Impact of Climate Change on Coastal Communities in Tanggamus Regency

Journal of Physics: Conference Series **1796** (2021) 012029 doi:10.1088/1742-6596/1796/1/012029

Impact of Climate Change on Coastal Communities in Tanggamus Regency

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Abstract. Global warming is a gradual increase in the earth's temperature due to greenhouse gas emissions. Climate change impacts various sectors and is very complicated because it covers various aspects of human life. In the marine sector, climate change promotes rising ocean temperature and sea levels, increasing the frequency and intensity of extreme weather. This study was aimed to: (1) analyze the impact of climate change on the business of processed fisheries in Tegineneng village, Limau subdistrict, Tanggamus Regency; (2) analyze adaptation strategies undertaken by fish processors in conducting business amid of climate change. This study employed a survey as the study method. Respondents in this study were traditional fish processing in Tanggamus Regency. The impact of climate change on processed fisheries products was analyzed by using descriptive analysis and SWOT analysis. Climate change perceived by fish processors includes; the declined fish caught, uncertain fish harvest season, and further fishing area. The results showed that climate change impacted on the decreased processed products due to declined fish caught. Development strategies that need to be performed are diversification of processed products, improvement of processed product quality to prolong the product shelf life, and marketing network.
Keywords: Climate change, Fisheries, Fish Processors, Processed products production

1. Introduction

Global warming is a process of increasing the earth's temperature [1, 2]. One effect of global warming is climate change in various parts of the world [3,4]. Climate change affects various sectors and is very complicated because it covers various aspects of human life[5,6]. In the marine sector, climate change results in an increased sea surface temperature increased frequency [7,8], and intensity of extreme weather [9]; changes in rainfall patterns and freshwater runoff triggered by El-Niño and La-Nina phenomena [10,11]; changes in ocean circulation patterns and sea-level rise [12,13].

Based on observations of the Indonesian Bureau of Meteorology, Climatology, and Geophysics (BMKG) in the last five years of experiencing extreme weather changes, the average air temperature continues to increase [14,15]. Observation data from BMKG stations in each province noted that 2016 was the year with the warmest air temperature with an anomalous value of 0,8^{o}C [16], which then occurred again but was slightly lower in 2019 value of 0,58oC. Furthermore, the phenomenon of

climate change can also be seen from the data on the height of sea waves [17], which are influenced by wind patterns and speeds that can reach a height of more than 2,5 meters in different areas [18]. This condition certainly has a significant impact on coastal communities that depend on marine resources, considering Indonesia is an archipelago surrounded by oceans.

Climate change makes people, especially in coastal areas, become more vulnerable [19-21]. One area that is potentially affected by climate change is Limau Subdistrict. Limau Subdistrict is located on the Semangka Bay coast, which is directly adjacent to the Indian Ocean. Administratively, it is located in Tanggamus Regency, Lampung Province. Limau Subdistrict is a center for producing processed fishery products. The processed fishery products in Limau Subdistrict consist of smoked fish, *pindang*, and salted fish, nuggets, *pempek*, crackers, and fish balls. Climate change impacts on the livelihoods of fishermen and people whose occupation are fish processors [22]. Erratic weather (rain and strong winds) makes it difficult for fishermen to go to the sea[23]. The peak catch season in Limau Subdistrict occurs in March-April, but now the peak catch season is unpredictable. The climate change felt by fish processors includes the difficulty of obtaining raw materials that are up to expectations due to the decline of fish caught, uncertain fish harvest season, and the further of the fishing area.

The government has implemented empowerment programs for coastal communities (especially fisheries processors). The aim is to increase the capacity of fish processors [24]. The empowerment program is carried out with a participatory extension approach conducted by fisheries extension agents based on the local community's needs [25]. The competence and visit intensity of fisheries extension agents will determine the success in changing the behavior of business actors. Each region has absolute uniqueness, both from its fish resources, cultural characteristics and social institutions, socio-economic characteristics of the community, and technical production and technology, the implemented empowerment program must follow the characteristics of the local community the needs of fishery processors.

The success of the fisheries business development program in coastal communities today is not only dependent on the aspects of fisheries extension agents and business actors but also environmental factors [26]. Changes in fish catch patterns and yields due to climate change will impact the success of fisheries processing businesses. The uncertainty of the weather and the catch makes it difficult for fishery processors to meet consumer demand for processed fishery products. Research on the impact of climate change on fishermen has been researched [27,28], but research on the impact of climate change on fisheries processors and their business sustainability has not been studied specifically [29]. It is necessary to analyze the impact of climate change and develop strategies through a participatory extension approach in fisheries business development.

2. Research Methods

The study location is in Tegineneng Village, Limau District, Tanggamus Regency. The district is the center of the fishery product processing industry. The fish processing business characteristics are smoking and *pemindangan*, crackers, and ready-to-eat processed materials (nuggets, meatballs, dumplings, and so on). This research is a quantitative descriptive. The technique used in this research was the census (survey) technique. Respondents in this study were fish processors with a total of 21 people. Several types of fish processors were chosen to be respondents that consisted of smoked fish, pindang fish, salted fish, and other ready-to-eat products (nuggets, *pempek*, crackers, and fish balls). The data were collected from surveys in both research locations, and qualitative data were obtained from Focus Group Discussion (FGD) activities using Participatory Rural Appraisal (PRA) techniques and in-depth interviews. The data collected from the survey results were analyzed statistically by descriptive analysis and SWOT (Strength, Weakness, Opportunity, and Threats) analysis it can be seen in Figure 1.

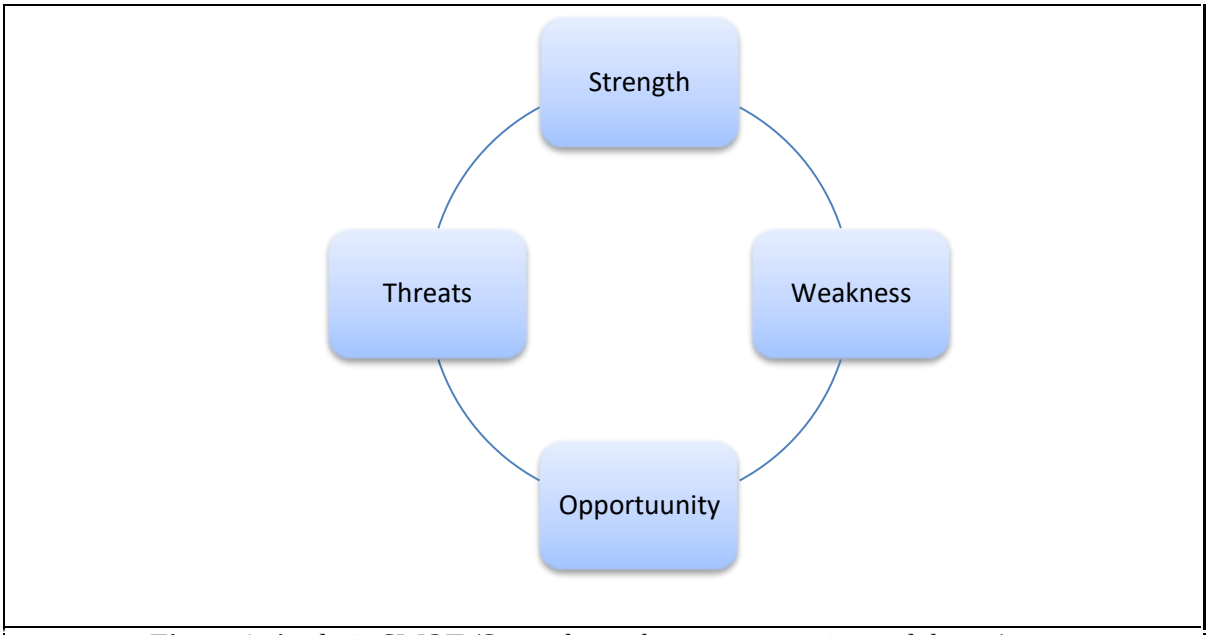

Figure 1. Analysis SWOT (Strength, weakness, opportunity, and threats)

3. Results and Discussion

3.1. The Characteristics of Fish Processors

Individual characteristics, in general, are traits or attributes that a person possesses related to all life aspects and their environment. Individual characteristics are made of biological factors, including genetics, nervous system, hormonal systems, and socio-psychological factors [30] in the form of conative components related to habit and effectiveness [31]. The adaptation resilience of processors in managing businesses due to the occurring climate change. Moreover, an essential element that must be considered is individual human resources (processors). The characteristics of fish processor respondents are shown in Table 1.

Table 1. The Characteristics of fish processors

Number	Age (y.o)	Education (year)	Business period (year)	Income (Rp/Month)
1	52	3	15	3.000.000
2	80	0	40	1.000.000
3	40	6	20	3.000.000
4	28	4	15	2.500.000
5	60	4	30	3.000.000
6	48	9	3	2.700.000
7	39	6	5	1.000.000
8	47	6	25	750.000
9	60	3	30	700.000
10	45	6	20	800.000
11	55	6	20	800.000
12	43	6	15	1.000.000
13	35	6	4	600.000
14	60	4	40	1.200.000
15	30	12	5	1.000.000

Number	Age (y.o)	Education (year)	Business period (year)	Income (Rp/Month)
16	32	9	20	2.100.000
17	50	6	40	2.300.000
18	28	9	8	1.500.000
19	35	9	15	1.500.000
20	40	9	30	3.000.000
21	52	6	40	3.000.000
Average	**46**	**6**	**21**	**1.735.714**

The age of fish processors in Limau Subdistrict, Tanggamus Regency, is around 46 years old with the oldest reaching 80 years and the youngest 28 years old. As the average age is under 50, the age category of fish processors is still in the productive age. Nurhardjo (2012) stated that the older a person was, the better performance had. Each individual has to determine the decision-making and concrete steps in the future for performing business. Age is an essential factor that affects the ability to run a business [32].

Education can influence a person in running a business because it is related to thinking patterns. If we look at the level of education, the average level of education for processors is up to the elementary school level (SD). Even though they have low education, fish processors can eloquently communicate well and not illiterate. Education will influence a person's attitude [33], action, and mindset in making decisions about innovation [34,35]

The average business period in Limau Subdistrict, Tanggamus Regency, is 21 years, with the most extended business period being 40 years and the youngest business period being three years. The fish processors living in Limau Subdistrict have managed the business for quite a long time, with an average of two decades. It means that the processors have gained much experience and have perceived the ups and downs of running the processed fishery products business. From the income aspect, the average respondent's income reached Rp. 1.700.000 with the most significant income of Rp. 3.000.000 and the lowest of Rp. 300.000 per month. The income category for fishery processors in Limau Subdistrict is still quite low. Thus it is necessary to increase the income of fish processors.

3.2. The Impact of Climate Change on Fishermen and Fish Processors

Fish processors are closely related to fishermen's life. The local community living in Limau Subdistrict, Teluk Semangka, Tanggamus Regency are located in a coastal area dominated by residents who work as fishermen. Fishermen depend on nature and natural resources. The catch of fishermen in the form of fish has a short time shelf-life period. This makes people have to assess the methods and technology to process fish to make it last longer.

Climate change is perceived by the coastal area community, especially in the Limau region. The phenomena perceived by the community are unpredictable weather, bigger sea waves, and unpredictable peak catch season. These phenomena cause the number of fish catches obtained by fishermen to be uncertain. This has an impact on sometimes abundant fish stocks on the market. This abundance of fish is utilized by further processing. Based on fieldwork, it is known that fishermen and fish processing businesses are highly dependent on natural conditions. Climate change makes the dynamics in fisheries more difficult. Weather is a natural factor as one of the essential factors in the businesses owned by fishermen and fish processors. The impacts of climate change felt by fishermen and fish processors in Limau Subdistrict include:

3.2.1. The fish season becomes unpredictable

The fishing business is also very dependent on the condition of resources and weather. Fishermen have perceived the climate change phenomenon impact. Fishermen think that it is complicated to predict the weather at the current time. Moreover, the sea waves got more prominent, and the storm intensity often made it difficult for fishermen to go to sea. One of the superior processed fish products from the

Liamu Subdistrict is smoked fish. The type of fish used for smoked fish is mackerel tuna. The peak catch season of mackerel tuna occurs from June to July. However, current fishermen cannot predict when the peak catch season is. Sometimes, fish are available in specific unusual season. The fishing month is increasingly challenging to predict, and the time is shorter.

3.2.2. Decreased fishing frequency

In addition to the difficulty of predicting the peak catch season, the frequency of fishing for fishermen is also becoming disrupted. Fishing activities can usually be done every day with a frequency of twice a day under normal circumstances. However, with increasingly erratic weather conditions and increasingly more significant sea waves and frequent storms, fishermen reduce the frequency of going to sea to decrease the risk of accidents in the ocean. Sometimes fishermen only go to sea once or twice a week. Several fishermen mentioned that they often do not go fishing for several weeks due to bad weather and big waves.

3.2.3. Reduced fishing time

The time spent at sea can also determine the amount of catch brought to the mainland. The standard fishing gears used are nets and fishing rods, which require time to wait for the fish to get caught. The worsening weather conditions and unpredictable storms have made fishermen make anticipatory efforts to avoid unfavorable conditions. Thus fishermen can quickly return to land. This unfavorable condition leads to the decreased waiting time for fish to get entangled or caught. Before the climate change phenomenon, fishermen were able to spend up to 4-8 hours at sea in a day, but currently, fishermen only spend around 2-3 hours a day at sea due to bad weather and sudden big waves.

Climate change makes peak catch season hard to predict, decreased fishing frequency, and reduced fishing time at sea. As the effect of climate change, fish caught by fishermen is declining, thus lead to the limited stock of mackerel tuna available for smoked fish. Fish processors stated that fish available was uncertain and frequently none, therefore fish processors are forced to discontinue the production. The effect of this situation is the unfulfilled demands of smoked fish, in the end, climate change lowering the income of fish processors at Limau Subdistrict.

3.3. Fishery Processed Product Business Development Strategy

The SWOT analysis is an analysis of an organization's internal and external conditions, which will then be used as a basis for designing strategies and work programs for fisheries business development in Limau Subdistrict, Tanggamus Regency. The internal analysis includes assessing the factors of strength (S) and weakness (W). Meanwhile, external analysis includes opportunities (O) and threats (T). The IFAS and EFAS factors for the development of processed fishery products business in Tegineneng Village Tanggamus Regency are shown in Table 2 and 3.

Table 2. IFAS *(Internal Factor Analysis Strategy)* of processed fishery products business development

No	Strengths / Weaknesses	Rate	Weight	Score
Strength				
1	Raw materials available are still fresh (good quality)	5	0.35	1.75
2	Close and easy access to raw materials	4	0.20	0.80
3	Cheap raw materials	4	0.10	0.40
4	Provide added value compared to unprocessed fish	4	0.20	0.80
5	The majority of the Limau residents work in the fisheries sector	4	0.15	0.60
Strength Score (*Strength)*			**1**	**4.35**
Weakness				
6	Short time product durability	3	0.20	0.60
7	The production process is highly dependent on the availability of	2	0.10	0.20

	local raw materials			
8	Limitations of marketing transportation	3	0.15	0.45
9	Business capital depends on the availability of raw materials	3	0.20	0.60
10	Minimal variety of processed products	5	0.35	1.75
Weakness Score (*Weakness*)			**1**	**3.60**
IFAS Score = 4.35-3.60				**0.75**

Table 3. EFAS (*External Factor Analysis Strategy*) of processed fishery products business development

No	Opportunities / Threats	Rate	Weigh t	Score
Opportunity				
1	Fish is high in nutrients	4	0.25	1.00
2	Increased public awareness regarding the importance of tourism, especially marine tourism	3	0.15	0.45
3	Increasingly open markets for processed fishery products	5	0.30	1.50
4	Increased movement and awareness of eating fish	4	0.20	0.80
5	Development of IT systems that facilitate marketing systems	5	0.10	0.50
Opportunity Score (*Opportunity*)			**1**	**4.25**
Threats				
6	Competitiveness of more innovative external processors	4	0.25	1.00
7	Raw material supplies are limited	5	0.30	1.50
8	There is no guarantee that fishery products are environmentally friendly	4	0.25	1.00
9	Increasing the number of fish processors from outside areas	3	0.20	0.60
Threats Score (*Threats*)			**1**	**4.10**
EFAS Score = 4.25-4.10				**0.15**

The first step in the SWOT analysis in developing the processed fishery products business in Limau Subdistrict, Tanggamus Regency, is to determine the components/factors that are included in the IFAS (internal factor analysis strategy) and EFAS (external factor analysis strategy). The IFAS includes factors of strength (S) and weakness (W), and EFAS includes factors of opportunities (O) and threats (T). The IFAS identification results obtained 5 (five) strength factors and 5 (five) weakness factors. After obtaining the factors, a rating and weight were given, and then both were multiplied to obtain a score. IFAS score was obtained by the reduction method, which was the strength score minus the weakness score. The results obtained an IFAS score of 0.75.

In the SWOT analysis, the identification of IFAS and EFAS analysis was carried out. EFAS is obtained through identification, including opportunity factors (Opportunity) and threats (Threats) in the development of processed fishery products. The EFAS identification results obtained 5 (five) opportunity factors and 4 (four) threat factors. After obtaining the factors (opportunities and threats), a rating and weight were given, followed by multiplying to obtain a score. The EFAS score was obtained by the reduction method, which was the opportunity score minus the threat score. The EFAS score obtained in the development of processed fishery products business was 0,15.

The strategy for developing fisheries business in Tegineneng Village Limau Subdistrict Tanggamus Regency is dominated by Strength (S) and Opportunity (O) factors (see table 4). This finding is in line with Yusuf and Muhartono's research which developed the fisheries sector from the strength and opportunity factors [36]. The main strategy for developing fisheries business is creating the best quality products using quality raw materials and the existence of marketing opportunities through marine tourism objects can become new attractions for the advancement of local resources. This is in

line with research which states that product quality and marketing are the main factors in fisheries business development [37,38].

Table 4. Processed fishery products business development strategy (S-O) in Limau Subdistrict, Tanggamus Regency

INTERNAL FACTOR / **EXTERNAL FACTOR**	**STRENGTH (S)** 1. The available raw materials are still fresh (good quality) 2. Close and easy access to raw materials 3. Cheap raw materials 4. Provide added value compared to unprocessed fish 5. The majority of residents of Limau work in the fishery sector
OPPORTUNITIES (O) 1. Fish contains high nutrition 2. Increased public awareness regarding the importance of tourism, especially marine tourism 3. Increasingly open markets for processed fishery products 4. Increased movement and awareness to consume fish 5. Development of technology information systems that facilitate marketing systems	**STRATEGY (S-O)** 1. Creating the best quality products using quality raw materials and the existence of marketing opportunities through marine tourism objects can become new attractions for the advancement of local resources 2. Extension or mentoring to provide more innovative product ideas 3. Access to transportation for marketing 4. Socialize the benefits of fish consumption 5. Assistance for production equipment and capital to facilitate business 6. Tourism progress is further enhanced to expand and facilitate product marketing 7. Use of Information Technology to expand product marketing 8. Use of clean guarantee and halal label to convince consumers of the products being marketed

4. Conclusion

The impacts of climate change on fishermen and fish processors in Limau Subdistrict include: fishing season becomes unpredictable, decreased fishing frequency, and reduced fishing time. Climate change causes fish caught by fishermen to decrease, and the fish supply that can be obtained by fish processors is limited. The limited supply of raw materials for processed fish has decreased fishery processors' income in Limau Subdistrict. Strategies for developing the fisheries business due to climate change are: diversification of processed products, improve the quality of processed products to prolong the shelf life of products, extension and assistance to processors in running a business, socializing the benefits of fish consumption to the broader community, and marketing networks.

Suggestions for further research, it is necessary to analyze the income and the amount of decline in fish catch due to climate change. This research can provide a real picture of the impact of climate change from economic and production aspects in the Limau coastal area, Tanggamus Regency.

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