

# Fishermen community's surviving strategy in facing climate change challenge in Kebonagung District Pacitan Regency Indonesia

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**Abstract.** Coastal people live dependently on nature. The change of nature condition has an impact on fishing activity. Damaged sea ecosystem affects the sea biota life and endangers fishermen's livelihood. Uncertain income leads to the less fulfilled economic need. Considering this problems, this research aims to formulate a strategy used by fishermen to face climate change challenge. The research taken place in Kembang and Gawang Villages, Pacitan Regency used qualitative method with case study approach. Data were collected through interview, observation, and documentation. SWOT analysis was used to formulate strategy by identifying strengths, weaknesses, opportunities, and threats. The research found that fishermen's persistence and experience with fishing should be optimized through training and facilitation strategies to face the condition of climate change. The organizing strategy through fishermen group can facilitate the activity of extension concerning technology application and improvement of social relation with other stakeholders. This study recommends the importance of cooperation between stakeholders to support the sustainability of fishermen's fisheries businesses in facing the challenges of climate change by optimizing existing potential.

## 1 Introduction

*Archipelago* or archipelagic state has been a predicate assumed by Indonesia and recognized by the world since the struggle through Declaration of Juanda (Indonesian: *Deklarasi Juanda*) [1]. Regarding this, Indonesia is entitled to exploit natural resources, either biological or non-biological. Indonesia's biological sea resources have potency in fisheries and maritime sector. Indonesia is on the second rank as the largest fish producer following China [2]. This condition results in the potency that can be used by coastal people as the source of income through working as fishermen. One of coastal areas with fisheries potency in Indonesia is Pacitan Regency. The coastal area in Pacitan Regency extends along 70.70 km and its sea area is 523.82 km<sup>2</sup> wide. One of the sub-districts in Pacitan Regency, namely Kebonagung District, which is a coastal sub-district directly borders the Indian Ocean and

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some of its people work as fishermen. The area produces marine products with export value, namely lobster commodities.

Coastal people rely on fisherman profession for their life and therefore, they should be faced with uncertain risky condition because they should face unpredictable weather [3]. Fishermen often face some situation compelling them not to go to the sea (fishing) because of the increase in sea water level with high wave intensity and frequency being one of challenges to the fishermen [4]. Climate change affects the fluctuating condition of sea during high and low tides precluding the fishermen from fishing. This unpredictable season encourages the fishermen to adapt to the use of fishing gear [5]. Climate change results in the decrease in predator species, changes sea current, increases temperature, and decreases salinity and thereby exerts negative significant impact on fisheries and raises concern among fishermen [6]. Climate change has a significant impact on the fishermen, with unpredictable weather pattern and decreased income during rainy season having an impact on coastal community [7].

In addition to facing the changing environmental condition today, fishermen should also face fluctuating selling price of fisheries commodities in the market. The fluctuating price is due to market play by brokers or companies buying the fishermen's fish catch. The fishermen's limited access to market is affected by the existence of brokers requiring them to sell their commodities in certain small-scale markets. Besides facing high risk in catching the fish during unpredictable wave condition, the fishermen are also faced with income disproportionate to the challenge they should encounter during fishing [8].

Technology development encourages the fishermen to forecast the condition of weather on the sea. Ironically, fishermen still have limited ability to keep up-to-date particularly concerning technology use. Limited access to digital technology inhibits them from utilizing this technology as a means of helping do fishing activity on the sea and their safety tool all at once [9]. On the other hand, the government has socialized and provided training intensively to fishermen in technology use as an aid in forecasting weather for the activities of sailing and marketing the fish catches. Limited economy due to market uncertainty makes the fishermen incapable of adopting technology and applying training provided by the government. Technology adoption is rarely carried out by the fishermen in coastal areas due to their socio-demographic condition such as education level, age, territory, environmental effect, experience with being fishermen, and access to credit [10]. Although the fishermen should face full-of-challenge condition in fulfilling their economic needs, many potencies and opportunities still can be identified to be optimized. The coastal people's life is inseparable from varying characteristics and local wisdoms they have. This local wisdom having been bequeathed hereditarily can be used as an effort to conserve nature and culture. The ability of identifying natural phenomena and taking them into account through local knowledge can help the fishermen prepare for doing fishing activities on the sea. A variety of governmental intervention is also required to improve the welfare of fishermen in coastal area in Pacitan Regency. Support from stakeholders is very important to the sustainability of fishermen's business in fisheries sector. Therefore, a strategy needs to be formulated for the fishermen to face climate change in Pacitan Regency. The fishermen's strategy to face climate change can be identified through identifying such aspects as strengths, weaknesses, opportunities, and threats the fishermen face. This strategy formulation is called SWOT analysis that can underlie the development of policy and allow for decision making [11].

## **2 Method**

This research used a descriptive qualitative method representing holistically the social phenomena occurring in the community. The qualitative research derives from constructivist epistemology understanding the meaning of event involving communication and interaction

between author and research object to create some meaning [12]. Case study approach is used in this research to reveal the phenomenon of climate change having an impact on the fishermen community’s life sustainability. The research was carried out in Kembang Village of Pacitan Sub district and Gawang Village of Kebonagung Sub District, Pacitan Regency, East Java Province, Indonesia. The characteristics of research location are: area close to coast and its people living as fishermen to earn living. Data collected in this research consisted of primary and secondary data. The methods of collecting data used were in-depth interview with several informants, observation, and documentation to support the research data. Several supporting documents, including village profile, previous studies, and several references relevant to the topic of research, were used by the author to confirm the data obtained in the field. The informants of research totaled 16 people consisted of fishermen, fisheries extensionist, village government officer, and local community leader. Data analysis was carried out using Miles and Huberman’s model of analysis through data display, data reduction and conclusion drawing [13]. The author used SWOT analysis to formulate an appropriate strategy to be used by fishermen community in the effort to face climate change. SWOT analysis is a method useful to determine external (opportunities and threats) and internal variables (strengths and weaknesses) then formulating action plan by utilizing opportunities, strengthening the advantages existing and minimizing threats and weaknesses [14]. The matrix of SWOT analysis used to formulate strategy in this research is shown in Figure 1.

		Internal	
		Strengths	Weaknesses
External	Opportunities	Optimizing strength to create opportunities	Minimizing the weaknesses to optimize the opportunities
	Threats	Optimizing the strengths to deal with threats	Minimizing weaknesses to avoid threats

**Figure 1.** Matrix of SWOT analysis

### 3 Result and Discussion

Fishermen community in Pacitan Regency, exactly in Kembang and Gawang Villages are dependent on marine resource to support their families. The job in fisheries sector is highly dependent on natural condition so that the climate change has an impact on the fishermen. The change of climate, including temperature and wind frequency, affects marine productivity in turn disturbing fishing activity. Several studies explained that some cases result from the climate change: raising sea level leading to large waves, raising sea water temperature generating algae blooming, and coral reef whitening leading to the decreased fish population [15]. This condition makes the fishermen fulfill their families’ basic needs (food, health, children’s tuition, and utility cost) difficultly [16].

The fishermen in Kembang and Gawang Villages, Pacitan, also encounter such condition as the climate change leads to large waves and strong wind and thus, they give their intention to go fishing. Unpredictable condition also gives rise to worry among the fishermen in doing fishing activity. A previous study mentions that Indonesia is very vulnerable to the impact of climate change, particularly the raising sea level having an impact on coastal area, according to International Panel on Climate Change (IPCC), the sea level raises by 2.5 mm per year on average [17]. Climate variability has adverse impact on local economy of fishermen, affecting their main income and food resilience. Fishermen are in trouble due to inconsistent

fishing catch and fluctuating price [18]. Considering the condition, an appropriate strategy is needed for the fishermen to survive in facing the impact of climate change. The strategy formulation can be carried out by analyzing internal factor including strengths and weaknesses and external factor including opportunities and threats faced by fishermen in Kembang and Gawang Villages. The identification of several aspects is explained further in the following subsection.

### **3.1 Strengths the fishermen have in Kembang and Gawang Villages**

Living side by side with the sea coast makes the fishermen communities in Kembang and Gawang Villages have high spirit of struggle, persistence, courage, and hard work character. This is because they do fishing activity daily and face various risks encouraging them to have strong work ethos to support their family [19]. Using their most of life to fish on the sea spurs the fishermen to have surviving skill such as the skills of reading surrounding condition with accurate estimation. This indicates the presence of experience bequeathed hereditarily from their predecessors and this skill is very important to their safety during fishing. The fishermen in Kembang and Gawang Villages are also supported by the government and important to their fishing activity performance.

### **3.2 The weaknesses of fishermen in Kembang and Gawang Villages**

Most of old fishermen in Kembang and Gawang Villages find difficulty in operating technology innovation introduced by fisheries extensionist. Age factor inhibits the fishermen to develop their ability, particularly in applying new technology because of low knowledge and skill level [20]. The quite expensive cost of purchasing and maintaining equipment also is an obstacle to the small fishermen whose income is only enough to meet their daily need. Social relation has not been established between fishermen in Kembang and Gawang Villages with non-government organization and leads to limited capitalization for the fishermen.

### **3.3 Opportunities the fishermen have in Kembang and Gawang Villages**

Fisheries sector has a promising opportunity in the presence of people's high demand and consumption for fisheries commodities. The fishermen in Kembang and Gawang Villages still maintain local cultures in their activities to catch the fish. Local wisdom is still maintained by them amid time development. This becomes a potency needing to be developed by the fishermen to integrate local wisdom with technology innovation existing.

### **3.4 Threats the fishermen face in Kembang and Gawang Villages**

The impact of climate change is also perceived by the fishermen in Kembang and Gawang Villages. Bad weather and large waves affect the fishermen in doing fishing activities. The change of sea condition and the damaged marine ecosystem affect the fishermen catches. A study found that environment-related and climate change problem has a significant effect on life and fish productivity as it damages the food source of marine biota and thereby reduces the primary production of marine resources [21]. Fish population on the sea will decrease due to the disturbed marine food chain because of the climate change phenomenon including raising sea level, changing rainfall pattern, changing temperature and ocean acidification [22]. Another factor is the changing selling price in the market disproportionate to the fishermen's fishing endeavor. The change of governmental policy can affect the fishermen's fishing operation and activity.

Considering the elaboration about internal and external factors in the fishermen’s fishing activity, a strategy is formulated using SWOT analysis matrix as explained in Figure 2.

		Internal	
		Strength (S)	Weaknesses (W)
External	<b>Opportunities (O)</b> - Demand for fish is still high - The application of local wisdom is still maintained	<b>S-O Strategy</b> - Improving the fishermen’s ability of developing fisheries business - More intensive material and non-material supports - Integration of technology development into local wisdom	<b>W-O Strategy</b> - Training and facilitation of technology use - Capitalization and facility aid - Government helps connect the fishermen to NGO and corporation
	<b>Threats (T)</b> - Climate Change - Large wave, strong wind - Damaged marine ecosystem - Market price change - Policy change	<b>S-T Strategy</b> - Improving the fishermen’s ability of adapting to climate change - Improving discussion forum between fishermen and government in formulating policy - Working in other sector during bad weather	<b>W-T Strategy</b> - Organizing through fishermen group - Improving the fishermen’s awareness of taking care of marine resources

**Figure 2.** Matrix of SWOT Analysis on fishermen in Pacitan Regency

### 3.5 S-O Strategy

This strategy is formulated through an activity of optimizing the strength the fishermen have to create more opportunities. The strong characteristic of fishermen and the experience they have in identifying natural symptoms are optimized through improving their competency. Local wisdom the fishermen communities still hold tightly in Kembang and Gawang Villages is, among others, setting the time to go to the sea using Javanese calculation. This skill is then integrated into the technology application and therefore supports the development of fisheries business. The support given by the government to see the potency of fishermen can be intensified. The government can provide training to fishermen so that they become more skilled in increasing the quantity and quality of fish [23].

### 3.6 W-O Strategy

This strategy is formulated through an action of minimizing the weakness to optimize the opportunities. The fishermen still encounter the limited competency to adopt technology and

to access capitalization and facilities. An appropriate strategy taken is to provide training and facilitation in using fishing point, GPS, engine, and etc. The government, through fisheries extensionist, helps connect the fishermen to non-government institution to support the development of fishermen's fisheries business. Policies and interventions for business development through increasing market access can significantly increase income [24].

### **3.7 S-T Strategy**

This strategy is formulated by optimizing the strengths to face the threats existing. The threats faced by the fishermen involve climate, market price, and policy affecting the fishermen's fisheries business activity. Persistence and experience the fishermen have had are used to face the threats through improving the fishermen's adapting ability in facing climate change. A previous study found that the adverse effect of climate change on the fishermen's livelihood can be dealt with through adaptive capacity building [25]. The fishermen's participation in policy formulation is also improved so that they do not feel harmed by new regulation. Coastal people can try to work in other sector when the weather does not allow them to go to sea; thus, governmental institution is required to equip them with some skills.

### **3.8 W-T Strategy**

This strategy is formulated by minimizing the weaknesses to face the threats. The obstacles including limited capitalization and facilities in facing the threats of climate change can be dealt with through organizing them in group. The presence of group facilitates them to get material and non-material supports from government and non-government. This presence of fishermen group can facilitate the extension activity related to the application of technology to adapt the climate change, the improvement their awareness of maintaining the survival of marine resource for the sustainability in the future. It is in line with the research finding that fishery group can improve production and selling system and the use of fisheries resource sustainably through some strategies including sale promotion, and crisis and financial management [26].

## **4 Conclusion**

Coastal people relying on the sea for their life face many challenges resulting in inadequate income to meet their life needs. Natural factor plays an important role in the sustainability of fishermen's business. If the nature has shown damage with the signs of change occurring, it will exert an impact on the fishing activity. Climate change and damaged marine resource impacts the fishermen with the reduced fish catches. This condition makes the fishermen face economic problem; thus an appropriate strategy is required through analyzing it using internal and external factor. Considering the result of SWOT analysis, some strategies are obtained, involving improving the competency of fishermen in adapting to climate change, improving technology and facilities, establishing cooperation relation with non-government organization, developing working skill in other non-fisheries sector, organizing and strengthening the institution of fishermen group.

## **References**

1. T. Sunaryo, Indonesia sebagai negara kepulauan indonesia sebagai negara kepulauan. *J. Kaji. Strat. Ketahanan Nas.* **2**, 103–111 (2019). <https://doi.org/10.7454/jkskn.v2i2.10022>

2. Badan Pusat Statistik, Statistik sumber daya laut dan pesisir, (Badan Pusat Statistik, Jakarta, 2023)
3. Z. Anna, A. A. Yusuf, A. S. Alisjahbana, A. A. Ghina, Rahma, Are fishermen happier? evidence from a large-scale subjective well-being survey in a lower-middle-income country. *Mar. Policy.* **106**, 1–10 (2019). <https://doi.org/10.1016/j.marpol.2019.103559>
4. K. N’Souvi, A. Adjakpenou, C. Sun, C. L. Ayisi, Climate change perceptions, impacts on the catches, and adaptation practices of the small-scale fishermen in Togo’s coastal area. *Environ. Dev.* **49**, 1–15 (2024). <https://doi.org/10.1016/j.envdev.2023.100957>
5. A. S. Hidayat, E. Agusliani, Fishermen’s perceptions of global climate change and adaptation to changing conditions of flood plain wetlands in South Kalimantan, Indonesia. *Environ. Ecol. Res.* **12**, 66–77 (2024). <https://doi.org/10.13189/eer.2024.120107>
6. E. Mason, A. H. Beaudreau, S. N. Arnold, S. Belknap, E. D. Scalisi, Adaptive capacity of the marine lobster fishery: insights from the marine fishermen’s climate roundtables. *Facets.* **9**, 1–13 (2024). <https://doi.org/10.1139/facets-2023-0193>
7. M. Chambon et al., Weaving scientific and local knowledge on climate change impacts in coastal Kenya, western Indian ocean. *Environ. Sci. Policy.* **160**, 1–13 (2024). <https://doi.org/10.1016/j.envsci.2024.103846>
8. M. S. Alam, A. Yousuf, Fishermen’s community livelihood and socio-economic constraints in coastal areas: an exploratory analysis. *Environ. Challenges.* **14**, 1–12 (2024). <https://doi.org/10.1016/j.envc.2023.100810>
9. S. Anand, M. Enayati, D. Raj, A. Montresor, M. Vinodini, Technology in society internet over the ocean : a smart IoT-enabled digital ecosystem for empowering coastal fisher communities. *Technol. Soc.* **79**, 1–21 (2024). <https://doi.org/10.1016/j.techsoc.2024.102686>
10. R. D. Putri, M. S. Rahman, A. A. Abdillah, W. C. Huang, Improving small-scale fishermen’s subjective well-being in Indonesia: does the internet use play a role? *Heliyon.* **10**, 1–11 (2024). <https://doi.org/10.1016/j.heliyon.2024.e29076>
11. B. Dey et al., Heliyon Strategic insights for sustainable growth of mushroom farming industry in Bangladesh : a comprehensive evaluation using SWOT-AHP and TOPSIS frameworks. *Heliyon.* **10**, 1–13 (2024). <https://doi.org/10.1016/j.heliyon.2024.e36956>
12. C. Jando, F. Dionne, A call for qualitative research in contextual behavioral science. *J. Context. Behav. Sci.* **32**, 1–18 (2024). <https://doi.org/10.1016/j.jcbs.2024.100751>
13. M. B. Miles and M. Huberman, Analisis data kualitatif, (Penerbit Universitas Indonesia, Jakarta, 1992)
14. M. Stylianou, P. Shiakallis, I. Papamichael, I. Voukkali, A. A. Zorpas, Analyzing the SWOT of circular economy development in established industrial zones: a case study from Cyprus. *Sustain. Chem. Pharm.* **39**, 1–16 (2024). <https://doi.org/10.1016/j.scp.2024.101513>
15. H. A. M. Shaffril, A. Abu Samah, J. L. D’Silva, Adapting towards climate change impacts: strategies for small-scale fishermen in Malaysia. *Mar. Policy.* **81**, 196–201 (2017). <https://doi.org/doi:10.1016/j.marpol.2017.03.032>
16. M. Kwadzo, M. K. Miyittah, D. B. K. Dovie, R. K. Kosivi, R. Owusu, Pollution and climate change impacts on livelihood outcomes of lagoon fishermen in Central Region, Ghana. *Curr. Res. Environ. Sustain.* **4**, 1–7 (2022). <https://doi.org/10.1016/j.crsust.2022.100137>
17. R. T. Vinata, M. T. Kumala, C. Yustisia Serfiyani, Climate change and reconstruction of Indonesia’s geographic basepoints: reconfiguration of baselines and Indonesian archipelagic sea lanes. *Mar. Policy.* **148**, 105443 (2023). <https://doi.org/10.1016/j.marpol.2022.105443>
18. L. Kapapa, P. Onyango, P. Bwanthondi, P. Mfilinge, The vulnerability of fisheries-

- based livelihoods to climate variability and change in coastal small pelagic fishing communities in Tanzania. *Mar. Policy.* **169**, 1–15 (2024). <https://doi.org/10.1016/j.marpol.2024.106344>
19. N. A. Saleh, Profil dan etos kerja nelayan sejahtera di pesisir kampung Kailikabupaten Bantaeng. Pangadereng J. Has. Penelit. Ilmu Sos. dan Hum. **4**, 199–214 (2019). <https://doi.org/10.36869/pjhpish.v4i1.84>
  20. A. A. Samah, H. A. M. Shaffril, M. F. Fadzil, Comparing adaptation ability towards climate change impacts between the youth and the older fishermen. *Sci. Total Environ.* **681**, 524–532 (2019). <https://doi.org/10.1016/j.scitotenv.2019.05.089>
  21. N. Ahmed, S. Thompson, M. Glaser, Global aquaculture productivity, environmental sustainability, and climate change adaptability. *Environ. Manage.* **63**, 159–172 (2019). <https://doi.org/10.1007/s00267-018-1117-3>
  22. T. Zhang, H. Liu, Y. Lu, Q. Wang, Y. C. Loh, Z. Li, Impact of climate change on coastal ecosystem: A comparative analysis among four largest coastline covering countries. *Environ. Res.* **250**, 1–18 (2024). <https://doi.org/10.1016/j.envres.2024.118405>
  23. D.W. Sari, H.A.T. Islamiya, W. Sylviana, M. Fawait, B.S. Amelia, I. Hidayanti, N.S. Alias. The behavior of fishermen in handling post-harvest fish and its quality in East Java province. *Aquac. Fish.* 1–18 (2024). <https://doi.org/10.1016/j.aaf.2024.08.003>
  24. W. Ma, D.B. Rahut, T. Sonobe, B. Gong. Linking farmers to markets: Barriers, solutions, and policy options. *Econ. Anal. Policy.* **82**, 1102–1112 (2024). <https://doi.org/10.1016/j.eap.2024.05.005>
  25. K. M. Green et al., How adaptive capacity shapes the adapt, react, cope response to climate impacts: insights from small-scale fisheries. *Clim. Change.* **164**, 1–22 (2021). <https://doi.org/10.1007/s10584-021-02965-w>
  26. Y. H. Lu, T. Sajiki, N. Yagi, Factors affecting fisherman satisfaction with fishermen’s self-governance organizations: a case study of the Taiwan Donggang Sakuraebi (*Sergia lucens*) production and management group. *Mar. Policy.* **115**, 1–10 (2020). <https://doi.org/10.1016/j.marpol.2020.103819>