



# Adaptation of Coastal Fishermen to Changes of Coastal Environment Case Study : Sungai Samak Village, Badau District, Belitung Regency

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## ABSTRACT

The occurrence of environmental changes on the coast of the Sungai Samak River Village gives influence to the life of coastal fishermen. This study aims to determine the adaptation of coastal fishermen in the face of coastal environment changes. This research uses mix method sequential exploratory to explore adaptation doing by coastal fishermen. In the qualitative phase, the data obtained by doing observation, interview and tracing documents / internet to then be analysed using interactive model analysis techniques. Analysis results on qualitative phase are then used as a reference for conducting a survey using questionnaires on quantitative phase which are then analysed using descriptive statistical techniques. The results showed that adaptation by coastal fishermen in Sungai Samak village was divided into 3 (three) aspects i.e. fishing techniques (use of technology (boat motorization) and moving / extending fishing ground), social aspect (established of social network, mobilization the role of family members and changes of fishermen status), and economic aspects (patron-client, job diversification, diversification of fishing gear, intensification of fishing gear and management of fishing capital). And through such adaptation, basically coastal fishermen can still fulfil their daily needs (subsistence), the confidence of the coastal fishermen to the existence of fishery resources in the ocean that will still exist even if they continue to be exploited making them no longer selective in fishing the change (decrease) of fishery resources has occurred significantly compared to 15 years ago, besides that as long as the waters in the Samak River Village are still open access make low trust of coastal fisherman to the success of protection and management of environment and coastal resources.

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## 1. Introduction

Changes in the coastal environment in the Sungai Samak Village have occurred. Where according to coastal fishermen in the Sungai Samak Village, the coastal environment changes that are most realized and felt by them is the decline of fish catches over the past 15 years as a result of over-exploitation (overfishing). In addition to over-exploitation of fishery resources as well as environmental changes occurring in the coastal areas of the Sungai Samak in the form of physical degradation of coral

reef ecosystem habitat due to destructive fishing activities (the use of fish poison), coral reef mining activities as a building material, and sedimentation from mining activities in land and clearing of oil palm plantations; and the occurrence of marine pollution due to tailings from mining activities in land (Wardhana, 2018).

The occurrence of coastal environment changes will impact to the life of fishermen who have a high dependence on the existence of fishery resources. And the group of fishermen who will most feel the impact of coastal environment change is the coastal fishermen. This is due to the characteristics of coastal

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fishermen who have limitations in technology, fishing gear, the size of the boat, cruising range and capital. This characteristic that causes coastal fishermen to become more vulnerable if there is a change in coastal environment.

The human perspective of environmental changes occurring in coastal areas impacting on the existence of fish resources itself requires humans to adapt to fulfill their life needs. Adaptation is an adaptation strategy that humans use during their lives to respond to changes in environmental and social change (Moran, 1982). Bennet (1976), sees adaptation as a human responsive behavior to the environmental changes that occur. Humans will always strive to adapt to the surrounding natural environment, both biologically / genetically and culturally. However, the adaptation is sometimes run not in accordance with the will of man if seen in the long run. Adaptation therefore requires appropriate action handling in order to preserve existing fish resources and not make things worse (sustainability).

The purpose of this paper is to describe the adaptation of what is done by the coastal fishermen in facing the coastal environment changes and through the adaptation will make they able to meet their needs but also can maintain the sustainability of fish resources in Sungai Samak Village.

## 2. Materials and Methods

### Research Area

This research was conducted in Sungai Samak Village, Badau District, Belitung Regency for 1 (one) month from October until November 2017. The research object is fishermen group with coastal fishermen category. The determination of coastal fishermen groups is determined based on the following characteristics:

1. Is an individual fishermen or fishery group of small fishing business.
2. Small fishermen without boats or with a boats without motor / outboard motor boats.
3. The catchment area is only about beaches, mangrove and coral reefs.



Figure 1. Research Location

### Data and Research Methods

This research uses sequential exploratory mix method. The mix method of sequential exploratory is a research method which first begins with a qualitative phase to exploit the views of the participants. The data obtained are then analyzed, and the information used to identify the appropriate instruments in the quantitative phase of *follow-up*, or to determine the variables that need to be continued into quantitative *follow-up* research (Creswell, 2016). While the type of data to be collected in the form of adaptation of coastal fishermen are grouped into social aspects, economic aspects and fishing techniques aspects.

In the first stage, qualitative methods are conducted using interview technique (by *snowball sampling method*) to extract information from key informants about their views / perspectives on the adaptation of what the fishermen do in the face of environmental change. Key informants selected are fishermen public figures.

In the second stage, the first stage result of the inventory of adaptation by fishermen will be used as the basis in making questionnaires to the micro level of fishery household (RTP) fishermen with the category of coastal fishermen as respondents. The number of coastal fishermen samples to be taken is calculated based on the formula of Taro Yamane (1967) in Shaleh (2013), i.e.:

$$n = \frac{N}{Nd^2 + 1} \quad (1)$$

Information:

n = Number of samples

N = Population

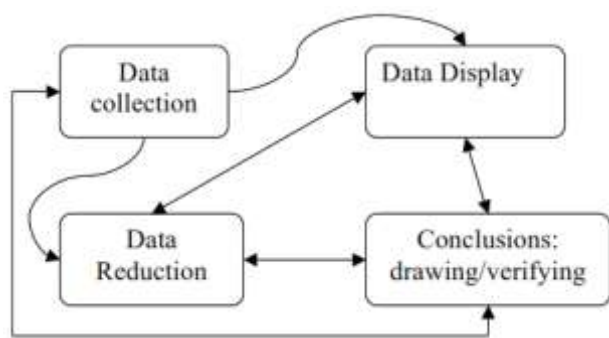
d = Precision set (10%)

From 92 RTP coastal fishermen in Sungai Samak Village then by using the above formula obtained by samples of coastal fishermen as many as 48 RTP.

### Data Analysis Method

#### Qualitative

Qualitative data will be analyzed using interactive model analysis techniques (Miles and Huberman, 1984) which generally include data reduction, data presentation and conclusion formulation. Data reduction steps include selection, simplification, and the making of abstractions. The process of analysis at this qualitative stage is done simultaneously with data collection. Presentation of data is done by arranging the data into a collection of information categorized and synthesized first to then presented in the form of narration supported by images, tables and charts. Qualitative data will be tested by triangulation.



**Figure 2.** Interactive model of data analysis  
(Miles dan Huberman, 1984).

#### *Quantitative*

Quantitative data collection was conducted by using questionnaire with the aim to inventory adaptation done by coastal fishermen in Sungai Samak Village in face of coastal environment change to responder which have been counted previously that is as many as 43 people. The data taken is the empirical experience of the respondents. Quantitative data will be analyzed by descriptive statistical analysis technique. Descriptive statistics are statistics used to analyze data by describing or delineating collected data as it is through data presentation using tables, graphs, pie charts, pictograms, mode calculations, mean, median, decile calculations, percentiles, deviations and percentage calculations (Sugiyono, 2011). Quantitative data will be tested for validity with the test of the validity of the constancy (construct validity) and the validity of the content (content validity) in which the test is subjected to the instrument of data collection techniques used at the time of the survey, i.e. questionnaires.

### **3. Results and Discussion**

#### *Changes in The Ecological Context*

Based on the results of interviews with fishermen public figure and questionnaires from coastal fishermen in the Sungai Samak Village it is known that the coastal environment changes most felt by the fishermen is the decline of fishery resources in the past 15 years. All respondents (100%) refer to humans as the main cause of the decline of fishery resources, which all agree that the increase in the number of fishermen operating in the same region causes overfishing. The territorial waters in Sungai Samak Village are open access makes fishing activities not only doing by local fishermen but also by the migrant fishermen. The migrant fishermen can come from neighboring villages or from other sub-districts in Belitung District (e.g from Tanjung Pandan and Membalong).

The phenomenon of overfishing also makes the fishermen start doing fishing activities (crab) that are not selective anymore. So small crabs are also kept captured. The ignorance and low awareness of the community regarding the importance of sustainable fisheries resource management coupled with the abundance of market opportunities for crab meat making this situation is worsening.

The public ignorance about the existence of regulations issued by the government related to certain types of fishing regulation,

certain size and condition as stated in Regulation of Menteri Kelautan dan Perikanan Number: 01 / PERMEN-KP / 2015 about "Penangkapan Lobster, Kepiting dan Rajungan"; which was subsequently replaced by Regulation of Menteri Kelautan dan Perikanan Number: 56 / PERMEN-KP / 2016 about "Larangan penangkapan dan/atau pengeluaran Lobster, Kepiting dan Rajungan dari Wilayah Republik Indonesia"; as well as the low level of government controlling as well as one of its own problems in the management and protection of fishery resources (especially Lobster and Crab).

Cinner et al. (2009) said that understanding of the role of humans as a cause of ecosystem degradation as well as a source of positive change is essential in articulating the space for experimentation. This means that if the understanding is not owned by a community, then most likely they will not want to try to follow the alternative management offered or in other words there will be no support for management efforts.

Understanding of the role of humans as the cause of ecosystem degradation and fishery resources is realized by coastal fishermen in the Samak River Village. However, the assumption that the existence of fish in the sea will not be exhausted even though overfishing occurs, because as long as they keep the coastal environment, fish (including crabs) will still come to their territorial waters. In addition, the right of access for all people causes the lack of confidence for local fishermen to succeed in the effort of environmental management and fishery resources, and often the efforts of environmental management and fishery resources are hampered or lost with higher economic interests due to the characteristics of the subsistence coastal fishermen.

#### *Adaptation of Coastal Fishermen*

Based on the results of interviews and questionnaires conducted to the coastal fishermen, it is known that the problems and constraints commonly faced by most of the coastal fishermen in the Sungai Samak Village in conducting fishing activities on the coast are:

1. Declining catches and increasing uncertainty of catch,
2. Limitations of types and number of fishing gear owned,
3. Limited fishing area (DPI),
4. Changes in wind season that affect the fishing activities,
5. High competition in fishing in coastal areas, and
6. Limited capital for business development.

Based on these problems, the coastal fishermen in Sungai Samak Village do some adaptation, where basically the adaptation done by the coastal fishermen is a form of adjustment response in facing the environmental changes (both the physical marine ecosystem and the social environment) in order to still get the fish catch to be better or at least keep awake in terms of quantity. Thus the coastal fishermen are still able to meet the needs of his life. The adaptation doing by coastal fishermen in Sungai Samak Village is shown in the Table 2.

**Table 2.** Matrix of problems and adaptation doing by coastal fishermen in Sungai Samak Village.

No.	Problems	Impact from	Coastal fishermen adaptation
1	Declining catches and increasing uncertainty of catch	Over exploitation, sea pollution	1. Use of technology (boat motorization) 2. Moving / extending fishing ground 3. Job diversification 4. Diversification of fishing gear 5. Extension of fishing gear 6. Mobilizing the role of family members
2	Limitations of types and number of fishing gear owned	Limited capital	1. Establish of social networks 2. Patron-client 3. Management of fishing capital
3	Limited fishing area (DPI)	Boat ownership status and size of boat owned	1. Establish of social networks 2. Patron-client 3. Change of fishermen status
4	Changes of the fishing activities	Weather, wind seasons and sea pollution	1. Change of fishermen status 2. Job diversification 3. Diversification of fishing gear
5	High competition in fishing in coastal areas	Over-exploitation	1. Changes of fishermen status 2. Diversification of fishing gear 3. Ekstensification of fishing gear 4. Mobilizing the role of family members
6	Business development	Limited capital	1. Establish of social networks 2. Patron-client 3. Management of fishing capital

### Use of Technology

The use of technology in this case is in the form of the use of propulsion engines on the fishing boat (motorization). Motorization of fishing boats in the Sungai Samak Village has been long enough known by the fishermen. In the past, the fishermen in the village used boats (jukong) paddles or sails, although these boats did not require a large cost in the operation but require more time and energy to be able to reach the location / fishing area (limited catchment area).

The motorization of fishing boats in the Sungai Samak village began around the 1990s when there was an Inpres Desa Tertinggal (IDT) program from the central government. Seeing the ease in doing fishing activities when using a motor boat, then since it started a lot of fishermen who use the engine on the boat in fishing activities are no exception coastal fishermen. However, to get this technology, coastal fishermen must spend a lot of money while one of the characteristics of coastal fishermen is limited capital. This is why not all the coastal fishermen can own this technology. This can be seen from the results of the survey which shows that 54.17% of fishermen who own boats (motor boat) and 18.75% of fishermen who have boats without machines (rowing boats).

### Moving/Extending Fishing Ground

The increasingly difficult availability of fish and the characteristics of the sedentary fish make the coastal fishermen begin to also move the fishing location by looking for locations that may be suitable / appropriate / considered many fish in it in accordance with his experience in fishing or information from fellow fishermen. However, the displacement of fishing sites for coastal fishermen is only local (not far from the beach where they moor the boat), given the limited size of the boat and also the capacity of human labor (for fishermen without boats and boats without machine) and machine capability (for fishermen with motor boat). Of course the distance of coastal fishermen who use a motor boat even further than the coastal fishermen who use boats without a motor.



“Jukung” Boat



Motor Boat

**Figure 4.** The Types of Boats used by coastal fishermen in the Sungai Samak Village

### Establishment of Social Networks

Based on the results of interviews and questionnaires to the respondents, it is known that coastal fishermen in the Sungai Samak Village form a social network to various parties such as family, neighbors, fellow fishermen and fish buyers (Perae and Bos). Family and neighbors are the first to know and see first hand the state of the fishermen. Perae is a place for fishermen to be able to sell the fish. While the boss is an excess of Perae, where the excess Bos is not only for fishermen to sell the fish, but also can provide capital assistance to the fishermen in need.

The relationship between the boss and the coastal fishermen (Patron-Client) is a kind of cooperation between the boss (the owner of capital) with the morally binding but unwritten. The advantage of this relationship is that all the needs of fishermen for fishing activities (eg bait, fishing gear, boat machine, boat) or other family needs (eg food, cash, etc.) are more easily met. However, there is a disadvantage of having such a relationship that the fishermen can not choose his / her own place to sell the fish to the person who giving the higher economic value due to the moral attachment.

Based on the interview results, it is known that there are also coastal fishermen who form a social network among fellow fishermen by establishing a “Kelompok Usaha Bersama” (KUB) Perikanan Tangkap. The establishment of KUB is aimed at improving the capability of joint efforts (in the provision and management of capital and the absorption and dissemination of technology and information) to increase the income and welfare of KUB members. Although it has not shown significant results in



improving the income and welfare of members, it is easy for the KUB group to request assistance from the government's in form fishing infrastructure / facilities as shown in the Fig. 5 below.



**Figure 5.** Kelompok Usaha Bersama (KUB) Kembang Karang get assistance of fishing infrastructure/facilities in the form of boats and engine outboard boats.

#### *Mobilizing the role of family members*

Family participation in catching fish and fish processing also become one of the adaptations of coastal fishermen in handling the decrease of fish catch and to increase the sale value of catch fish. Wife and children sometimes or even often participate with husband or with others in fishing activities (generally do nyulo / nyuluh activity (fishing activity by foot (ngarong) at night using seser, lamp and ambong (as a temporary place for fish) with fishing area just around the beach).

Processing of fish caught by coastal fishermen family generally is processing menjadi semi-finished goods. In this case the process of crab processing done to separate the crab meat from the shell (crab peel). By stripping, the price of crab that originally ranges from Rp. 80.000, - / kg can rise to reach the price of Rp. 250.000, - / kg.

#### *Change of fishermen status*

Obstacles experienced by coastal fishermen when entering the west wind season (around November - January) will disturb or indeed of fishing activities. The small boat size and high waves increase the risk of going to sea (shipwreck). So in the west season, the coastal fishermen generally choose not to go to sea and do other work (farming) when not to go to sea. Even if some are still fishing, the coastal fishermen will choose the right time (when the daily west wind is shady) and just looking for fish just beachside (eg nyungkur / nyungkor and fishing with the hook).

In addition, when the west wind season, the coastal fishermen can also switch professions as fishermen workers by way of participating to do work with people who have a large boat that is not too affected by weather factors, but this is not common / common done by coastal fishermen. While in the wage system, generally wage system is done when we work with other people as a fishermen of the fish that is the sale of fish will be reduced first with the operational costs during fishing. Then the rest (net) will be divided equally into 3 (three) portions of Shipowners / Captains, Boat, and the crew (ABK).

#### *Patron client*

In addition to physical equipment, access to capital in general can also be financial or financial capacity (Ribot and Pelusco, 2003). For coastal fishermen in Sungai Samak Village, the problem of capital is one of the main problems in conducting fishing activities. Generally the coastal fishermen get fishing capital from the sale of the previous catch fish. In addition, other sources of capital for some coastal fishermen in the Sungai Samak Village to run fishing activities can also be derived from Patron (ie "Boss").

The establishment of Patron-Client relationship is intended by some coastal fishermen to overcome the capital constraints they face. Any coastal fishermen who wishes for this connection may request capital assistance (boats, ship engines, fishing gear or bait) to the Boss without a written agreement but with a trust system on the condition that any catches of fish obtained must be sold to him, otherwise the provisions of the amount of installments to be paid by the coastal fishermen but to see the condition of fish catches. Thus the availability of capital for coastal fishermen in fishing activities can be maintained even can do business development. The same thing is also pronounced by Prityatna and Sumartono (2011) who say that the reason why such patron-client pattern is maintained is because bonding with patrons (pelele and penampung) is an important step to maintain the fishermen's business continuity.

#### *Job Diversification*

Fishing activities to catch fish for coastal fishermen in Sungai Samak Village is the easiest way to fulfill they needs. However, there are times when the coastal fishermen can not go to sea because of the unlikely circumstances (weather factor). For example the west wind season, although generally the coastal fishermen mentioned that in the west wind season caused their fishing activities disrupted so that the frequency of their fishing to be much reduced. In addition, the increasing uncertainty of catch due to the fish season that has not come (crab season in July) will certainly give effect to the income they get. To get around the situation then in general the coastal fishermen will maximize the skills they have (farming and carpentry), and 83,33% of respondents have skills other than fishing (most of them is farming).

Berkes and Sexias (2006) mentioned that the flexibility of resource users to move from one job strategy to another is a key aspect of resilience. Although coastal fishermen respondents have considerable side jobs (68.75%), their dependence on fishery resources is still high. This is related to the type of side job they are involved in (eg, builders). Although the income earned from the work is quite large, it is not always available throughout the year but depends on people who need their carpentry skills. As for those who have odd jobs in the field of agriculture / farming (generally the plantation sahang / pepper) is also not much different from the respondents who have side jobs in the field of carpentry, limited land owned, land that is not very suitable for cultivation/fertile (because sandy soil), the limited capital to buy agricultural fertilizers and limited time to take care of crops and harvest can be obtained only once a year to make the limiting

factor in the development of the business. While the opportunity to seek non-fishery work in Sungai Samak Village (eg oil palm plantation company, sand mining company, Suge-Pegantungan power plant and tin smelting company) and outside Sungai Samak Village for respondents is actually available due to the distance to Pegantungan Village and to the city center not too far ( $\pm$  5 Km and 23 Km) but this is not usual. This condition may be caused by the constrained of education, skill, age and habit of becoming fishermen as "way of life".

#### *Diversification of Fishing Gear*

Diversification of fishing gear used by coastal fishermen in Sungai Samak Village is doing by combining different types of fishing gear in each time to go fishing or changing / using different fishing gear following weather conditions and fish season. The purpose of using these various fishing gear is to increase or maintain the quantity of catches by different fishing methods. Based on survey results, all coastal fishermen respondents own and use more than one fishing gear (eg traps and fishing lines, nets and traps, etc.).

#### *Extensification of Fishing Gear*

Extensification of fishing gear is to increase the number of similar fishing gear. Basically extensification is the same purpose as the diversification of fishing gear that is to improve the catch and minimize the uncertainty of the catch. However, the extensification of fishing gear in coastal fishermen is limited by the characteristics of coastal fishermen who generally work individually, so that the types of fishing tools that can be extensified are passive such as fish traps (bubu, nets and sero). By extensification it will increase the chances of coastal fishermen to get catch fish.



Crab Traps (Bubu keping)

Squid Fishing Line (Pancing cumi)

**Figure 5.** Fishing gear commonly used by coastal fishermen in the Sungai Samak Village .

#### *Management of Fishing Capital*

Maintaining the availability of fishing capital is a must for every fishermen. Mostly, coastal fishermen use a capital for the purchase of bait and fuel. So when the coastal fishermen get enough income from fish sales after they fulfill the family needs, they spare some of their income for the next fishing. This is seen from the survey results of 100% of respondents stated that the results of their fish sales are used to fulfill the daily family needs and fishing capital for next trip. Based on the above explanation, the adaptation doing by coastal fishermen in Sungai Samak Village is divided into 3 (three) aspects, i.e.:

1. Aspects of fishing techniques, consisting of the use of technology (motorization boat) and moving/extending fishing ground.
2. Social aspects, consisting of the establishment of social networks, mobilizing the role of family members and changes of fishermen status.
3. Economic aspects, consisting of patron-client, job diversification, diversification of fishing gear, extensification of fishing gear and management of fishing capital.

#### **4. Conclusions**

Based on the results of the study and analysis of the problems presented in this study, it can be concluded:

1. According to coastal fishermen in Sungai Samak Village, the coastal environment changes that are most realized and felt by them is the decrease of fish catch in the last 15 years as a result of over-exploitation (overfishing).
2. Adapted by coastal fishermen in Sungai Samak Village divided into 3 (three) aspects ie fishing technique (using technology (boat motorization) and moving / extending fishing ground), social aspect (establishing of social network, mobilizing the role of family members and changes of fishermen status) and economic aspects (patron-client, job diversification, diversification of fishing gear, extensification of fishing gear and management of fishing capital).
3. Through the adaptation, basically coastal fishermen can still fulfill their daily needs (subsisten), the confidence of coastal fishermen to the existence of fishery resources in the ocean that will still exist even if they continue to be exploited make them no longer selective in fishing although changes (decrease) of fishery resources has occurred significantly compared to 15 years ago, besides that as long as the territorial waters in the Sungai Samak Village are still open access make low trust of coastal fishermen to the success of protection and management of environment and coastal resources

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