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Coastal Communities in a Changing Climate: Exploring the Interplay of Climate Change Impacts and Adaptation Practices

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ABSTRACT

This study investigated the impacts of climate change and adaptation strategies among residents of coastal communities in Iloilo's 4th District, Philippines. Using a descriptive-correlational research design and convenience sampling, 152 household heads were surveyed in Leganes, Dumangas, Barotac Nuevo, Anilao, and Banate. Data was collected on respondent profiles, climate change impacts, and adaptation practices. Findings revealed a moderate overall impact of climate change across physical, social, economic, and environmental dimensions. Energy consumption patterns have shifted due to rising temperatures, leading to increased electricity use. Fisheries productivity has significantly declined, impacting food security and livelihoods. The findings of the study further revealed that identified coastal areas occasionally practiced adaptation strategies in terms of waste management, cleanliness, responsible fishing, education, and infrastructure. Physical, social, economic, and environmental impact of climate change is significantly related to waste management, cleanliness, and responsible. Education is significantly related to the physical impact, social and environmental impact while there is no significant relationship between education and economic impact. Significant relationships exist between infrastructure and physical, economic and environmental impact while infrastructure is not significantly related to social impact. It is recommended to strengthen existing adaptation practices, invest in infrastructure development, promote sustainable waste management practices and enhance education and awareness.

1. Introduction.

Coastal areas are on the front lines of climate change, bearing the brunt of rising sea levels, more giant waves, and more frequent storms. These effects are driven by warming temperatures, shifting rainfall patterns, and extreme weather events. In the coming century, almost all coastal regions will face rising seas, with small islands bearing the brunt of the impact.

Rising water levels lead to a cascade of problems, including flooding, salt intrusion, land loss, shoreline changes, damage to vital ecosystems like mangroves and wetlands, and depletion of freshwater reserves. These devastating impacts will degrade ecosystems, destroy livelihoods, and disrupt essential services in coastal communities (Amaratunga, 2022). Long-term alterations in the planet's average temperature and weather patterns, primarily driven by human activities like burning fossil fuels, are collectively known as climate change. These activities release greenhouse gases, which trap heat in the atmosphere, causing global warming (Intergovernmental Panel on Climate Change, 2021). As Whatlife (2022) highlights, climate change poses a major threat to the world due to its extensive negative impacts on various aspects of our planet and society.

At the same time, United Nations Development Programmes (2021) highlights the escalating impact of climate stressors and shocks, characterized by increased frequency and intensity, on various aspects of human well-being, including disrupted lives and livelihoods, competition for resources, displacement, and food insecurity. The majority, or 65 percent, of Filipinos noted a significant change in their respective area's climate in 2023,

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based on the Pulse Survey Research survey results. Visayas saw the highest increase of respondents noticing big changes in their climate, from 65 percent in June 2022 to 81 percent in 2023, followed by Metro Manila from 66 to 75 percent and Mindanao from 55 to 65 percent. Meanwhile, most Filipinos needed more knowledge about climate change (Sarao, 2023).

Ignoring the science of climate change is no longer an option. Its effects on communities and ecosystems are undeniable. It is necessary to embrace and translate this knowledge into immediate action, motivating others to join the fight for a sustainable future. This study aims to gear toward sustainable climate change adaptation practices, which align with the United Nations Sustainable Development Goals encompassing SDG13 to take urgent action to combat climate change and its impacts.

2. Statement of the Problem.

This study aims to determine the adaptation practices and impacts of climate change among the residents along coastal areas of the 4th District of Iloilo, Philippines.

Specifically, it aims to answer the following questions:

1. What is the impact of climate change as perceived by the respondents in terms of physical, social, economic, and environmental impact?
2. What are the respondents' adaptation practices regarding waste management, cleanliness, responsible fishing, education, and infrastructure?
3. Is there a significant relationship between the impact of climate change and the extent of the respondents' adaptation practices?

3. Review of Related Literature.

3.1. Climate Change.

As the World Wildlife Fund (2023) warns, climate change, synonymous with global warming, manifests in the Earth's ongoing rise in temperature. This rise, already reaching 1°C in the past century, can escalate significantly without intervention. The consequences of this warming are vast and concerning, encompassing the melting of Arctic sea ice, amplified weather extremes like heatwaves, floods, and hurricanes, rising sea levels, disease dissemination, and ocean acidification.

Climate change's increasing frequency and intensity of extreme weather events like heat waves, droughts, floods, and tropical cyclones are exacerbating water management problems, reducing agricultural production and food security, increasing health risks, damaging critical infrastructure, and disrupting essential services like water and sanitation, education, energy, and transport (UN Environment Programme, 2023).

3.2. Impacts of Climate Change.

Driven by a changing climate and escalating extreme weather events, a global surge in hunger and poor nutrition is just one facet of the multifaceted health crisis unleashed by climate change. This environmental threat, already the single biggest risk to human health, casts a long shadow, encompassing air pollution, disease spread, displacement, mental health burdens, and food insecurity in regions struggling to cultivate or access sufficient sustenance. Each year, an estimated 13 million lives are claimed by environmental factors, with shifting weather patterns expanding disease ranges and extreme weather events overwhelming healthcare systems and keep people in poverty. Floods may sweep away urban slums, destroying homes and livelihoods (United Nations Climate Action, 2023).

According to World Health Organization (2023), climate change is directly contributing to humanitarian emergencies from heatwaves, wildfires, floods, tropical storms and hurricanes and they are increasing in scale, frequency and intensity. Research shows that 3.6 billion people already live in areas highly susceptible to climate change. Between 2030 and 2050, climate change is expected to cause approximately 250 000 additional deaths per year, from undernutrition, malaria, diarrhea and heat stress alone. The direct damage costs to health (excluding costs in health-determining sectors such as agriculture and water and sanitation) is estimated to be between US$ 2–4 billion per year by 2030. Areas with weak health infrastructure – mostly in developing countries – will be the least able to cope without assistance to prepare and respond. Reducing emissions of greenhouse gases through better transport, food and energy use choices can result in very large gains for health, particularly through reduced air pollution.

Close to 40% of the global population resides near coastlines, with over 3 billion people relying on the oceans for their livelihoods (World Bank, 2020; FAO, 2021). The very seas facilitate 80% of global trade (International Maritime Organization, 2023), contributing significantly to food security and poverty reduction (UNESCAP, 2016).

However, this vital resource faces immense pressure from human activities, Occasionally prioritizing economic gain over environmental well-being (CBD, 2021). Ocean acidification, pollution, warming, eutrophication, and fishery collapse are just some of the alarming consequences for marine ecosystems, posing devastating threats to both the planet and the millions who depend on the oceans' health (IPCC, 2022; FAO, 2020).

3.3. Climate Change Adaptation Practices.

While adapting to climate change presents a significant challenge, the potential consequences of inaction are far more severe. Protecting people and communities requires proactive adaptation strategies.

Climate change presents a significant threat to societies around the world. Rising sea levels, extreme weather events, and changes in precipitation patterns are already causing widespread damage and displacement. To address these challenges, communities are increasingly turning to adaptation practices. This literature review explores the current state of knowledge on climate change adaptation practices, focusing on their effectiveness, challenges, and future directions.

Adaptation refers to adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects. It refers to changes in processes, practices and structures to moderate potential damages or to benefit

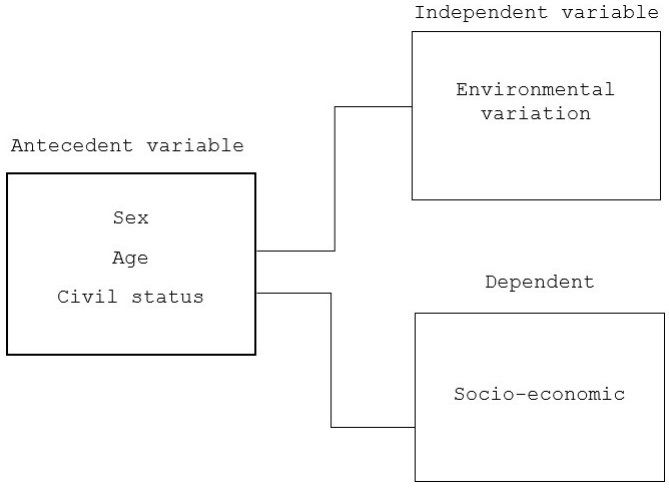
from opportunities associated with climate change. In simple terms, countries and communities need to develop adaptation solutions and implement actions to respond to current and future climate change impacts (United Nations Framework Convention on Climate Change, 2010). Accordingly, adaptation actions can take on many forms, depending on the unique context of a community, business, organization, country or region. There is no 'one-size-fits-all-solution'—adaptation can range from building flood defences, setting up early warning systems for cyclones, switching to drought-resistant crops, to redesigning communication systems, business operations and government policies. Many nations and communities are already taking steps to build resilient societies and economies. However, greater action and ambition will be needed to cost-effectively manage the risks, both now and in the future.

The Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report 2022 says "Climate change is affecting nature, people's lives and infrastructure everywhere. Its dangerous and pervasive impacts are increasingly evident in every region of our world. These impacts are hindering efforts to meet basic human needs and they threaten sustainable development across the globe." the world must also take urgent action to adapt to the current and near-future impacts of climate change, which it is too late to avoid. The IPCC says adaptation to climate change means "adjusting our behaviour (eg, where we choose to live; the way we plan our cities and settlements) and adapting our infrastructure (eg, greening of urban areas for water storage)" (Intergovernmental Panel on Climate Change, 2022).

4. Conceptual Framework.

The study can be illustrated with the help of the paradigm shown in below:

Figure 1: Schematic diagram showing the relative of the antecedent, independent and dependent variables.



Source: Authors.

5. Methodology.

5.1. Research Design.

This study utilized descriptive-correlational research method. Descriptive, in the sense that information is collected from a group of people to describe some aspects or characteristics of the population of which that group is a part (Fraenkel, 2023). The correlation research method was used to find out the direction and extent of the relationship between variables of the population under study (Yanson et al., 2019). It is establishing the relationship among adaptation practices and impact of climate change. Descriptive-correlational research aims to both describe and explore relationships between variables within coastal areas in Leganes, Dumangas, Barotac Nuevo, Anilao, and Banate. This research design provides a framework for investigating the complex interplay between adaptation practices and impacts of climate change in coastal communities.

5.2. Respondents.

This research targeted 152 household heads of residents living in identified coastal communities within Iloilo province between January and August 2024, chosen through a convenience sampling method. Identified coastal areas in Leganes, Dumangas, Barotac Nuevo, Anilao, and Banate were the research locale. Choosing the barangays within the municipalities was be based on proximity to the coast, dependence on fisheries, or other coastal resources.

The computation of the sample size was guided by GPower (Faul et al., 2007), using the "Exact" test family with an alpha level of 0.05, a beta level of 0.80, and a medium effect size (d = 0.3). Based on these parameters, GPower recommended a minimum sample size of 84 participants.

5.3. Research Instrument.

A researcher-made instrument composed of two parts was utilized. Part 1 of the instrument determined the profile of the respondents. Part 2 was utilized to measure the impact of climate change in terms of physical, social, economic and environmental impact and Part 3 identified the adaptation practices of the respondents in terms of waste management, cleanliness, responsible fishing, education and infrastructure The questionnaire has undergone content validation and its reliability was established using Cronbach alpha. Cronbach's alpha values above 0.7 are generally considered acceptable for research purposes (Tavakol & Dennick, 2011).

To determine the impact of climate change, the researcher employed the following scale of means and their corresponding descriptions:

Mean Score Descriptive Rating
4.20 – 5.00 Devastating
3.40 – 4.19 Significant
2.60 – 3.39 Moderate
1.80 – 2.39 Minimal
1.00 – 1.79 No Impact

To determine the extent of adaptation practices, the researcher employed the following scale of means and their corresponding descriptions:

Mean Score Descriptive Rating
4.20 – 5.00 Almost Always
3.40 – 4.19 Frequently
2.60 – 3.39 Occasionally
1.80 – 2.39 Rarely
1.00 – 1.79 Not

5.4. Data Gathering Procedure.

A structured survey instrument was administered to a representative sample of households within the target community. The researchers will coordinate with community leaders and local organizations for survey administration. Materials, including printed questionnaires, are organized. The questionnaire will be personally fielded to the respondents so that the nature and objectives of the study will be explained. The survey was conducted in a comfortable and private setting, allowing sufficient time for completion. The researchers offered assistance if needed.

5.5. Data Analysis Procedure.

The data gathered were tallied, recorded, and analyzed using appropriate statistical tools. Mean was utilized to determine the impact of climate change and adaptation practices. To find the relationship between impact and adaptation practices, Spearman rho was used.

6. Results and Discussion.

6.1. Impact of Climate Change.

Findings indicate a moderate impact of climate change across physical (M = 3.14), social (M = 3.120, economic (M = 3.04), and environmental (M = 3.23) aspects in Iloilo's coastal areas. This suggests that climate change is already affecting the province, but the consequences may not be as severe as in other regions. However, "moderate" shouldn't be interpreted as insignificant. Changes in energy consumption patterns (M = 3.55), particularly due to rising temperatures in coastal areas, can have a significant physical impact. As respondents explained, an increase in heat index (M = 3.53) occasionally leads to a rise in electricity consumption, creating a cycle that can intensify environmental challenges. Energy consumption is closely related to global climate change through greenhouse ga emissions (Piao & Managi, 2023).

Climate change significantly decreased fisheries productivity (M = 3.99). The significant decrease in fisheries productivity due to climate change requires immediate attention. Fisheries are a vital source of protein and nutrition for millions of people globally. A decline in fish populations can threaten food security, particularly for coastal communities that rely heavily on fishing for subsistence and livelihoods. Global climate change is increasingly and profoundly threatening fishes, resulting in an uncertain future for both wild fish diversity and global fisheries (Huang et al., 2021).

Table 1: Impacts of Climate Change.

	Mean	Description
PHYSICAL IMPACT	3.14	Moderate
1. damage to critical infrastructure	3.02	Moderate
2. interrupted access for emergency services	3.00	Moderate
3. degradation of house materials and structures	3.17	Moderate
4. changes in energy consumption	3.55	Significant
5. governance and institutional change	2.98	Moderate
SOCIAL IMPACT	3.12	Moderate
6. threat to life	3.12	Moderate
7. decreased fisheries productivity	3.99	Significant
8. need for social protection program	3.18	Moderate
9. displacement of people	2.98	Moderate
10. food and freshwater insecurity	3.08	Moderate
ECONOMIC IMPACT	3.04	Moderate
11. loss of income leading to economic depression	3.18	Moderate
12. loss of employment in fisheries industries	2.93	Moderate
13. depleted resources	3.18	Moderate
14. inability to plan for economic development	2.93	Moderate
15. adaptation and reconstruction costs.	2.98	Moderate
ENVIRONMENTAL IMPACT	3.23	Moderate
16. damage to the ecosystem	3.49	Significant
17. impact on biodiversity	3.10	Moderate
18. increase heat index	3.53	Significant
19. reduced quality of surface, ground and drinking water	3.10	Moderate
20. cost of environmental restoration.	2.95	Moderate

Legend: 4.20 – 5.00 Devastating, 3.40 – 4.19 Significant, 2.60 – 3.39 Moderate 1.80 – 2.39 Minimal, 1.00 – 1.79 No Impact

Source: Authors.

Climate change has a moderate overall physical impact on all identified coastal areas.

However, specific locations (Anilao, Barotac Nuevo, Dumangas, Leganes) experience significant impacts in different areas. Dumangas (M = 3.53, M = 3.41) face issues with degradation of house materials and structures, and require governance and institutional changes to adapt. Barotac Nuevo (M = 3.84), Dumangas (M = 3.71), and Leganes (M = 3.80) experience changes in energy consumption.

The results imply that Dumangas might need to focus on infrastructure upgrades and policy changes, while Barotac Nuevo, Dumangas, and Leganes might need to explore ways to adapt energy consumption patterns to the changing climate.

Table 2: Physical Impacts of Climate Change.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
PI1	2.95	Moderate	2.84	Moderate	3.16	Moderate	3.12	Moderate	3.16	Moderate
PI2	2.90	Moderate	2.89	Moderate	3.08	Moderate	3.12	Moderate	3.08	Moderate
PI3	3.33	Moderate	2.79	Moderate	3.28	Moderate	3.53	Significant	3.28	Moderate
PI4	3.29	Moderate	3.26	Moderate	3.84	Significant	3.71	Significant	3.80	Significant
PI5	3.24	Moderate	2.55	Moderate	3.04	Moderate	3.41	Significant	3.04	Moderate
Mean PI	3.14	Moderate	2.87	Moderate	3.28	Moderate	3.38	Moderate	3.27	Moderate

Legend: 4.20 – 5.00 Devastating, 3.40 – 4.19 Significant, 2.60 – 3.39 Moderate , 1.80 – 2.39 Minimal, 1.00 – 1.79 No Impact

Source: Authors.

Climate change has a significant social impact in Barotac Nuevo (M = 3.41), whereas the impact is moderate in other coastal areas. This suggests a specific vulnerability in Barotac Nuevo that needs further investigation. All five coastal areas (Anilao; M= 4.00, Banate; M = 3.95, Barotac Nuevo; M = 4.08, Dumangas; M = 3.47, Leganes; M = 4.32) experience a significant decrease in fisheries productivity. This raises concerns about food security and livelihoods across all communities.

A comprehensive social support plan for Barotac Nuevo is crucial to address the significant social impacts of climate

change. This plan could include a range of interventions, such as programs to diversify livelihoods, assistance for residents who need to relocate due to climate-related issues, and mental health support services.

The decline in fish populations threatens the livelihoods of fishing communities, leading to potential job losses and economic hardship. To ensure the long-term sustainability of these fisheries and the communities that depend on them, implementing stricter regulations and promoting sustainable fishing practices across all five areas is crucial.

Table 3: Social Impacts of Climate Change.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
SI1	2.90	Moderate	3.18	Moderate	3.20	Moderate	3.18	Moderate	3.08	Moderate
SI2	4.00	Significant	3.95	Significant	4.08	Significant	3.47	Significant	4.32	Significant
SI3	2.95	Moderate	3.08	Moderate	3.36	Moderate	3.24	Moderate	2.95	Moderate
SI4	2.86	Moderate	2.89	Moderate	3.08	Moderate	3.12	Moderate	2.86	Moderate
SI5	2.90	Moderate	3.00	Moderate	3.32	Moderate	3.00	Moderate	2.90	Moderate
Mean SI	3.12	Moderate	3.22	Moderate	3.41	Significant	3.20	Moderate	3.12	Moderate

Legend: 4.20 – 5.00 Devastating, 3.40 – 4.19 Significant, 2.60 – 3.39 Moderate , 1.80 – 2.39 Minimal, 1.00 – 1.79 No Impact

Source: Authors.

Research findings reveal a disparity in the economic impacts of climate change across the five coastal areas. Dumangas experiences a significantly higher impact (M = 3.40) compared to the moderate impact in other areas. Dumangas might rely more heavily on economic sectors highly sensitive to climate change, such as tourism or agriculture. Disruptions due to extreme weather events, sea level rise, or changing weather patterns can significantly affect these sectors.

Table 4: Economic Impacts of Climate Change.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
EI1	3.0952	Moderate	3.3158	Moderate	3.0000	Moderate	3.3529	Moderate	3.1200	Moderate
EI2	2.8095	Moderate	2.8158	Moderate	2.9600	Moderate	3.2353	Moderate	2.9600	Moderate
EI3	3.3333	Moderate	3.0789	Moderate	3.1200	Moderate	3.5294	Moderate	3.0400	Moderate
EI4	2.9524	Moderate	2.7895	Moderate	2.8000	Moderate	3.4706	Moderate	2.8800	Moderate
EI5	3.0000	Moderate	2.8684	Moderate	2.9200	Moderate	3.4118	Moderate	2.9200	Moderate
Mean EI	3.0381	Moderate	2.9737	Moderate	2.9600	Moderate	3.4000	Significant	2.9840	Moderate

Legend: 4.20 – 5.00 Devastating, 3.40 – 4.19 Significant, 2.60 – 3.39 Moderate , 1.80 – 2.39 Minimal, 1.00 – 1.79 No Impact

Source: Authors.

The findings of the study revealed a concerning variation in how climate change affects the five coastal areas. Dumangas stands out with a significantly higher environmental impact (M = 3.58) compared to the moderate impacts observed in other coastal areas.

While Dumangas experiences the most significant impact in terms of ecosystem damage, biodiversity loss, pollution, and the cost of restoration, other areas are not immune. Anilao and Banate face imminent threats to their ecosystems, and pollution affects Banate, Barotac Nuevo, and Leganes.

Dumangas significantly feel the impact in terms of damage to the ecosystem, impact on biodiversity, pollution and cost of environmental restoration. This finding underscores the urgent need to understand and address Dumangas' specific vulnerabilities. Perhaps Dumangas has a geographical layout that makes it more susceptible to climate change effects. This could involve factors like low-lying coastal areas vulnerable to sea level rise or exposure to strong winds and storm surges.

Table 5: Environmental Impacts of Climate Change.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
EV1	3.57	Significant	3.53	Significant	3.32	Moderate	3.76	Significant	3.36	Moderate
EV2	3.24	Moderate	3.03	Moderate	2.92	Moderate	3.53	Significant	3.00	Moderate
EV3	3.10	Moderate	3.47	Significant	3.68	Significant	3.94	Significant	3.56	Significant
EV4	2.86	Moderate	3.08	Moderate	3.20	Moderate	3.24	Moderate	3.12	Moderate
EV5	2.90	Moderate	2.82	Moderate	2.96	Moderate	3.41	Significant	2.88	Moderate
Mean EI	3.13	Moderate	3.18	Moderate	3.22	Moderate	3.58	Significant	3.18	Moderate

Legend: 4.20 – 5.00 Devastating, 3.40 – 4.19 Significant, 2.60 – 3.39 Moderate, 1.80 – 2.39 Minimal, 1.00 – 1.79 No Impact

Source: Authors.

7. Adaptation Practices.

The findings of the study revealed that identified coastal areas occasionally practiced adaptation strategies in terms of waste management (M = 3.18), cleanliness (M = 3.24), responsible fishing (M = 3.21), education (M = 3.21), and infrastructure (3.06). These practices might not be happening as frequently as needed for optimal effectiveness. Coastal clean-up and building of sea walls and breakwater arms are frequently practiced as proactive approach to climate change.

The respondents believe that implementing proper waste management practices reduces pollution and its negative impacts on ecosystems and human health. Maintaining a clean environment minimizes the spread of disease and improves overall well-being, especially important in the face of climate change disruptions. Sustainable fishing practices help conserve fish populations and ensure the long-term viability of fisheries, crucial for food security and livelihoods. Educating communities about climate change and adaptation strategies empowers them to make informed decisions and take action. Investing in infrastructure upgrades can strengthen coastal defenses against rising sea levels, storm surges, and erosion.

The existing adaptation practices provide a strong foundation. However, there's always room for improvement. The results imply that more sustainable waste management solutions may be explored, educational programs may be tailored to address specific local vulnerabilities and provide practical skills for adaptation, and regularly assess infrastructure and prioritize upgrades based on evolving threats can ensure continued effectiveness.

Waste management practices are occasionally employed by all identified coastal areas suggesting a lack of consistent or widespread implementation (Anilao; M= 2.97, Banate; M = 3.21, Barotac Nuevo; M = 3.19, Dumangas; M = 3.23, Leganes;

Table 6: Adaptation Practices.

PRACTICES	M	D
Waste Management	3.18	Occasionally
1. Segregate biodegradable from non-biodegradable	3.29	Occasionally
2. ReUse ecobags/ cloth bags	3.29	Occasionally
3. Wash and reuse plastic containers	3.22	Occasionally
4. Compost food waste.	3.25	Occasionally
5. Recycle grey water	2.87	Occasionally
6. Avoid burning of wastes	3.13	Occasionally
Cleanliness	3.24	Occasionally
7. Coastal Clean-up	3.44	Frequently
8. Cleaning of canals/ drainage	3.33	Occasionally
9. Mangrove planting and rehabilitation	3.15	Occasionally
10. Cleaning of rivers	3.13	Occasionally
11. Plant trees	3.13	Occasionally
Responsible Fishing	3.21	Occasionally
12. Reduce overfishing	3.18	Occasionally
13. Eliminate the use of small-mesh nets	3.13	Occasionally
14. Prohibit destructive fishing	3.23	Occasionally
15. Observe closed season	3.25	Occasionally
16. Not fishing in areas declared as reserves, refuge and sanctuaries (Area closure)	3.25	Occasionally
Education	3.21	Occasionally
17. Climate change literacy	3.22	Occasionally
18. Attend seminars on climate change	3.25	Occasionally
19. Attend disaster risk management training	3.27	Occasionally
20. Establishing rescue teams	3.12	Occasionally
Infrastructure	3.06	Occasionally
21. Use of solar lights	2.96	Occasionally
22. Building of sea walls and breakwater arms	3.42	Frequently
23. Build a compost pit	2.94	Occasionally

Legend: 4.20 – 5.00 Almost Always, 3.40 – 4.19 Frequently, 2.60 – 3.39 Occasionally, 1.80 – 2.39 Rarely, 1.00 – 1.79Not

Source: Authors.

M = 4.25). Frequently practiced are segregation (M = 3.58) in Banate, reusing of ecobags/ cloth bags (M = 3.40) in Barotac Nuevo while composting food waste (M = 3.52), recycling grey water (M = 3.40) and avoid burning of wastes (M = 3.40) in Leganes. The frequent practice of segregation in Banate indicates a commitment to separating waste streams for proper recycling and disposal. The frequent reuse of eco-bags and cloth bags in Barotac Nuevo suggests a focus on reducing plastic waste. Leganes demonstrates a commitment to sustainable practices with frequent composting of food waste, greywater recycling, and avoiding waste burning. Coastal areas stand out because of their rich biodiversity and high tourist potential due to their privileged geographical position. However, one of the main problems in these areas is the generation of waste and its management (Herrera-Franco et al., 2024)

Table 7: Adaptation Practices.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
WM1	3.14	Occasionally	3.58	Frequently	3.16	Occasionally	3.24	Occasionally	3.16	Occasionally
WM2	2.90	Occasionally	3.24	Occasionally	3.40	Frequently	3.35	Occasionally	3.52	Frequently
WM3	2.86	Occasionally	3.29	Occasionally	3.28	Occasionally	3.18	Occasionally	3.40	Frequently
WM4	3.10	Occasionally	3.21	Occasionally	3.32	Occasionally	3.24	Occasionally	3.40	Frequently
WM5	2.67	Occasionally	2.89	Occasionally	2.88	Occasionally	3.06	Occasionally	2.88	Occasionally
WM6	3.14	Occasionally	3.05	Occasionally	3.12	Occasionally	3.29	Occasionally	3.12	Occasionally
Mean WM	2.97	Occasionally	3.21	Occasionally	3.19	Occasionally	3.22	Occasionally	3.25	Occasionally

Legend: 4.20 – 5.00 Always, 3.40 – 4.19 Frequently, 2.60 – 3.39 Occasionally, 1.80 – 2.39 Rarely, 1.00 – 1.79 Not

Source: Authors.

Research findings indicated that identified coastal areas occasionally practiced cleanliness in their areas (Anilao; M= 3.03, Banate; M = 3.33, Barotac Nuevo; M = 3.24, Dumangas; M = 3.31, Leganes; M = 3.22). This suggests a need to bridge the gap and improve overall cleanliness in the identified coastal areas. Coastal clean-up is frequently practiced in Banate (M = 3.61), Barotac Nuevo (M = 3.48) and Dumangas (M = 3.41). These three coastal areas demonstrate a positive commitment to cleanliness through frequent coastal clean-up activities.

Table 8: Practices in terms of Cleanliness.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
C1	3.19	Occasionally	3.61	Frequently	3.48	Frequently	3.41	Frequently	3.36	Occasionally
C2	3.24	Occasionally	3.39	Occasionally	3.28	Occasionally	3.35	Occasionally	3.32	Occasionally
C3	2.90	Occasionally	3.39	Occasionally	3.12	Occasionally	3.06	Occasionally	3.08	Occasionally
C4	3.05	Occasionally	2.97	Occasionally	3.16	Occasionally	3.59	Occasionally	3.12	Occasionally
C5	2.76	Occasionally	3.29	Occasionally	3.16	Occasionally	3.12	Occasionally	3.20	Occasionally
Mean C	3.03	Occasionally	3.33	Occasionally	3.24	Occasionally	3.31	Occasionally	3.22	Occasionally

Legend: 4.20 – 5.00 Always, 3.40 – 4.19 Frequently, 2.60 – 3.39 Occasionally, 1.80 – 2.39 Rarely, 1.00 – 1.79 Not

Source: Authors.

Banate frequently practice responsible fishing (M = 3.43) while other areas occasionally practice responsible fishing. Banate's frequent practice of responsible fishing suggests a strong commitment to sustainable fishery management. The "occasional" practice in other areas indicates a need for improvement. Respondents from Banate claim about frequently reducing overfishing (M = 3.47), prohibiting destructive fishing (M = 3.47), and respecting fishing restrictions (M = 3.55) support the idea of established traditions, educational programs, and strong enforcement.

Table 9: Practices for Responsible Fishing.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
RF1	2.71	Occasionally	3.47	Frequently	3.08	Occasionally	3.18	Occasionally	3.24	Occasionally
RF2	3.14	Occasionally	3.26	Occasionally	2.88	Occasionally	3.41	Frequently	2.96	Occasionally
RF3	3.05	Occasionally	3.47	Frequently	3.08	Occasionally	3.18	Occasionally	3.20	Occasionally
RF4	3.19	Occasionally	3.39	Occasionally	3.08	Occasionally	3.35	Occasionally	3.20	Occasionally
RF5	2.81	Occasionally	3.55	Frequently	3.16	Occasionally	3.12	Occasionally	3.32	Occasionally
Mean RF	2.98	Occasionally	3.43	Frequently	3.06	Occasionally	3.25	Occasionally	3.18	Occasionally

Legend: 4.20 – 5.00 Always, 3.40 – 4.19 Frequently, 2.60 – 3.39 Occasionally, 1.80 – 2.39 Rarely, 1.00 – 1.79 Not

Source: Authors.

Education plays a crucial role in empowering communities to adapt to the challenges posed by climate change. All identified coastal areas occasionally praticed climate change adaptation strategies through education (Anilao; M= 3.02, Banate; M = 3.22, Barotac Nuevo; M = 3.23, Dumangas; M = 3.24, Leganes; M = 3.34). The occasional use of education for adaptation suggests a lack of consistent educational efforts across all areas. This inconsistency might leave some community members uninformed or unprepared to address climate change challenges.

The frequent practice of climate change literacy in Barotac Nuevo suggests a strong emphasis on educating the community about climate change. This likely involves ongoing programs, workshops, or educational initiatives focused on building climate awareness and knowledge. While in Leganes, attending seminars suggests a more targeted approach. Leganes might

focus on occasional workshops or seminars to address specific topics related to climate change. Climate change literacy empowers communities to understand the challenges they face and take action to adapt.

This is in line with the findings of Arimi (2014) in Nigeria, where training courses increased adaptation of fish farmers to climate change. Also, Trinh et al. (2018b) noted attendance at training courses as a significant predictor of climate change adaptation in agricultural production in Vietnam.

Table 10: Practices for Education.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
E1	2.86	Occasionally	3.18	Occasionally	3.40	Frequently	3.29	Occasionally	3.36	Occasionally
E2	3.05	Occasionally	3.32	Occasionally	3.28	Occasionally	3.06	Occasionally	3.40	Frequently
E3	3.14	Occasionally	3.29	Occasionally	3.20	Occasionally	3.35	Occasionally	3.36	Occasionally
E4	3.05	Occasionally	3.08	Occasionally	3.04	Occasionally	3.23	Occasionally	3.24	Occasionally
Mean E	3.02	Occasionally	3.22	Occasionally	3.23	Occasionally	3.23	Occasionally	3.34	Occasionally

Legend: 4.20 – 5.00 Always, 3.40 – 4.19 Frequently, 2.60 – 3.39 Occasionally, 1.80 – 2.39 Rarely, 1.00 – 1.79 Not

Source: Authors.

Infrastructure, the backbone of modern society, is increasingly vulnerable to the impacts of climate change. From rising sea levels and extreme weather events to changing precipitation patterns, infrastructure systems must adapt to ensure resilience. All identified coastal areas occasionally practiced climate change adaptation strategies through education (Anilao; M= 2.89, Banate; M = 3.08, Barotac Nuevo; M = 3.21, Dumangas; M = 3.10, Leganes; M = 3.23). Building of sea walls and breakwater arms are frequently practiced in Banate , Barotac Nuevo and Dumangas. Seawalls and breakwater arms act as barriers, mitigating coastal erosion and preserving valuable land. These structures can help protect coastal communities from flooding caused by storm surges and heavy rainfall.

Table 11: Practices for Education.

	Anilao		Banate		Barotac Nuevo		Dumangas		Leganes	
	M	D	M	D	M	D	M	D	M	D
I1	2.71	Occasionally	2.92	Occasionally	3.04	Occasionally	2.94	Occasionally	3.16	Occasionally
I2	2.90	Occasionally	3.63	Frequently	3.68	Frequently	3.12	Occasionally	3.48	Frequently
I3	3.05	Occasionally	2.68	Occasionally	2.92	Occasionally	3.23	Occasionally	3.04	Occasionally
Mean I	2.89	Occasionally	3.08	Occasionally	3.21	Occasionally	3.10	Occasionally	3.23	Occasionally

Legend: 4.20 – 5.00 Always, 3.40 – 4.19 Frequently, 2.60 – 3.39 Occasionally, 1.80 – 2.39 Rarely, 1.00 – 1.79 Not

Source: Authors.

7.1. Relationship Between Impacts of Climate Change and Adaptation Practices.

Physical, social, economic, and environmental impact of climate change is significantly related to waste management (p = .000, p = .002, p = .000, p = .000), cleanliness (p = .003, p = .000, p = .000, p = .000), and responsible fishing (p = .005, p = .001, p = .004, p = .000). Education is significantly related to the physical impact (p = .047), social (p =.002) and environmental (p = .010) impact while there is no significant relationship between education and economic impact (p = .336). Significant relationships exist between infrastructure and physical (p = .003), economic (p = .001) and environmental (p = .000) impact while infrastructure is not significantly related to social impact (p = .084).

Education significantly influences physical, social, and environmental impacts, emphasizing its critical role in fostering climate change awareness and adaptation. Investing in climate change education is vital for building resilient communities. It can foster behavioral changes leading to improved waste management, cleanliness practices, and responsible fishing. Infrastructure is necessary in mitigating physical and economic impacts of climate change, but its influence on social and environmental dimensions is less evident. Prioritize infrastructure development that can withstand climate change impacts, such as resilient buildings, efficient drainage systems, and sustainable transportation networks.

Waste management, cleanliness, and responsible fishing are factors that directly influence physical and environmental impacts, highlighting the need for improved practices. Periodic assessments of current and future climate change impacts on ecosystems are important for developing and updating natural resource management plans and evaluating adaptation actions (West et al., 2009). Climate change poses increasingly severe risks for coastal ecosystems and coastal communities all around the globe. This condition requires implementing climate adaptation policy and advancing scientific knowledge to adapt to the current and future climate risks (Cabana et al., 2023).

Table 12: Relationship Between Impacts of Climate Change and Adaptation Practices.

		Waste Management	Cleanliness	Responsible Fishing	Education	Infrastructure
Physical Impact	Correlation Coefficient	.480**	.261*	.249*	.178*	.265*
	Sig. (2-tailed)	.000	.003	.005	.047	.003
Social Impact	Correlation Coefficient	.268*	.357**	.282*	.279*	.154
	Sig. (2-tailed)	.002	.000	.001	.002	.084
Economic Impact	Correlation Coefficient	.484**	.373**	.257*	.086	.290*
	Sig. (2-tailed)	.000	.000	.004	.336	.001
Environmental Impact	Correlation Coefficient	.445**	.457**	.412**	.230*	.345**
	Sig. (2-tailed)	.000	.000	.000	.010	.000

*p < .05, **p <.001

Source: Authors.

Conclusions.

The moderate overall impact might suggest a less severe situation compared to other regions; it is crucial to recognize that even gradual changes can have long-term consequences. While the overall physical impact might be characterized as moderate, the localized variations in specific areas reveal significant challenges. The decline in fisheries productivity across all coastal areas poses a significant threat to food security and livelihoods. Implementing comprehensive fisheries management strategies is vital to ensure the long-term sustainability of this vital resource. It is imperative to continue monitoring climate change indicators and their impacts on coastal communities to inform evidence-based decision-making and policy development.

There is a complex interplay between human practices and the environment in the studied coastal areas. Although the coastal communities recognize the value of waste management, cleanliness, responsible fishing, education, and infrastructure, the irregular implementation of these measures limits their overall effectiveness in building resilience to climate change. Continuous monitoring and evaluation are essential to track progress and inform future adaptation strategies.

The effects of climate change are undeniable and intensifying. While there's no guaranteed way to completely avert its consequences, proactive and adaptable preparation can significantly minimize its impact on individuals and communities. By taking action in advance, can not only enhance the ability to respond to natural disasters but also safeguard the progress of the community.

Recommendations.

Based on the findings and discussion, the following recommendations are crucial for building resilience to the adverse effects of climate change in these coastal areas:

1. Develop localized adaptation plans that address the specific vulnerabilities and challenges identified in each coastal area. Localized plans can identify and address the specific vulnerabilities and challenges faced by each community. This ensures that adaptation measures are relevant and effective.
2. Prioritize the development of infrastructure that can withstand extreme weather events, such as seawalls, drainage systems, and resilient buildings. Resilient infrastructure can minimize damage and loss of life during extreme weather events such as typhoons, floods, and storm surges.
3. Implement comprehensive waste management systems to reduce pollution and minimize environmental hazards. Proper waste disposal prevents pollution of water bodies, air, and soil, safeguarding public health and ecosystems.
4. Integrate climate change education into formal and informal learning programs to raise awareness and foster understanding of climate risks. Climate change education can equip individuals with the skills needed to adapt to changing conditions, such as disaster preparedness, sustainable practices, and community organizing.

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