Impacts and Adaptation Strategies on Climate Variability and Change of Coastal Communities along Banate Bay

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Abstract. People living in the coastal communities are first and foremost vulnerable to climate change, both socio-economically and environmentally. This paper discusses the adaptation strategies used by the local people of Banate Bay in combating the impacts of climate variability and change. A questionnaire was constructed and administered to the residents of the different communities along Banate Bay. Results showed that majority of the respondents are males, aged 30-40 years, married with no education, with less than five family members with the income of less than P50,000 per annum and have stayed in the community for ten years but less than 20 years. In terms of respondents’ perceptions on climate variability and change, all categories are rated as strongly agree, which means that the respondents are knowledgeable and aware of the situation in relation to climate change and variability. On the causes of climate change variability and change the respondents were highly aware; this indicates that the respondents are knowledgeable of the causes of climate variability and change. Further, the study implies that people living in the coastal areas of Banate Bay are aware of the impacts of climate variability and change. The residents are highly aware of the adaptation strategies which will make them resilient to climate variability and change.

1. Introduction

Climate variability and change is one of the greatest socioeconomic and biophysical challenges confronting the world in the 21st century. It is brought about by the complex interactions within the climate system (atmosphere, oceans, cryosphere, surface lithosphere, and biosphere) (Le Treut, H., Somerville, R., Cubasch, U., Ding, Y., Mauritzen, C., Mokssit, A., Prather, 2007)

People living in the coastal communities are first and foremost vulnerable to climate change, both socio-economically and environmentally. Various calamities and even low fish catch are a few examples of the effects of climate change. This present study dwells on the impact and adaptation strategies on climate variability and change among the coastal people of Banate Bay.

2. Methodology

Climate variability and change is one of the greatest socioeconomic and biophysical challenges confronting the world in the 21st century. It is brought about by the complex interactive within the climate system (atmosphere, oceans, cryosphere, surface lithosphere, and biosphere) (Le Treut, H., Somerville, R., Cubasch, U., Ding, Y., Mauritzen, C., Mokssit, A., Prather, 2007)

People living in the coastal communities are first and foremost vulnerable to climate change both socio-economically and environmentally. Various calamities and even low fish catch are a few
examples of the effects of climate change. This present study dwells on the impact and adaptation strategies on climate variability and change among the coastal people of Banate Bay.

Data and information for this research work were obtained from a field study based on the result of 1000 questionnaires administered to household heads along Banate Bay in November – December 2018. According to the, there has been no agreement as to how large a sample a researcher should choose since sample size is just an indicator of representativeness. They continue by saying that many researchers have relied on what others have done before to justify the size of the sample. It is often claimed that the sample chosen should bear some proportional relationship to the size of the population from which it is drawn.

A total of 1000 questionnaires were administered among four (4) municipalities covered by the area of study. Eight (8) research assistants were trained to conduct the survey and the interview. The questionnaires were purposively administered to household heads which are 30 years and above and must have been residing in the area for at least 20 years. The basis for this was to gather information from respondents who have had experiences in climate variability and change over the years and are more concerned and conscious about the imminent impacts of these changes on their environment. In addition, a Focus Group Discussion (FGD) of people (5 representatives from each coastal barangay of the four (4) municipalities along Banate Bay) in order to obtain in-depth information on recent environmental changes, changes in agricultural and fisheries productivity, disaster preparedness and adaptation strategies of the communities.

The data gathered were subjected to certain statistical procedures for descriptive statistics utilizing the Statistical Package for Social Sciences (SPSS) Software in order to get the mean, percentage, and frequency distribution.

A mean score of less than 3.0 was considered fewer impacts, and it was excluded. While a mean score of less than 3.0 for adaptation strategies was not considered important adaptation strategies in minimizing the impacts of climate change.

3. Result and Discussion

Socio-demographic Characteristics of Respondents

The socio-demographic characteristics in the study show that majority of the respondents are males 91%, while only 9% are females. These findings are in consonance with the results of the study conducted by Abaje (2014) that the fisheries sector and the tedious activities related to climate change adaptation strategies are dominated by males. In addition, the belief that men do the actual fishing, with women more involved in post-harvest and marketing activities, remains prevalent across most cultural, social, political and economic strata. Global average figures, which support this perception, mask the real importance of women at country level. In the world’s two major fish producing countries, China and India, women represent respectively 21% and 24% of all fishers and fish farmers (FAO, 2012)

Fifty-three per cent (53%) of the respondents are aged 30-40 years old, 36% are aged 41-50 years old, 9% are aged 51-60 years old, and 2% are aged 61-70 years old. Seventy-two per cent (72%) of the respondents are married, 13% are single status, 12% are widow/widower status, and 3% are divorced. In terms of education level, most of the respondents have had no education (34%), 32% are elementary, 25% are a high school, and 9% are college level. This is in consonance with the findings that education is an influential factor affecting farmers’ climate change coping and adaptation strategies. Sixty-two per cent (62%) of the respondents have less than five family members, 32% have greater than five but less than ten members, and 6% have more than ten family members. This is consistent with the fact that the majority of the fishing families are polygamous, and this translates to higher responsibilities and lots of pressure on the finances of the family. Mostly or 83% of the respondents have an income of less than P50,000.00 per annum, 15% have an income of above P50,000.00, but less than P100,000.00, and only 1% of the respondents has an income of P100,000.00 and above per annum. This finding contradicts the findings of Huda, 2011, which states that most of the respondents have a high-income level of 50% because that is the primary occupation in the riverine
area and so can afford some basic needs of life with their fishing income. Fifty-four per cent (54%) of the respondents have stayed in the community for 10 years but less than 20 years, 33% have stayed in the community for 20 years but less than 30 years, and 13% have stayed for 30 years or more. Table 1 reflects the data. (Huda, M., Hossin, M., Ashik-E-Elahi, S. and Mahbub, 2016)

Table 2 presents the perceptions of respondents on climate variability and change. The computed mean ranges from 4.15 to 4.75. The respondent’s perception of the sea surface temperature has increased over the 20 years with a mean of 4.15, and the respondent’s perception of the drought occurrences are increasing with a mean of 4.75. All categories were rated and interpreted as strongly agree, which means that the respondents are knowledgeable and aware of the situation in relation to climate change and variability. These findings are in consonance with the study of Abaje 2010 in that the perceived causes of climate variability and change that were scientifically proven include: industrial pollution, destruction of nature, combustion of fossil fuel among others (IPCC, 2007a)

Table 3 reflects the perceptions of respondents on the causes of climate change and variability. The computed mean ranges from 2.47 to 4.85. The respondents rating on coral mining received the lowest with a mean of 2.47. In contrast, the category on temperature shifts received a mean of 4.85. This indicates that the respondents are knowledgeable of the causes of climate variability and change.

Table 1. Socio-demographic characteristics of respondents

| Characteristics                  | F    | %  |
|----------------------------------|------|----|
| Gender                           |      |    |
| Male                             | 912  | 91 |
| Female                           | 88   | 9  |
| Age                              |      |    |
| 30 -40 years old                 | 534  | 53 |
| 41- 50 years old                 | 357  | 36 |
| 51- 60 years old                 | 85   | 9  |
| 61- 70 years old                 | 24   | 2  |
| Marital Status                   |      |    |
| Single                           | 134  | 13 |
| Married                          | 720  | 72 |
| Divorced                         | 25   | 3  |
| Widow/Widower                    | 121  | 12 |
| Level of Education               |      |    |
| Elementary                       | 323  | 32 |
| High School                      | 254  | 25 |
| College                          | 87   | 9  |
| No Education                     | 336  | 34 |
| Household Size                   |      |    |
| Less than 5 members              | 624  | 62 |
| Greater than 5 but less than 10  | 321  | 32 |
| More than 10 members             | 55   | 6  |
| Income per Annum                 |      |    |
| Below P50,000.00                 | 830  | 83 |
| Above P50,000.00 but less than P100,000.00 | 152  | 15 |
| Above P100,000.00 but less than P200,000.00 | 13   | 1  |
| P500,000.00 and above            | 5    | 1  |
| Years as Residence of the Area   |      |    |
| 10 years but less than 20 years  | 537  | 54 |
| 20 years but less than 30 years  | 329  | 33 |
| 30 years and above               | 134  | 13 |
Perceptions towards Climate Variability and Change

Table 2. Perceptions towards climate variability and change.

| Category                                                                 | Mean | Interpretation     |
|--------------------------------------------------------------------------|------|--------------------|
| 1. The sea surface temperature has increased over the 20 years.           | 4.15 | Strongly Agree     |
| 2. The sea surface temperature is likely to increase in the future that could destroy coral reefs and bleaching. | 4.23 | Strongly Agree     |
| 3. The rainfall has decreased over the last 20 years.                    | 4.53 | Strongly Agree     |
| 4. The rainfall is likely to increase in the future by increasing the frequency of flash floods. | 4.25 | Strongly Agree     |
| 5. The rainfall intensity is increasing.                                 | 4.50 | Strongly Agree     |
| 6. The rainfall variability is increasing.                               | 4.36 | Strongly Agree     |
| 7. The drought occurrences are increasing.                               | 4.75 | Strongly Agree     |
| 8. The coastal flood occurrences are increasing.                         | 4.67 | Strongly Agree     |
| 9. The sea-level rise is an increase in the future.                      | 4.51 | Strongly Agree     |
| 10. The seawater intrusion due to sea-level rise will severely affect aquaculture in heavily populated areas. | 4.73 | Strongly Agree     |
| 11. A one-meter sea-level rise could inundate the communities completely. | 4.65 | Strongly Agree     |
| 12. The increase of 2°C in temperature could result from losing the island along the area. | 4.66 | Strongly Agree     |
| 13. The residence exposed to flooding by storm surges will increase in the future. | 4.73 | Strongly Agree     |
| 14. The pH of the seawater is decreased, and it will continue in the future. | 4.65 | Strongly Agree     |

Scale:
1.00 - 2.00 - Disagree
2.01 - 3.00 - Uncertain
3.01 - 4.00 - Agree
4.01 - 5.00 - Strongly Agree

Table 4 presents the impacts of climate change on coastal residents. The computed mean ranges from 4.05 to 4.95. The respondents identified the impact on the cause of mortality of mangroves as highest and increased coastal erosion as the lowest. This implies that people living in the coastal areas of Banate Bay are aware of the impacts of climate variability and change. The increase in temperature, high inter-annual rainfall variability, floods, and drought incidences have been leading to crop infestation and diseases, posited that the communities are therefore exposed to these extreme climate events and indirectly through changes in water, air, food quality and quantity, agriculture and livelihoods. These direct and indirect exposures can cause death, disability and hardship in the study area. The results of the respondents are in line with the report of the (IPCC, 2007b) that increases in climate extremes (e.g., storms, floods, temperature, droughts) associated with climate variability and change would cause deaths and injuries, population displacement, and adverse effects on food production, freshwater availability and quality, and would increase the risks of infectious disease, particularly in low-income regions.

Causes of Climate Variability and Change

Table 3. Causes of climate variability and change.

| Category                              | Mean | Interpretation     |
|---------------------------------------|------|--------------------|
| 1. Land-based sources pollution       | 4.59 | Strongly Agree     |
| 2. Community disobeying GOD           | 4.80 | Strongly Agree     |
| 3. Mangrove Deforestation/Conversion  | 4.60 | Strongly Agree     |
| 4. Combustion of fossil fuels         | 4.15 | Strongly Agree     |
| 5. Natural factors                    | 2.75 | Agree              |
| 6. Mangrove Burning                   | 2.57 | Agree              |
| 7. Use of Chemicals                   | 3.90 | Strongly Agree     |
8. Coral Mining 2.47 Agree
9. Oil Spill 3.05 Strongly Agree
10. Land-based Sources Pollution 3.21 Strongly Agree
11. Freshwater inflows to estuaries 3.56 Strongly Agree
12. Spreads on invasive species 3.00 Strongly Agree
13. Coastal reinforcements 3.75 Strongly Agree
14. Sand and Gravel Mining 3.00 Strongly Agree
15. Destructive Fishing 4.80 Strongly Agree
16. Sedimentation of coastal systems 3.60 Strongly Agree
17. Temperature shifts 4.85 Strongly Agree
18. Ocean Acidification 3.52 Strongly Agree

Scale:
- 1:00 - 2.00 - Disagree
- 2.01 - 3.00 - Uncertain
- 3.01 - 4.00 - Agree
- 4.01 - 5.00 - Strongly Agree

**Impacts of Climate Variability and Change**

| Category                                                                 | Mean   | Interpretation |
|--------------------------------------------------------------------------|--------|----------------|
| 1. Increase the sea level rise.                                          | 4.70   | Strongly Agree |
| 2. Increase coastal erosion.                                             | 4.05   | Strongly Agree |
| 3. Change sea surface temperature.                                       | 4.63   | Strongly Agree |
| 4. Increase the occurrence of typhoons and other weather disturbances.   | 4.75   | Strongly Agree |
| 5. Cause mortality of mangrove species.                                  | 4.95   | Strongly Agree |
| 6. Increase the frequency of El Nino events, and it will become intense. | 4.86   | Strongly Agree |
| 7. Increased saltwater intrusions                                         | 4.79   | Strongly Agree |
| 8. Increase incidence of malnutrition and food shortage.                 | 4.90   | Strongly Agree |

Scale:
- 1:00 - 2.00 - Disagree
- 2.01 - 3.00 - Uncertain
- 3.01 - 4.00 - Agree
- 4.01 - 5.00 - Strongly Agree

**Adaptation Strategies to Mitigate Climate Variability and Change**

| Category                                                                 | Mean   | Interpretation |
|--------------------------------------------------------------------------|--------|----------------|
| 1. Coastal wetland protection and restoration that acts as buffer against extreme weather events, storm surge, erosion, and floods; limits saltwater intrusion. | 4.10   | Strongly Agree |
| 2. Marine conservation agreements that improve the resilience of coastal ecosystems to climate change and improves the economic and social conditions of coastal communities. | 4.17   | Strongly Agree |
| 3. Marine protected areas that maintain healthy and resilient coastal habitats and fisheries productivity; acts as “refugia” and critical sources of a new larval recruit. | 4.39   | Strongly Agree |
| 4. Payment for environmental services that provide incentives to protect critical habitats that defend environmental as a means to fund sustainable environmental management policies and actions. | 4.50   | Strongly Agree |
| 5. Beach and dune nourishment that protects shores and restores beaches; serves as a “soft” buffer against flooding, erosion, scour and water damage. | 4.31   | Strongly Agree |
| 6. Coastal development setbacks that reduces the infrastructure losses and human safety risks of sea level rise, storm surge, and erosion. | 4.80   | Strongly Agree |
8. Living shorelines that mitigate erosion and protect people and ecosystems from climate change impacts and variability in low to medium energy areas along sheltered coastlines (e.g. estuarine and lagoon ecosystems).

9. Structural shoreline stabilization that temporary buffer against the impacts of erosion and flooding caused by factors such as sea-level rise, storm surge, and wave attacks.

10. Fisheries sector good practices that contributes to the protection of rural livelihoods, food security and marine biodiversity against the impacts of extreme climate events, precipitation change, ocean acidification, sea-level rise and sea surface warming.

11. Mariculture best management practices that integrates climate change considerations helps safeguard against extreme climate events, precipitation change, ocean acidification, sea-level rise and sea surface warming.

12. Tourism best management practices that integrate climate change concerns helps promote the sector’s sustainability as well as safeguard against extreme climate events, precipitation change, sea-level rise and sea surface warming.

13. Community-based disaster risk reduction that includes proactive planning and capacity building that addresses the specific needs of local communities increases their resilience and ability to respond to the effects of extreme climate events and flooding.

14. Flood hazard mapping that informs coastal planning processes and policy, reducing the impact of flooding resulting from storm events, heavy rains, storm surges, and extreme tides.

15. Coastal watershed management that preserves estuaries, which act as storm buffers and protect against coastal groundwater salinization.

16. Integrated coastal management that provides a comprehensive process that defines goals, priorities, and actions to address coastal issues, including the effects of climate change.

17. Special area management planning that improves the management of discreet geographic areas where there are complex coastal management issues and conflicts, including issues related to extreme climate events, precipitation change, ocean acidification, sea level rise and temperature change.

Table 5B. Adaptation strategies to mitigate climate variability and change

| Category                                                                 | Mean | Interpretation |
|--------------------------------------------------------------------------|------|----------------|
| 12. Tourism best management practices that integrate climate change      | 4.54 | Strongly Agree |
| 13. Community-based disaster risk reduction that includes proactive      | 4.60 | Strongly Agree |
| planning and capacity building that addresses the specific needs of     |      |                |
| local communities increases their resilience and ability to respond to    |      |                |
| the effects of extreme climate events and flooding.                     |      |                |
| Flood                                                                    | 4.56 | Strongly Agree |
| 14. Flood hazard mapping that informs coastal planning processes and     | 4.32 | Strongly Agree |
| policy, reducing the impact of flooding resulting from storm events,     |      |                |
| heavy rains, storm surges, and extreme tides.                           |      |                |
| 15. Coastal watershed management that preserves estuaries, which act     | 4.35 | Strongly Agree |
| as storm buffers and protect against coastal groundwater salinization.  |      |                |
| 16. Integrated coastal management that provides a comprehensive process  | 4.61 | Strongly Agree |
| that defines goals, priorities, and actions to address coastal issues,   |      |                |
| including the effects of climate change.                                |      |                |
| 17. Special area management planning that improves the management of    |      |                |
| discreet geographic areas where there are complex coastal management    |      |                |
| issues and conflicts, including issues related to extreme climate events |      |                |
| precipitation change, ocean acidification, sea level rise and           |      |                |
| temperature change.                                                     |      |                |

Scale:

- 1.00 - 2.00 - Disagree
- 2.01 - 3.00 - Uncertain
- 3.01 - 4.00 - Agree
- 4.01 - 5.00 - Strongly Agree

Table 5A and 5B reflect the adaptation strategies of residents on climate variability and change. The residents along Banate Bay are all knowledgeable of the adaptation strategies as part of the coping mechanisms in the adverse effects of climate variability and change. Computed mean ranged from 4.15 to 4.61.
4.10 to 4.80 and interpreted as strongly agree. Adequate information on climate variability and change still lacks in the study area as enlightenment programs on climate change are poorly attended because these programs are perceived as not significant adaptation strategies by the communities (Abaje, I. B., Ati, O. F., & Iguisi, 2012)

4. Conclusion

The findings revealed that coastal peoples’ perceptions on climate variability and change are high due to the fact that they are oriented and highly informed about the effects of this phenomenon. High perceptions on causes of climate variability and change in the area among residents were also noted; this is due to the informal educations and training on disaster risk reduction management which discuss the issue on climate change. The results on impacts of climate variability and change on their livelihoods showed strong agreement because residents probably experienced the effects of climate change on their livelihood wherein fishing is the primary. (IPCC, 2007c) The adaptation strategies used by the local people in combating the impacts of climate variability and change also strongly agreed. This implies that people are highly knowledgeable on how to respond to the situation; this is probably the result of experience and education, thus making the people resilient to the effects of climate change. (Abura, B., Tonui, W., Hayombe, 2017)

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