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Strengthen The Capacity of Traditional Fishermen Who are Facing the Threat of Coastal Ecosystem Damage in Bangka Island Based on Local Capacity

Endang Bidayani[1], Devi Valeriani[2], Reniati Reniati[3]*

[1]Fisheries and Marine Science Department, Agriculture Fisheries and Marine Science Faculty, Universitas Bangka Belitung, Bangka, Indonesia
[2]Department of Economy, Faculty of Economics, Universitas Bangka Belitung, Indonesia
[3]Department of Management, Faculty of Economics, Universitas Bangka Belitung, Indonesia

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Corresponding Author:
Reniati
r3ni4ti@gmail.com

ABSTRACT

The impact of tin mining activities in coastal regions on Bangka Island is cause for concern due to the damage inflicted on the coastal ecosystem. The study aims to analyze: 1) the resilience strategies used by traditional fishermen impacted by tin mining along the coast of Bangka Island; 2) Examining the attributes of conventional fishermen with adaptable abilities; 3) Studying the factors that contribute to the resilience of traditional fishermen; 4) Also, provide suggestions to enhance the skills of traditional coastal fishermen regarding tin mining, focusing on local capacity. The current approach for research includes carrying out surveys. The site selection is centered on coastal regions that have been shaped by tin mining, with a particular emphasis on the central area of Bangka. The data analysis technique involves exploring and describing information. Findings of the study indicate that: 1) Traditional fishermen utilize an active resilience strategy; 2) Key qualities of resilient traditional fishermen include Insight, Independence, Relationships, Initiative, Creativity, Humor, and Morality; 3) Family plays a crucial role in supporting the resilience of traditional fishermen; and 4) A recommended policy to enhance the resilience of traditional fishermen involves implementing a social empowerment program with a degrowth perspective, focusing on initiatives like fostering agricultural enterprises, marine cultivation, and coastal tourism. A recommended policy to enhance the resilience of traditional fishermen involves implementing a social empowerment program with a degrowth perspective, focusing on initiatives like fostering agricultural enterprises, marine cultivation, and coastal tourism.

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1. Introduction

Tin mining operations on Bangka Island primarily involve unconventional methods (Sulista and Rosyid, 2022). The consequences of coastal mining include the devastation of coastal ecosystems (Wulandari *et. al.,* 2022). According to Savira *et al.* (2018) over the past two decades, approximately 240,467.98 hectares, or 86.2%, of mangroves have been lost, leaving 33,224.83 hectares, or 13.8%, in good condition de Sausa *et al.* (2022) and Diaz *et al.* (2016), highlight that this is an alarming situation, as it may lead to an ecological catastrophe that threatens economically significant species like mangrove crabs, shrimp, oysters, and other wildlife, as well as causes erosion, saltwater intrusion, wave and wind erosion, and sediment accumulation (**Figure 1**).

Fig 1. Several sites on Bangka Island have been degraded

Mining waste includes heavy metals such as chromium, cadmium, copper, lead, aluminum, and others (Jamieson *et al.,* 2015). The water quality may take 20 to 30 years to return to acceptable (Dehkordi *et al.,* 2024). The accumulation of water bodies during runoff can harm benthic communities and breeding habitats for aquatic species, leading to a decline in populations and a loss of biodiversity (Mensah *et al.,* 2015). Besides its environmental repercussions, tin mining also brings about social and economic advantages (Nurtjahya *et al.,* 2017), while negatively impacting the incomes of fishermen (Ibrahim *et al.,* 2024) and causing traditional fishermen to lose their livelihoods (Akbar, 2023).

Traditional fishermen rely on conventional fishing methods and equipment, modest business investments, and basic fishing cooperatives. According to Azhar *et al.* (2018), traditional fishermen have limited work areas near coastal waters since they operate non-motorized boats.

Resilience refers to an individual's capacity to enhance their response to stressful circumstances, as well as their ability to adjust and endure in such situations Rapaport *et al.,* (2018) and Johnson *et al.,* (2014). As noted by Sabihaini *et al.,* (2018) and (Fajar, 2023), resilience signifies the capability to successfully adapt in challenging conditions and when faced with risks. Effective strategies employed by traditional fishermen in the Central Bangka area involve broadening their access to the sea and seeking alternative employment (Shajahan and Radovic, 2023) and Satumanatpan and Pollnac, 2020). Additional approaches include livelihood strategies (Riptanti *et al.,* 2024) and modifications in lifestyle, such as hunting management and improving survival rates (Vogel *et al.,* 2023). The aspects that serve as indicators for assessing fishermen's capacity encompass social, economic, political, structural, resource-related, and management dimensions (Irewati *et al.,* 2024).

According to Islam *et al.* (2024) and Bidayani (2021), a resilient individual possesses seven key traits: knowledge, independence, relationships, initiative, creativity, humor, and ethics. Hornor *et al.* (2017) and Amadu *et al.* (2021), identify four phases of resilience: delivery, survival, recovery, and flourishing. Stanford *et al.* (2017) and Leite *et al.* (2019), outline survival strategies that can be employed to counter economic shocks, which are

categorized into active strategies, passive strategies, and network strategies. Ummaheswari *et al.* (2021), suggest that the factors enhancing resilience are grouped into three categories: individual, family, and community support systems for tackling challenges.

Traditional Bangka Island fishermen have been prompted to work toward resilience due to economic shocks brought on by coastal damage. These communities' resilience differs depending on the area. Additionally, coastal communities' local potential differs by region. In this study, the problem is formulated as follows: 1) How do traditional fishermen affected by tin mining activities approach resilience? 2) What are the traits of individual traditional fishermen who possess resilience capabilities? 3) What are the factors that contribute to the resilience of traditional fishermen on Bangka Island? 4) What are the policy recommendations for enhancing the resilience of traditional fishermen affected by tin mining based on local potential?

This research provides an overview of previous studies carried out by researchers in coastal conflict zones over the past 15 years. These studies include Analysis of the Economic Value of Unconventional Mining with Fishing and Tourism Activities on the Coast of Tanjung Ular, West Bangka Regency (2009); Model Components of Mangrove Resources Management Based on Blue Economy Concept (2016); Lead (Pb) heavy metal content in seagrass *cymodocea serrulata* in the Tin Mining Area of South Bangka Regency (2017); The Policy Strategy of Utilization of Coastal Area Resources in South Bangka Regency (2019); Overlapping Utilization of Fisheries Resources with Tin Mining in the Waters of Pangkalpinang City, Bangka Belitung (2019); Conflict resolution in coastal resource utilization among fishermen and unconventional tin miners (2020); Utilization conflict analysis of fisheries resources with tin mining and marine tourism in east coast of Bangka Island (2020); Traditional fisherman resilience strategy to coastal pollution pressure impact of tin mining in central Bangka district (2021); Local wisdom of coastal communities in management of fishery resources in conflict areas of unconventional tin mining in Central Bangka Regency (2023); The application of the blue economy concept for traditional fisheries management in a conflict zone (2023); and Efficiency of Small-Scale Capture Fisheries in Conflict Areas, Bangka Regency.

However, no local capacity - building studies have been conducted for traditional fishermen concerning the Bangka coastal ecosystem. By making the most of the special resources found in each location, it is anticipated that this research will help to improve the economic standing of native fishermen in damaged coastal areas.

The study employs a qualitative problem-solving method, utilizing in-depth analysis techniques to address specific research goals: 1) Investigation into the resilience tactics of The equipment used in this study was stationery, a camera and several questionnaire. This research was conducted with the approval of Lembaga Penelitian dan Pengabdian kepada Masyarakat at Universitas Bangka Belitung, Indonesia.

The survey took place between June and August 2024, covering several villages in different districts of Bangka Island, including Batu Belubang and Kebintik in Central Bangka District, Baskara Bhakti in Namang District, Teluk Kelabat Dalam and Pusok in Kalapa District of West Bangka District, as well as Teladan in Toboali District of South Bangka District. Due to the presence of various mining activities in the region, purposeful sampling techniques are being implemented. Figure 2 displays a map of the study area.

Fig 2. Map of Research Location in Bangka Island

The research methodology applied in this study involves gathering data and information from participants using a questionnaire to collect, observe, and record data. Fink *et al.* (2003), the effectiveness of an investigation can be gauged when multiple individuals can easily reach a consensus on the terminologies and ideas used to define the investigation's aims. The research period witnessed a single instance of this study being conducted. The study population consisted of traditional fishermen impacted by illegal tin mining.

Survey research involves gathering information from a group by asking open-ended questions or conducting interviews in order to provide insights into different facets of society. This study took place in two coastal villages impacted by unlawful tin mining, namely Kabintik village and Baskara Bhakti village. This study was conducted once throughout the research period. Respondents were interviewed in an interconnected way using the snowball method. Yulianah *et al.* (2022), suggests that a sample size of 30 is needed to enhance the representativeness of the sample for a broader population.

Observing allows one to gather ample information about an individual as it reveals inconsistencies between their words and deeds. Observations are conducted on-site, where the results are recorded and documented based on the observations. The technique of documentation entails capturing information from different sources like interviews, observations, and relevant research materials. Beyond mere transcription of facts, this approach enables scholars to uncover the essence of language and acquire a more profound comprehension of the situation. Data like personal information or official documents from companies are presented in document form.

Sampling techniques involve the use of sampling methods. This technique involves choosing the sample or respondent according to specific criteria, such as fishermen with over two decades of experience in the traditional methods. The reason for choosing the respondents is to gain insight into the environmental changes. There are 30 respondents.

There are two types of data collection methods, primary data and secondary data. Primary data collection will involve the utilization of questionnaires, observation, and documentation tools. Interviews were carried out by directly engaging with respondents through a

questionnaire guide. Collecting secondary data the reviewing literature. Observing how researchers dedicate significant time in the field and engage in various activities to fully understand the individuals under study. A survey was conducted where the respondents were observed. The purpose of the articles is to conduct interviews.

The data analysis method employed is a qualitative descriptive approach that uncovers recurring patterns and is dependable in elucidating and addressing the research issue. A method for effectively gauging the attitudes, opinions, and beliefs of fishermen using descriptive techniques Dey *et al.* (2003), the qualitative research approach entails exploring phenomena in authentic settings, distinguishing itself by a post-positivist stance and reliance on the researcher as the primary instrument in the study. Factors contributing to resilience were examined through the application of a multiple linear regression technique. The equation for the multiple linear regression model is as shown below:

$$Y = \alpha + \beta 1\ X2 + \beta 2\ X2 + \beta n\ Xn + e$$

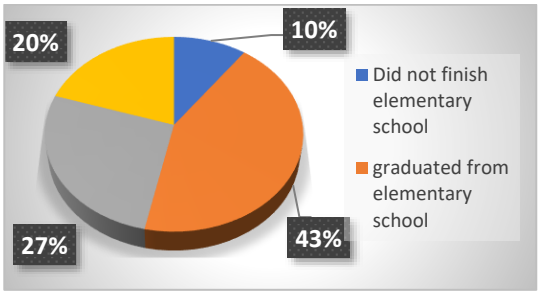
Description:
Y = dependent variable or response variable.
X = independent variable or predictor variable.
α = constant.
β = percentage or coefficient estimate.

Suggestions for enhancing the skills of traditional coastal fishermen regarding tin mining through the utilization of local capacity with a modeling method. Suggestions for policies are being made by analyzing how coastal damage affects the social and economic aspects.

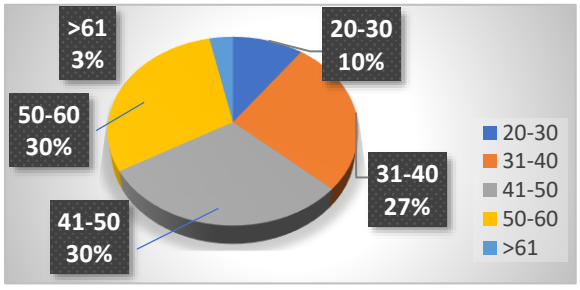
3. Results and Discussion

3.1. Results

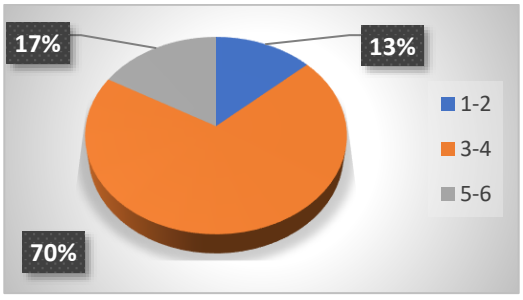
3.1 Respondent Profile



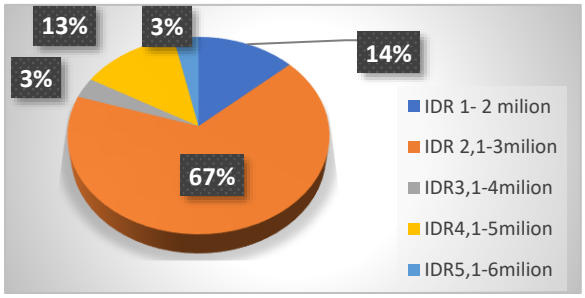
(a)



(b)



(c)



(d)

Fig 3. Respondent's profile by (a) level of education. (b) age; (c) number of dependents in the family and (d) monthly income.

Based on Figure 3, the data shows the traditional fishermen's information of respondents in various villages within Central Bangka District, including Batu Belubang Village and Kebintik Village in Pangkalan Baru District, as well as Baskara Bhakti Village in Namang District of West Bangka District. In Teluk Kelabat Dalam, located in Pusuk Village District of South Bangka District, and Teladan Village in Toboali District, the majority of respondents had completed primary school education at 43%. The majority of respondents fall within the age range of 41 to 60 years old, accounting for 60%. Likewise, the largest number of dependents consists of 3-4 individuals, making up 70%. Additionally, the predominant income bracket lies between IDR2,100,000 to IDR3,000,000 monthly, constituting 67%. It is believed that these four factors have an impact on the livelihoods of fishermen. According to Bidayani *et al.* (2023), the season has a significant impact on traditional fishermen's earnings.

The education level of most elderly fishermen is typically limited to those who have finished primary school. It is thought to impact the quality of life in the community, which remains quite modest. As per the viewpoint of Aini and colleagues. In 2018, education serves as a key indicator of social well-being. For a society with advanced education to thrive, it should prioritize a superior quality of life.

Fishermen in the age range of 41 to 60 typically show a correlation between their educational background and the financial opportunities available to them. Many of the participants mentioned that their parents were experienced fishermen. Atmaja *et al.* (2024) has found that fishermen's income is influenced by their age.

As you grow older, you will gain more industry experience. Many dependent fishermen are between the ages of 3 and 4, impacting the nutritional health of the fish farms. Lein *et al.* (2018) has shown that income, number of dependents, and education are factors that affect the dietary habits of households engaged in fishing. The greater the number of dependents, the greater the amount of food available to the household.

On average, fishermen earn between IDR2,100,000 to IDR3,000,000 per month. It is thought to impact the well-being of the fishermen. Sometimes, fishermen choose to stay on land due to unfavorable sea conditions such as strong winds and large waves. Tahir and colleagues in 2023, the community's standard of living is significantly influenced by a 40. 8% variation in income levels.

3.2 Resilience strategies for traditional fishermen

People can enhance challenging situations and to adapt and persevere in such circumstances Al-hafidz *et al.* (2024). Based on a study by Bueno *et al.* (2019), resilience refers to the capacity to thrive amidst challenging and unfavorable circumstances. Traditional fishermen in the study area typically utilize a variety of fishing tools, including nets, rocks, lifting nets, boxes, crates, traps, and fishing rods. The wooden boats they use measure 4-5 meters in length and are equipped with an outboard motor.

Some of the strategies to enhance the situation involve broadening fishing activities and boosting local job opportunities, implementing changes in livelihoods, addressing overfishing concerns, enhancing survival rates, and introducing creative and innovative approaches. Based on the research findings, the majority of traditional fishermen, specifically 67% of them, are adopting proactive tactics such as broadening their fishing grounds and seeking additional work opportunities to sustain their livelihoods. Ithe meantime, a passive strategy is employed by the remaining 33% of fishermen. Opting to save some money by taking a break and fixing their fishing gear or damaged boats. Based on Shaw *et al.* (2013) insights, survival tactics can be harnessed in various manners to navigate economic upheavals, falling within three classifications: active, passive, and network-oriented strategies. Figure 4 displays the proportion of tactics employed by fishermen.

Fig 4. Resilience strategies of traditional fishermen

The aim of broadening the fishing stock is to explore new locations for fish catching. Even though there will be an increase in administrative costs, it will ultimately result in saving the lives of the fishermen. Nainggolan and colleagues have substantiated this claim. In 2021, enhancing the fishing stock can be a beneficial strategy to boost the earnings of fishermen. Oftentimes, fishermen take on temporary work as day laborers when faced with poor weather conditions during the off-season. Additionally, some fishermen run family businesses like food shops, gardening, and boat rentals.

3.3 Traditional fishermen possess strong characteristics

Min *et al.* (2013), there are seven characteristics of a responsible person, namely: knowledge, autonomy, relationships, initiative, creativity, humor and ethics. Based on the results of the research, traditional fishermen have individual characteristics of resilience, which are: knowledge, independence, relationships, initiative, creativity, humor and culture. Knowledge is the ability to understand other people and situations. This trend is reflected in their ability to run businesses between the ages of 20 and 40.

In Esteghlal, fishermen respond to the problem of pollution of the local beaches without emotion. But they are looking for a way out and they live with strange tin miners who are local people.The relationship between fishermen and tin miners is very good in coastal communities. to minimize conflicts of interest. The social initiatives to try to deal with the problems are expressed through attitudes such as the division of the coastal zone by using trees planted one kilometer from the sea, for fishing activities and tin mining as in the village of Baskara Bhakti. Currently, in the village of Kettik, there is no division between the fishing ports and the empty tin mine.

The creativity of fishermen can be seen, among other things, by finding additional income from non-fishing activities such as gardening, foreign work and boat hire. Even though they are funny people, fishermen never lose their sense of humor. Some examples of entertainment include listening to music with a loud sound system on the nose that can be heard several meters away, and trips to the islands.

Ethics, this attitude is reflected in their ability to manage the family well. Financial problems due to low income they solve by trying to find extra income. In addition, government aid programs such as fishing gear and boat engines can reduce production costs.

3.4 Factors that support the resilience of traditional fishermen

Irawan *et al.* (2021), the factors that support resilience are divided into three categories namely individual, family and community, as supportive role models An environment to deal with stress. The objective of this study is to determine the family (X1), community (X2) and individual (X3) factors affecting traditional fishermen's capacity (Y). Below, the results of data processing using the multi-linear approach are shown in Table 1.

Table 1. The multiple linear regression results.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.636719
R Square	0.405411
Adjusted R Square	0.336805
Standard Error	0.37957
Observations	30

ANOVA

	Df	*SS*	*MS*	*F*	*Significance F*	
Regression	3	2.554092	0.851364	5.90924	0.003248	
Residual	26	3.745908	0.144073			
Total	29	6.3				

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-1.36881	0.758238	-1.80525	0.08263	-2.92739	0.189774	-2.92739	0.189774
X Variable 1	0.249925	0.08532	2.929265	0.006983	0.074547	0.425303	0.074547	0.425303
X Variable 2	0.218733	0.15345	1.425431	0.165928	-0.09669	0.534154	-0.09669	0.534154
X Variable 3	0.180816	0.077448	2.334687	0.027554	0.02162	0.340012	0.02162	0.340012

Based on Table 1, the significance F 0,003 < 0,05 can be interpreted as three factors, namely family, individual, and community have a significant effect on the resilience of traditional fishermen. The R Square value of 0.40 can be interpreted as 40% of resilience is influenced by family, individual, and community factors. While the other 60% is influenced by other factors outside the model. The P value X1 of 0,006 < 0,05 can be interpreted as Family Factors having a significant effect on the resilience of fishermen. The family plays a big role in the

efforts of fishermen to pursue their profession. This is reinforced by the opinion of Nugroho *et al.* (2024) that family harmony plays a role in work discipline and motivation.

3.5 Enhancement of Policy to Strengthen the Resilience of Traditional Fishermen

The appropriate approach to enhance the resilience of traditional fishermen involves social policy, specifically a policy crafted to avert social issues. The anticipated social policy form involves a program focusing on community empowerment, utilizing local potential by enhancing entrepreneurship. Wahyuningsih *et al.* (2011), emphasized the significance of social policy as a key tool in fostering public trust and enhancing the efficiency of governance.

Not adopting the correct approach when formulating and developing social policies may lead to the public losing trust in the government. Ahdan *et al.* (2019), noted that community empowerment programs have the potential to enhance the economy of coastal communities. Community resilience and strength can be enhanced by promoting the growth of social entrepreneurship and cooperative businesses such as joint venture groups or rural cooperatives with innovative financial models, combined with the improvement of diverse capacities and skills within rural communities.

Programs to empower coastal communities in Pangkalan Baru, Namang, Kelapa, and Toboali Districts can follow the blue degrowth model by focusing on agricultural entrepreneurship, marine cultivation, and coastal tourism. Lindsay and colleagues. In 2020, the degrowth approach promotes the development of coastal villages focused on lowering community poverty levels and protecting precious land and sea resources through activities like agriculture, livestock, industry, transportation, and energy. Ocean-based economic activities like marine cultivation and coastal tourism.

3.2. Discussion

Tin mining activities on Bangka Island are dominated by unconventional mining. The impact of coastal mining is the destruction of the coastal ecosystem. This situation is very worrying, because it can cause an ecological disaster, such as the destruction of economically important organisms such as mangrove crabs, shrimps, oysters and other animals, erosion, or seawater erosion, wave and wind erosion and sedimentation.

Economic shocks caused by coastal damage have encouraged traditional fishermen on Bangka Island to make resilience efforts. Adamson and Bromiley (2013), noted that community empowerment programs based on local wisdom have the potential to enhance the economy of coastal communities. Programs to empower coastal communities are the blue degrowth model by focusing on agricultural entrepreneurship, marine cultivation, and coastal tourism. The degrowth approach promotes the development of coastal villages focused on lowering community poverty levels and protecting precious land and sea resources.

4. Conclusion

In wrapping up the study, it was found that traditional fishermen have a proactive resilience strategy. Certain personal traits of resilient traditional fishermen include insight, independence, strong relationships, initiative, creativity, humor, and a moral compass. Family plays a significant role in supporting the resilience of these fishermen. As for policy recommendations to enhance their resilience, a social approach is suggested, emphasizing empowerment programs with a degrowth perspective. This involves encouraging ventures like agricultural-based entrepreneurship, marine cultivation, and coastal tourism.

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