from the perception of experts respondents and the local coastal people of Sumbawa. It is possible that the information provided by respondents were biased or misunderstood. Therefore, it is important to conduct other research that based on objective secondary data to identify which business activities are more efficient, more profitable, and more sustainable to be developed as marine based industry.

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