

Climate Change Impacts to Coastal Communities in Kudat, Sabah, Malaysia

Nurrul Fazlina Osman¹, Ejria Saleh^{2*}, Nurulain Ismail³, Justin Sentian⁴,
Madiah Jafar Sidek⁵

¹Borneo Marine Research Institute, Universiti Malaysia Sabah, Jalan UMS, 88400, Sabah, Malaysia.

Email: nfazlina12@gmail.com

²Borneo Marine Research Institute, Universiti Malaysia Sabah, Jalan UMS, 88400, Sabah, Malaysia;
Natural Disasters Research Centre, Faculty of Science and Natural Resources, Universiti Malaysia Sabah,
Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia.

Email: ejsaleh@ums.edu.my

³Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu,
Sabah, Malaysia.

Email: nurulainismail98@gmail.com

⁴Natural Disasters Research Centre, Faculty of Science and Natural Resources, Universiti Malaysia Sabah,
Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia;

Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu,
Sabah, Malaysia.

Email: jsentian@ums.edu.my

⁵Borneo Marine Research Institute, Universiti Malaysia Sabah, Jalan UMS, 88400, Sabah, Malaysia.

Email: madiah@ums.edu.my

ABSTRACT

CORRESPONDING AUTHOR (*):

Ejria Saleh
(ejsaleh@ums.edu.my)

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Climate change is the among major threats to marine ecosystems, representing both a challenge and an opportunity for researchers and the government. Impacts are not experienced uniformly, and the existing unbalanced ecosystems will be further exacerbated without urgent action to mitigate climate change and enhance community resilience. The objective of this study is to draw insights on the impact of climate change based on the coastal community input and environment change at Kimihang, Kelambu Beach and Bavang Jamal, Kudat, Sabah. Interviews and fieldwork were carried out in March and August 2020. The unstructured questionnaire was applied to 15 respondents to know in-depth experiences on the impacts of climate change. The data were presented as timeline narration before and after the year 2000. Results show that the respondents addressed climate change through the reduction of natural resources yields, and change of surrounding environment, career paths of the young generation, and the existence of structural management. The coastal communities were found to have lacked the know-how and awareness to manage and maximized the use of their coastal resources sustainably. This is to suggest that constructing the best adaptation strategies requires attention in this region.

Contribution/Originality: This is the first record of historical timeline documents before and after the year 2000 occurred on the west coast of Kudat (Bavang Jamal, Kelambu Beach, and Kimihang) to understand the impacts of climate change on the surrounding environment and the community livelihood.

1. Introduction

Climate change is a global phenomenon and has become a global environmental issue that dominates the international agenda. Climate change is known to be the most challenging issue to tackle as it has become particularly evident in the past three decades. While climate-related greenhouse gases have changed the balance of seasonal variation of temperature in most parts of the world. Several of the major observed changes include the global average air and ocean temperatures, decreases in snow and ice extents, declining mountain glaciers and snow cover, and increases in sea level. Observation data points to the fact that climate change has caused more frequency and intensity of extreme weather events, such as increased intensity of tropical cyclones, more hot days/nights, and increase heavy precipitation (Nakicenovic et al., 2000; Rayanakorn, 2011). The extreme weather events in Malaysia are characterized by days of high temperature, high rainfall, dry spell, thunderstorm and strong winds. According to Ho (2018), in the 21st century, there were records of the increasing occurrence of extreme weather events.

Climate change can be depicted in many ways in the coastal areas of Sabah. Sea level rise is one of the most severe impacts of climate change. National Hydraulic Research Institute of Malaysia (2010), reported that the rate of sea level rise in Kudat coastal areas is estimated at 5.27 mm/yr and it is projected to be between 0.43 and 1.06 m in the year 2100. Even though the process of sea level rise is slow, but the increase in occurrences of extremely high-water level due to storm surges can be apparent (Bindoff et al., 2007). Climate change also contributes to marine resources degradation. The impacts of climate change can be felt by the coastal communities who are highly dependent on fisheries resources. Climate change makes the dynamics in fisheries more difficult to predict (Yanfika et al., 2021). The objective of this study is to draw on insights on the impact of climate change based on the coastal community experience and environmental change in several coastal communities in Kudat. The findings of this study contribute to the climate change adaptation and mitigation measures to the area. This information is also required by the local government in the development plan and management of the area.

2. Methodology

The target respondents of this study were the head of the villages and local communities in Kimihang, Kelambu Beach and Bavang Jamal, Kudat, Sabah. The respondents from diverse lives: conservationists, governmental retirees, fishers and farmers. The demographic of the respondents are summarised in Table 1.

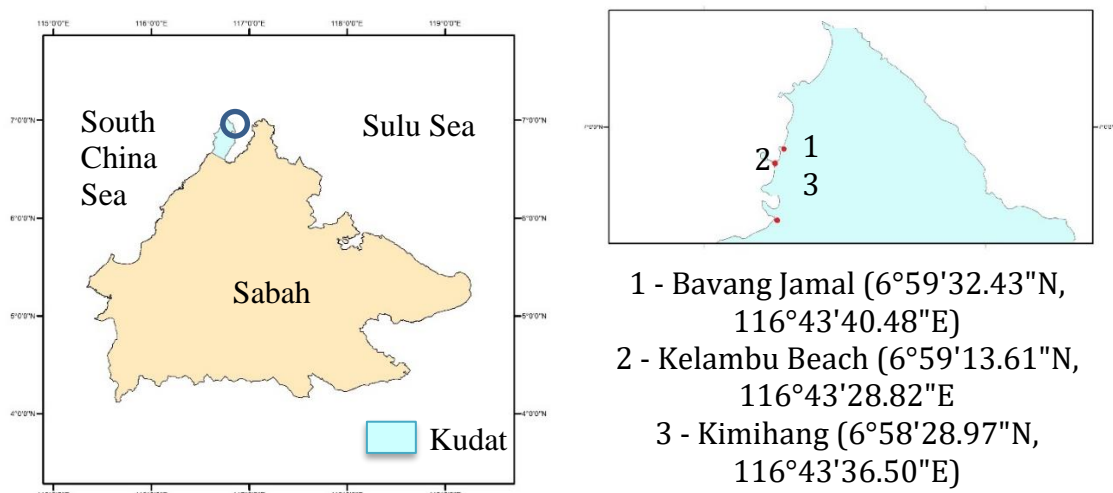
Table 1 summarises the distribution of the respondents. The respondent's age are mostly between the range of 36-45 and 46-55 that equally distributed at 33.3%. Majority (60%) of the respondents earned in the range of RM 501-1000 per month, while 20% in the range of 1001-2000, another 20% in the range of RM500 and below. This indicate that most respondents have low-income and falls under the poverty line. Meanwhile, 60% of the respondents from Kelambu Beach, 20% from Kimihang and another 20% from Bavang Jamal. To maintain privacy, the names of the respondents were assigned by number.

Table 1: Demographic Analysis of the research respondents

Demographic Characteristics	Count n=15	Percentage (%)
Age		
25-35	4	26.7
36-45	5	33.3
46-55	5	33.3
56-65	1	6.7
Income (RM)		
500 and below	3	20.0
501-1000	9	60.0
1001-2000	3	20.0
Location (Village)		
Kimihang	3	20.0
Kelambu Beach	9	60.0
Bavang Jamal	3	20.0

They were selected through a non-probability sampling technique (purposive sampling) (Osman et al., 2021). The interviews and fieldwork were conducted on the west coast of Kudat (Figure 1), Sabah in March and August 2020. The unstructured questionnaire was applied to know the in-depth of the communities' experience and this helped illustrate the history of climate change in their area as the process of interpreting the risks of climate change was linked by participants to have felt physically or emotionally impact in their memory. The scopes of the questions were covering their activities, livelihood and the challenges of climate change. The data from the interviews were presented as a timeline narrative before and after the year 2000 (environmental changes) to reflect government initiatives and policies in developing the tip of Borneo, Kudat, Sabah (Teh & Cabanban, 2007). The timeline narrative started back in the 1970s. The surrounding environment was also observed and noted during the site's visit and compared with the information from the questionnaires. The narratives approach was employed in framing climate change and it can communicate scientific studies to the public (Boykoff, 2007; Bremer et al, 2017; Wardekker et al., 2009).

Figure 1: Location and coordinates of Kimihang, Kelambu Beach and Bavang Jamal in Kudat, Sabah



3. Results and discussion

The year 2000 was set as a baseline as there are changes in the early 21st century that marked major coastal development. In Sabah, the Halatuju Pembangunan dan Kemajuan (State Development Agenda) was launched as the tourism industry becomes one of the fastest-growing sectors in the state economy. The 'Tip of Borneo' was launched as the product of tourism promotion to support the growing international tourism development in Sabah (Teh & Cabanban, 2007). As result, the Simpang Mengayau was established in the year 2004 while the Kudat Turtle Conservation Society (KTCS) and turtle hatchling hatchery at Bavang Jamal were started in 2008. In 2011, KTCS has constantly recorded the turtles landing (based on the records, a large amount of turtles landing was between (2011-2013)) around the tip of Borneo. Since 2014, the number of coastal developments at Bavang Jamal (resorts and homestays) continues to increases in number. According to the respondents, even though the eco-tourism initiative has improved the livelihood of the coastal communities, but this may affect the natural environment in Bavang Jamal, as claimed from the respondent "... I think there is too much development (resort and homestay), it disturbed the turtles landing and also caused the coastal erosion in our areas..." (Respondent 15). After the Year 2000, the career paths of the young generation in the communities (below 30 years old) are shifting to eco-tourism related activities or working in the major towns in Sabah or west Malaysia for better job opportunities.

3.1. Experience Before the Year 2000

3.1.1. Impacts of climate change

The respondents tend to draw personal experience to make sense of the possible event that happens in their lives. The most memorable environmental changes occurred in the 1970s. The occurrence of the algal bloom (red tide) (~1974) contributes to the vast number of fish that died was observed between Bavang Jamal to Simpang Mengayau (Tip of Borneo). Bigger grouper fish (~ 1.5 m) and 9 m long stingray fish were stranded on the beach. They recalled, "the fishes were big in size and it was hard for one person to bring them to the shoreline..." (Respondent 1). After this event, the coral fish was disappeared up to 1977. The fish caught were drastically decreased and small in size after the red tide incident. In 1995, the spring water as the source of freshwater in Kimihang was dried without any explanation, excerpt from respondent 3 "long time ago (before 1995) we have spring water coming from here, but now it is gone...".

3.1.2. Human activities

There were also human activities as the respondent shared their experience on oil spill incident in the 1970s, excerpt from respondent 2 "...we have variety sea snails here, but because of the oil spill it is all gone..." the beaches from Simpang Mengayau to Tanjung Lara was contaminated with oil. The loss of marine resources was continued for the next 3 years. In the 1980s, Bavang Jamal beach was identified as a turtle nesting area. The villagers reported the incident of a leatherback turtle (*Dermochelys coriacea*) was stranded in Bavang Jamal with UPM Tag. This historical evidence has inspired the community to build conservation areas in Bavang Jamal with the support of a non-profit organization. The beautiful sandy beaches with various huge trees such as *Casuarina* sp and coconuts fringing the coastline contribute to one of Sabah's popular tourist attractions. However, due to beach erosion, the old big *Casuarina* trees were unrooted, and the houses were exposed to strong wind from the sea. The communities living at the

seaside must relocate their properties further inland. In 1996, a large number of sea cucumbers in Kimihang and Kelambu were taken by the immigrant. To date, these species are hardly found in the coastal areas. Before the Year 2000, most of the coastal communities were small-scale farmers and fishers. The livelihood of these communities is dependent on marine resources and small-scale agriculture. The small-scale farmers and fishers juggle depending on the season and the impact of climate change will affect their productivity and profitability levels (Osman et al., 2021).

3.2. Experience After the Year 2000

3.2.1. Impact of climate change

Major environmental changes of the villages were started after the year 2000. There was a change in the paddy planting season. In the past, planting season was started in September-October. Now the planting season is sometimes shifted to December due to the delay of the rainy season. Extreme wind and wave during the monsoon season cause erosion and sedimentation, especially during the northeast monsoon. According to the Rungus community in the study area, the term “ungkal gamut/ mararad” was used to describe the large change in seawater level. It is expected to occur every 10 years where extreme water level that causes severe erosion or flooding in the coastal area. In December 2017, Sabah was strike by a typhoon caused by strong waves that contribute to the great change of beach morphology in the study areas. Many coastal trees were unrooted. Most of the trees observed during the site’s visit are new generations and are dominated by *Casuarina* trees. The turtle hatchery in Bavang Jamal was also damaged, excerpt from the respondent “this (hatchery) has drifted from its original position, now we have to relocate it...” (Respondent 15). Since March 2019, thick green algae were covered the intertidal area of Kelambu beach. During high tide, the green algae were stranded on the beach up to 2-3 inches thick and produced a strong smell for days. This phenomenon can be very concerning to the aquatic lives and seagrass beds in that area.

3.2.2. Human activities

The respondents reported that the current fisheries yield is decreased compared to the abundance of fish species was caught a decade ago. As claimed by the respondent, “...yes, it is easier to get fish sometime in the past (15 years ago), now (2020) it depends...” (Respondent 10). The respondents claimed that large size of lobsters was easily found in the reef’s areas of Kimihang in 2005. However, it is now nearly impossible to find a lobster in that same spot. The anchovy was still abundant during its season. The anchovy can be found around 10 feet square for 3 to 4 clusters at Kelambu coastal area, excerpt from the respondent 12 “...you can still see the clusters of the anchovy from here (shoreline), but now you have to go farther offshore and hard to detect ...”. The respondent was mentioned that the oil and gas exploration activities (~2012) offshore of Kudat could cause fish death in their area. Sometimes the commercial fishing boat (trawler boat) is trawling closer to the shore, excerpt from the respondent “...we can see the big boat (trawler boat) pulling their net very near to the beach and affecting the areas of coral reef ...” (Respondent 4).

Management of structures is essential to be implemented before more coastal development along the shoreline of Kudat. Since the study sites are under the governance of Sabah Parks and Kudat District, the park regulation and government policies need to be strengthened as part of mitigation measures of the area. During the site’s observation, coastal erosion is an issue in Kimihang and Bavang Jamal beaches. The erosion could be

due to the increasing coastal development or related to seasonal monsoon change. A certain part of the beach is a deposition area and disturbed the water circulation at Bawang Jamal River. As result, the unpleasant smell of stagnant waters caused mangrove trees to wither. The estuary of Bavang Jamal River was reconstructed to improve the water pathway as part of the community's adaptation measures. However, further scientific study on the shoreline changes is needed for long-term adaptation and mitigation measures on climate change impacts to the areas.

4. Conclusion

Coastal communities experience impacts of extreme events during the northeast monsoon which causes beach erosion and then sedimentation at the river mouth. There was a major change in terms of marine resources before and after the year of 2000 due to climate change and human activities such as unsustainable fishing and harvesting of marine resources. In the early 21st century, there was an increase in coastal development to support tourism sectors, but this study also finds that there was a decreased in fishing yields. The findings of this study provide baseline data for the management of Tun Mustapha Park marine protected area. The local communities and local government should commit to strengthen cooperation and pursuing policy coherence to manage the marine resources and coastal development. Alternative livelihoods such as eco-tourism would help change the career paths of the young generation. The current condition of natural resources should be maintained by minimizing structures development in the coastal area to reduce beach erosion. Educational and awareness programs would enhance their knowledge on managing the coastal area and maximized the use of natural resources sustainably. The findings would enhance the implementation of national policy on climate change by ensuring climate-resilient development to fulfil national aspirations for sustainability.

Ethics Approval and Consent to Participate

The researchers used the research ethics provided by the Sabah Biodiversity Centre. All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of this Centre.

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Conflict of Interests

The authors reported no conflicts of interest for this work with respect to the research, authorship, or publication of this article.

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