Maritime Technology and Research

https://so04.tci-thaijo.org/index.php/MTR

Review Article

Impact of climate change on coastal communities and security

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Article information
Received: February 12, 2025
Revision: April 22, 2025
Accepted: May 15, 2025

Keywords
Anthropogenic;
Biosphere;
Coastal security;
Ecosystems;
Livelihood;
Sea level rise

Abstract

Oceans are an indispensable component of the Earth's biosphere, one that plays a pivotal role in regulating global climate, sustaining biodiversity, and supporting human livelihood. However, their health has been under threat as a result of various anthropogenic activities and naturally occurring events caused by climate change. With nearly 29 % of the world population residing within 50 km of the coast, the impact of climate change on coastal communities cannot be undermined or overlooked, as climate change is difficult to stop. Hence, it becomes important to define contours of the expected impact, so as to mitigate high-probability and high-risk future scenarios while ensuring ocean sustainability to create resilience and adaptation mechanisms for coastal communities. To address this, this review paper examines evolving multifaceted impacts of climate change globally on coastal communities and emerging security issues for a nation to help identify inescapable areas for mitigation and adaptation. The study shows that the impact of climate change on coastal communities and security underscores an urgent need for concerted efforts to mitigate and adapt to these challenges. By prioritising resilience, collaboration, and innovation, security issues for nations and their coastal communities can be addressed better. To achieve this requires a united global effort, blending science, technology, and policies together to address complex interplay between climate change and coastal security.

1. Introduction

Climate change refers to significant and lasting changes in climate patterns of the Earth, particularly those related to temperature, precipitation, and wind. While climate naturally fluctuates over long periods, recent changes have been found to be largely driven by anthropogenic activities, especially burning of fossil fuels, deforestation, and industrial processes, among others, as observed by many researchers including Agarwala and Polinov (2021). These activities have resulted in increased concentrations of greenhouse gases (GHG) in the atmosphere that are known to trap heat which, in return, causes global temperature rise, alters weather patterns, and disrupts natural systems. The consequences are far-reaching, especially for coastal ecosystems, as they affect ecosystems, weather systems, and human societies.

Coastal regions are dynamic interfaces between land and sea that encompass diverse ecosystems like mangroves, wetlands, coral reefs, and estuaries. They hold ecological, economic, and climatic importance, supporting biodiversity, livelihoods and natural climate regulation. Hence, understanding the importance of coastal regions is considered crucial for addressing the challenges posed by climate change (Pietro et al., 2024).

These regions host diverse ecosystems, including wetlands (Spieles, 2022) and estuaries (Thrust et al., 2013), which serve as critical habitats for fish, birds, and other wildlife. Additionally, coastal regions encompass mangroves (Banerjee & Agarwala, 2024) and coral reefs (Hughes et al., 2017), providing shelter to numerous species of flora and fauna, and contributing significantly to biodiversity and ecosystem services (Rahman et al., 2024). An impact on these ecosystems will have an impact on the supported flora and fauna, thereby impacting coastal communities for their sustenance. Economic significance is another crucial contributor, as these coastal regions are often economic powerhouses (Aamir et al., 2023). Economically, the fishing industry provides livelihoods to millions, while tourism attracts visitors to beaches and marine parks and generates substantial revenue for local economies. Similarly, ports facilitate international trade, making coastal regions key nodes in global supply chains (Tanaka, 2023). In terms of climate regulation, coastal ecosystems, like mangroves and seagrass, sequester carbon, helping to mitigate climate change, while coastal regions play a vital role in climate regulation and disaster mitigation. Mangroves, wetlands, and coral reefs act as natural barriers against storm surges and high waves, reducing the impact of extreme weather events and protecting inland areas from flooding. Owing to their diverse significance, these coastal regions are considered crucial for research and education (Alongi, 2021). They serve as living laboratories for scientific studies on marine biology, ecology, and climate change, providing valuable insights into environmental health and sustainability (Andrew et al., 2025).

When climate change related extreme events occur, like sea level rise, inward shifting baselines, submerged coastal areas, scarcity of food, water and energy supplies, increased competition for natural resources, loss of livelihoods, forced migration, destabilization of marine ecosystems. and alteration of traditional fishing practices, they disturb the balance in these ecosystems, impacting coastal communities and the coastal security of the nation (Bhavan et al., 2024). Hence, it is important to define contours of the expected impact to mitigate high-probability and high-risk future scenarios while ensuring ocean sustainability, so as to create resilience and adaptation mechanisms for coastal communities. Accordingly, this review paper, using a systemic literature review, will examine evolving multifaceted impacts of climate change globally on both coastal infrastructure and coastal communities to help identify inescapable areas for mitigation and adaptation mechanisms that would ensure that the coastal security of a nation is not compromised.

The paper will begin by discussing some major studies undertaken to understand the impact of climate change on coastal infrastructure and coastal communities and, hence, coastal security. A discussion of the impact of climate change events on coastal communities and the security of a nation, followed by their interdependence, will be addressed next. To close the discussion, adaptive strategies will precede the conclusion of the study.

2. Studies on climate change

The temperature of the Earth changes naturally (see **Figure 1**) and is largely due to change in energy received from the Sun and that reflected from the surface of the Earth. However, this energy balance is not linear, as the atmosphere of the Earth partially traps outgoing longwave radiation, thereby maintaining a mean global temperature of approximately 15 °C, rather than the expected −18 °C in the absence of atmospheric interference (Fourier, 1827). It was in 1896 that Arrhenius systematically quantified the role of atmospheric carbon dioxide in modulating this temperature through what is now recognized as the greenhouse effect (Arrhenius, 1896). Since then, numerous studies have shown that the speed at which the temperature of the Earth is increasing is primarily due to anthropogenic activities. The studies to follow focused primarily on issues of ecology, water resources, agriculture, human health, economy, socioeconomics, sociopolitics, infrastructure, adaptation, resilience, and sustainable mitigation, with security being added as late as the early 2000s (Goodman, 2024). All these studies focus on rising temperatures, sea level rise,

drought, flooding, and more as areas of concern due to climate change. These studies show that changes have become more intense since the early 2000s and, hence, our study will be largely limited to the present century.

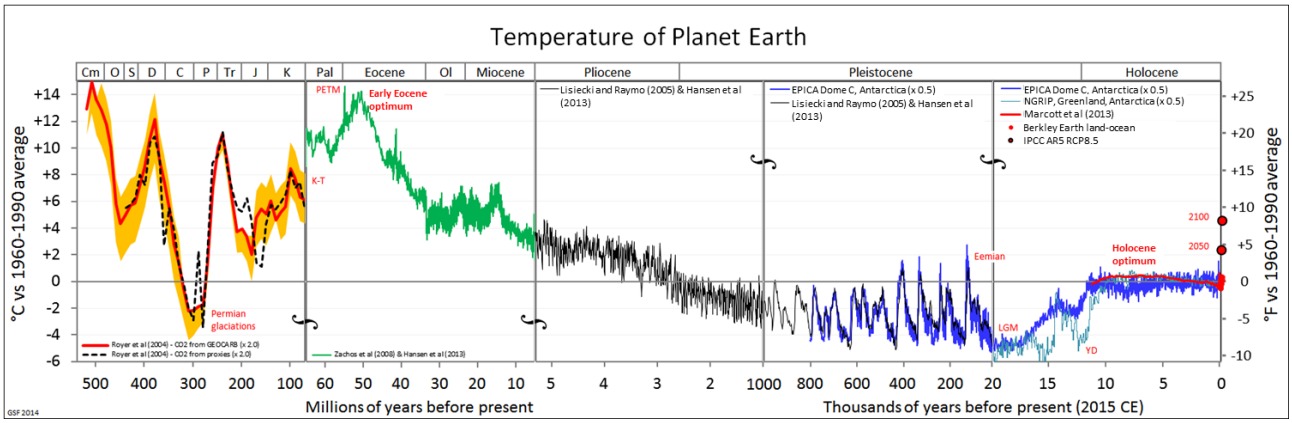

Figure 1 Temperature of Earth over the years. (Source: Agarwala & Polinov, 2021).
Note that temperature fluctuation is natural. The rate at which it has been happening since the Industrial Revolution is what is of concern in recent times.

The most influential studies on climate change in recent times have been by the Intergovernmental Panel on Climate Change (IPCC). These provide comprehensive information on shifting environmental conditions, their potential impacts, and various response options (Lindwell, 2023). While most of the information provided in IPCC reports is probabilistic, with the possibility of actual values being exceeded, and risk analysis erring on the higher side, these reports provide a start point for climate studies and future scenarios to provide governments with scientific information about climate change for developing climate policies. So far, six reports have been published, with each coinciding and helping international collaborations in climate. Since these reports do not account for the efforts of governments, uncertainty is natural in their predictions, for which the IPCC considers modern climate models (provided as the Coupled Model Intercomparison Project (CMIP)) which run on various GHG emission scenarios. Most recent models are CMIP5, which uses representative concentration pathways (RCP), and CMIP6, which uses shared socioeconomic pathways (SSP).

SSP provides a storyline of how a certain level of warming is reached, and accounts for GHG emissions due to population, economic growth, education, urbanization, and technological development. RCP, on the other hand, tells where we can reach without discussing the path taken, and is based on atmospheric GHG concentration. Even though SSP and RCP are two independent indicators, they are related to each other and help policy makers to decide the future they wish to create. Until the fifth assessment report (AR5) of 2014, SSP and RCP were related (Climate Hubs, 2024). From AR5, SSP and RCP have been combined to provide an SSP-RCP scenario by imposing global warming targets on SSP scenarios using the radiative forcing levels in RCP. Accordingly, SSP5-8.5 indicates an increase of 8.5 Watt/m^2 between 1,750 and 2,100. Even with known multiple risk scenarios, AR6 shows that nothing is being done to adapt to climate change, especially in vulnerable communities, with adaptation efforts being ‘fragmented’ and ‘incremental’, while requirement is that of ‘transformational changes’ (Lindwell, 2023).

One notices that, even though the perils of climate change have been known for decades, very little has been done to address them. Though the world was on the verge of signing binding international treaties to mitigate the acceleration of global warming, the oil industry, for survival and economic gains, ensured that such treaties did not happen. They lobbied against climate policies, funding misinformation campaigns to cast doubt on scientific consensus, to turn climate change into

a *partisan* rather than a *bipartisan* issue, and delaying meaningful climate action despite decades of scientific warnings (Flanagan & Goods, 2022). Today, the challenge in addressing climate change is not technology or intellectual ability, but the lack of political will (Guenther, 2024) and the need for specialized action (Von Uexkull & Buhaug, 2021). The decision of the US to withdraw from the Paris Agreement (The White House, 2025) is testimony to the lack of this political will.

3. Impact on coastal communities

While coastal communities are the worst impacted by climate change, being close to the coast, these communities additionally face the brunt of maritime crimes like Illegal, Unreported and Unregulated (IUU) fishing, transnational crimes, and migration (Kismartini et al., 2024; Germond & Mazaris, 2023). However, detailed scholarship in this regard is lacking. It is, thus, opined that informing decision makers and stakeholders about the interdependence of climate change and maritime security is important to improve global ocean governance and mitigate security in the maritime domain. This demands new governance frameworks to make coastal areas healthier and safer while ensuring that maritime security is strengthened. However, such new governance frameworks can be developed only by considering natural and human systems holistically (Rolfer et al., 2022). Simultaneously, it is essential to develop adaptation and mitigation techniques, since climate change is difficult to stop. Studies of 45 selected coastal cities show socio-economic sensitivity, insufficient infrastructure systems, and limited adaptive capacity to address future climate change impacts (Dasgupta et al., 2021). In developing countries, since socio-economic development and capacity enhancement cannot be separated, trade-offs become essential. Realising the difficulty in creating adaptive mechanisms, a framework for climate adaptation planning has been developed to act as an additional source of information and help improved decision making (Eriksen et al., 2021).

While climate change is a natural phenomenon, its intensity and pace have been significantly amplified by human-induced activities. Consequences are complex and far-reaching and intensify competition over natural assets, disrupt livelihoods, trigger displacement, destabilize marine ecosystems and alter long-established fishing practices (David & Sirkku, 2021). Since nearly 29 % of the world population resides within 50 km of a coast, the resulting impact due to climate change on coastal communities cannot be undermined or overlooked. This requires greater introspection to define contours of expected impact to mitigate high-probability and high-risk future scenarios while ensuring ocean sustainability to create resilience and adaptation mechanisms for coastal communities (Till et al., 2024). It is, thus, essential that the likely impact of climate change on coastal communities and the security of a nation are examined in greater detail before adaptive and mitigation mechanisms can be discussed.

Studies show that resulting impact experienced by these communities may be socio, socioeconomic, sociopolitical, or security related (see **Figure 2**). It is, thus, important that these multifaceted impacts are understood better.

3.1 Sea level rise

One of the most direct consequences of climate change is sea level rise, driven by thermal expansion of seawater and melting of land-based glaciers and ice sheets and polar ice cap (Dilworth & Hughes, 2025). According to AR6 (IPCC, 2023), sea levels have risen by approximately 20 cm since the late 19th century, with projections suggesting an additional rise of up to 1 m by 2100 if business continues as usual. If the trend is towards a worst-case scenario (RCP8.5) the expected rise would be nearly 2 m. This rise would lead to the inundation of low-lying coastal areas, resulting in loss of land and displacement of communities (Dhiman et al., 2022). While many homes on Shishmaref Island in Alaska and small islands in the South Pacific have already been washed away (Pilkey and Young, 2009), bigger islands, such as Maldives, will face existential threats by 2100 due to significant land loss as a result of sea level rise (Haque, 2024). Similarly, coastal cities like New

York and Miami are at risk of flooding and damage to infrastructure (Anderson, 2024; Colten et al., 2022) resulting in increased financial burden towards greater maintenance cost and/ or conflict-cost in areas to which coastal communities will migrate. Cities like Mumbai and Chennai in India, too, are at high risk, as a significant portion of their populations live in low-lying coastal areas (Kumar, 2023). Mumbai alone will see 14 million people affected by 2050 (Raj, 2023). Projections indicate that, by 2100, around 600 sq. km of Chennai may be submerged, while in Kolkata, an estimated 500,000 people could be affected (Madhanagopal, 2022). Jakarta, Indonesia, one of the fastest-sinking cities in the world, is expected to see large portions submerged by 2050 due to rising sea levels and land subsidence, prompting the government to plan the relocation of the capital (Sari & Adytia, 2024). Coastal regions of Bangladesh, including the Sundarbans, face severe threats, with millions at risk of displacement by 2100 as farmland and villages are lost to encroaching waters (Shariot-Ullah, 2024). In Nigeria, Lagos- Africa's largest coastal city- faces recurrent flooding, with rising sea levels projected to displace hundreds of thousands and disrupt economic activities (Obada et al., 2024).

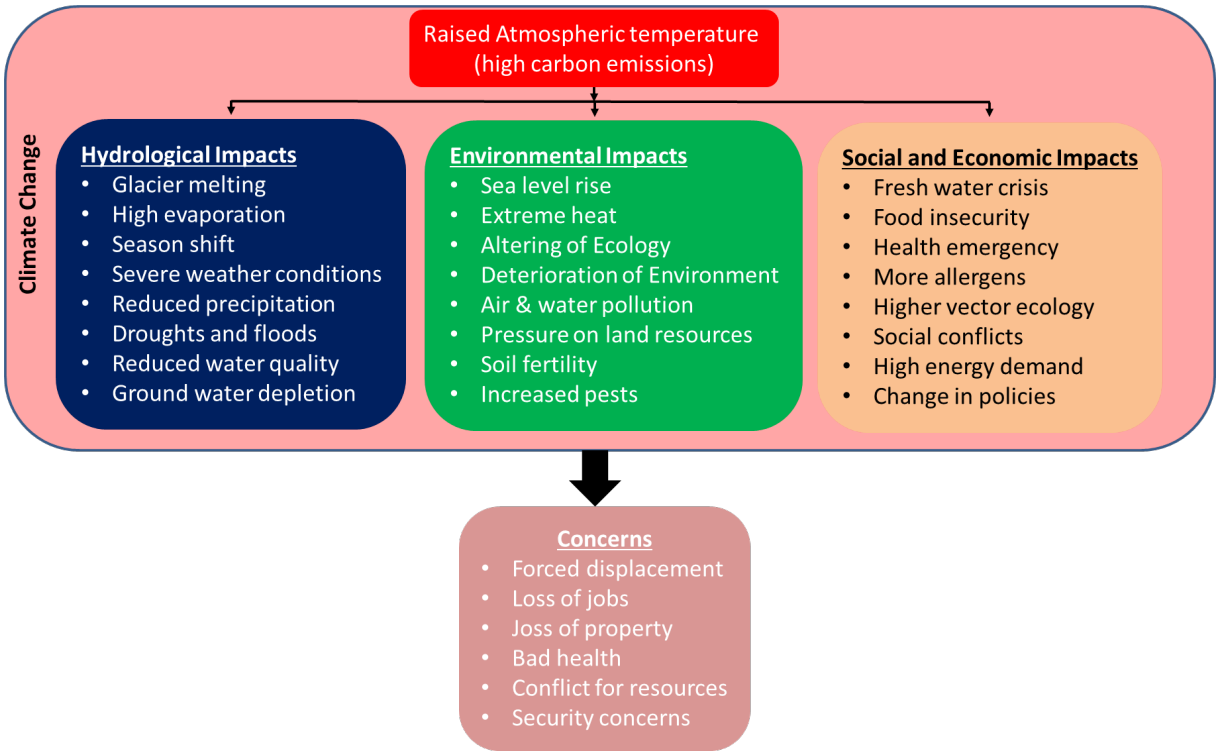

Figure 2 Social and economic impacts of climate change (Source: Authors).

3.2 Increased frequency of extreme weather events

The frequency and intensity of extreme weather events, due to alteration of the precipitation cycle, thawing cycle, and weather system, have escalated with time (Bolan et al., 2024). These events are a result of increasing global temperature that encourages the atmosphere to hold greater moisture and alter the precipitation cycle. The resulting high temperature provides additional energy to weather systems, leading to more powerful and destructive tropical cyclones (National Oceanic and Atmospheric Administration, 2023). Since warmer oceans contribute to the melting of polar ice caps and glaciers, sea levels rise, the impact of storm surges, and coastal flooding is exacerbated (Griggs & Reguero, 2021). All these events have profound implications on coastal ecosystems, infrastructure, economies, and human health (Wahiduzzaman, 2024) and lead to displaced communities, forced migration, economic loss, increasing poverty, health issues, destruction of property and infrastructure,

and many more. A single event like cyclone Amphan, which hit the coast of West Bengal and Odisha in May 2020, caused damages exceeding US $13 billion and affected millions of people (Galicia, 2022). Considering that a single event can cause massive destruction, it is natural to expect greater destruction due to the occurrence of simultaneous climate events. This is a matter of serious concern, especially because studies show that simultaneous heat waves, droughts, and heavy rainfall events are likely to increase due to climate change (Fang et al., 2025).

3.3 Altered atmospheric circulation

Increasing global temperatures influence atmospheric circulation patterns, such as jet streams and pressure systems (Lindsey & Dahlman, 2023). These changes alter precipitation patterns and can lead to prolonged periods of extreme weather events, such as hurricanes, that can cause significant economic losses for coastal fishing and coastal tourism (Li et al., 2024). Changes in wind patterns disrupt marine ecosystems, impacting fisheries and, hence, local economies reliant on fishing. Such shifting monsoon patterns can bring about droughts and impact freshwater availability, as seen in Kenya and Somalia (Roy et al., 2024). In India, it is expected that, as a result of such events, seafood exports will decline by 30 % by 2050, affecting the livelihoods of millions of fishermen (Hussain et al., 2024). The changes in atmospheric circulation can even alter precipitation patterns, leading to droughts, thereby straining available freshwater resources (Woollings, 2023), or floods, leading to the displacement of communities and changing abiotic (e.g., temperature, salinity, oxygen, acidification) and biotic (shifting distribution, species composition and abundance of predators and prey) conditions, making it difficult to predict the response of marine life (Sinha et al., 2023). Altering precipitation pattern can alter freshwater availability for monsoon dependent countries like India (Reddy, 2023). Studies indicate that, by 2050, India could experience a freshwater shortfall of up to 50 % during peak demand periods (Fayaz et al., 2024). The result of altered atmospheric circulation, amongst others, is reduced food for coastal communities, economic loss due to floods, and droughts that could result in forced migration.

Florida, Bangladesh, and the Netherlands are examples that find themselves extremely vulnerable to the impact of climate change, as these regions face extreme heat, intense hurricanes, and sea level rise frequently, putting their populations, especially in low-lying areas, at serious risk of floods and damages. The coastal areas of Florida generate nearly US $102 billion each year as a result of tourism and coastal activities but find themselves at risk of losing this revenue due to climate change (Mondal et al., 2025). Similarly, the economies of both Bangladesh and the Netherlands are largely dependent on the coastal ecosystem which too is threatened by the increasing impacts of climate change (German Watch, 2004).

3.4 Health risks

A major impact of climate change is significant health risk in coastal areas. Changes in temperature and precipitation patterns, increased frequency and intensity of storms, and rising sea levels all contribute to a range of health hazards (Sadanandan, 2023). Flooding can lead to waterborne diseases such as cholera and other gastrointestinal infections (Mishra et al., 2014). Higher temperatures can lead to increased ground-level ozone and air pollutants, which aggravate respiratory conditions like asthma and chronic obstructive pulmonary disease (COPD). Coastal areas, with dense populations and industrial activities, may experience worsened air quality as a result of climate-induced changes, leading to increased respiratory issues (Pacheco et al., 2021). These resulting impacts are as seen in **Figure 3**. A study in Miami found rising temperatures linked to increased heat-related illnesses, particularly among vulnerable groups (Onyena & Nwaogbe, 2024). Studies in many states of India indicate that, in recent years, there has been an increase in the frequency and intensity of heat waves. These heat waves cause heat-related mortality that could rise by 20 - 50 % by 2100 if mitigation measures are not implemented. To add, warm temperatures expand the range of mosquitoes, increasing incidents of dengue and Zika (Khraishah et al., 2022).

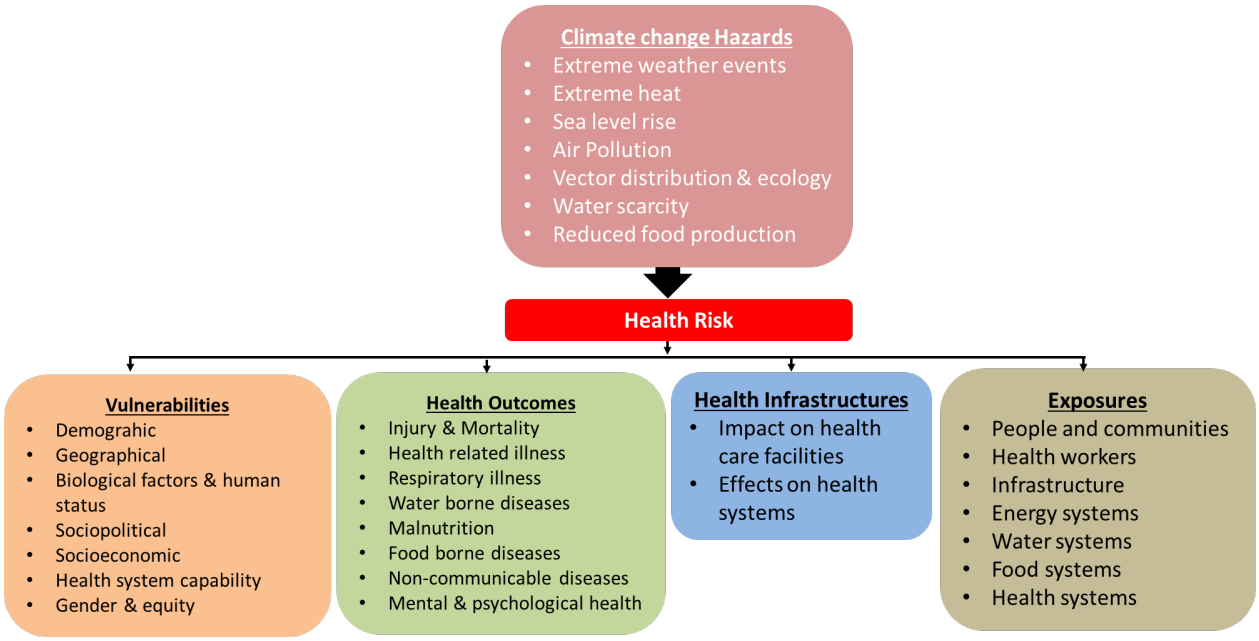

Figure 3 Impact of climate change on human health.

3.5 Coastal erosion

Wave-induced currents and tides cause coastal erosion. The impact of these oceanic events is intensified during hurricanes and typhoons. Since climate change increases the frequency of hurricanes and typhoons, coastal erosion also increases with climate change (Roger & Meyer, 1998). A combination of intense rainfall and high winds can lead to reduced sediment supply, further contributing to erosion. The coastal marshes of Louisiana are a living example of this phenomenon. These marshes are eroding at a rate of about 1,000 square miles since 1930s. This erosion has severely impacted local communities, leading to habitat loss, increased flooding, and threats to the fishing industry. As a result, many residents face displacement as their land becomes uninhabitable (Caison & Gina, 2024). In Kivalina, Alaska, the small Inupiat community has lost significant land to coastal erosion, leading to infrastructure damage and increased vulnerability to storms. Residents are facing the prospect of relocation, with costs estimated at tens of millions of dollars (Sindico et al., 2024). In Bangladesh, the Sundarbans region is experiencing severe coastal erosion, affecting millions of people. Loss of land has resulted in decreased agricultural productivity, increased salinity in freshwater supplies, and heightened vulnerability to cyclones, leading to food insecurity and displacement (Banerjee & Agarwala, 2024).

3.6 Saltwater intrusion

Saltwater intrusion occurs when rising sea level pushes saltwater into freshwater aquifers, contaminating drinking water sources and affecting agriculture (Basack et al., 2022). This intrusion could occur by as much as several hundred feet inland, particularly in low-lying coastal regions. For example, in the Florida Keys, saltwater intrusion has been documented to extend more than 5 miles inland in some areas (O'Donnell et al., 2024). In the Sundarbans of Bangladesh, saltwater intrusion has increased by 1 - 3 km per decade due to rising sea levels and human activities, threatening freshwater supplies for millions of people (Mukhopadhyay, 2023). On the Northeast coast of the US, studies have shown that salinity levels in groundwater can exceed 1,000 mg/l (milligrams per litre) in areas affected by saltwater intrusion, far surpassing the World Health Organisation's guideline of 250 mg/l for drinking water. In India, the National Agricultural Research System estimates that saline intrusion could reduce rice yields in affected areas of Sundarbans in West Bengal by up to 50 %, leading to increased food insecurity (Kumar, 2023). Similarly, Mueller et al. (2024) identified that

41 countries are projected to experience inland saltwater intrusion of at least 1 km by 2050 under the high emission RCP 8.5 scenario, and 26 countries under the intermediate emission RCP 4.5 scenario.

3.7 Economic impact

Since ocean services allow economic activities for monetary gains, it is natural that an impact on the coastal ecosystem will have an impact on these economic activities and, hence, expected monetary gains. Accordingly, economic impacts expected, and those observed, on coastal communities as a result of climate change are discussed.

3.7.1 Real estate and property values

Rising sea levels and increased flooding undermine coastal property values. As coastal areas become more vulnerable to inundation, property values can decrease, leading to financial losses for homeowners and investors. The cost associated with property damage due to storms and flooding, coupled with increased insurance premiums and the potential for reduced mortgage, increases economic stress on the communities staying in the coastal areas (Nwokedi, 2023). A report by the Swiss Re Institute estimates that climate change could result in global real estate and property losses of up to US $7 trillion (USD 7×10^{12}) by 2050 (Swiss Re Institute, 2024).

3.7.2 Tourism industry

Coastal tourism industry faces huge losses due to change in climate (Siddiqui & Imran, 2022). While coastal tourism is a major economic driver that generates substantial revenue and employment opportunities in many regions, climate change threatens this industry through beach erosion, habitat loss, and increased frequency of extreme weather events. Studies estimate that climate change could reduce global tourism revenue by US $1.4 trillion annually by 2025 due to impacts like rising temperatures, extreme weather, and sea level rise affecting popular destinations (United Nations World Tourism Organisation, 2022).

3.7.3 Fisheries and marine resource

Climate change affects marine ecosystems and fisheries, which are crucial components of coastal economies. Rising ocean temperatures, ocean acidification, and changing marine currents disrupt fish populations and habitats (Koondee et al., 2022). For example, climate change contributed to the collapse of cod fishery in Newfoundland and Labrador, leading to rapid ecosystem shifts in the region. Rising sea temperatures and altered oceanographic conditions weakened cod populations, disrupted their spawning, and altered predator-prey dynamics, leading to significant changes in the marine ecosystem, including proliferation of other species and long-lasting impacts on fisheries management (Wudrick, 2024). A report by the World Bank estimates that climate change could lead to a decline in global fisheries revenues by approximately US $10 to $30 billion annually by 2050 due to factors such as fish stock reductions, shifting fish populations, and disruptions in fishing industries (World Bank, 2020). Such reduced incomes will impact the earnings of coastal communities and force them to change their professions and their places of stay.

3.7.4 Infrastructure damage and adaptation cost

IPCC (2021) shows that coastal infrastructure, including roads, railways, bridges, ports, and seawalls, faces significant risks due to climate change. Increased flooding, storm surges, and coastal erosion cause substantial damage to these structures across various parts of the globe, resulting in costs towards rebuilding. Such trends are visible on every continent. In the US, the tourism sector of Florida is likely to face annual losses of US $1.5 billion by 2040 due to climate-related damages to infrastructure and natural attractions (Shi et al., 2024). Similarly, the Netherlands, which is below sea level, has been forced to develop sophisticated infrastructure to manage water and prevent flooding, thereby spending more than € 5 billion (US $ 5.15 billion) to construct and maintain a series of dams,

sluices, locks, dikes, and storm surge barriers, better known as the 'Delta Works' (Van Doorn-Hoekveld et al., 2022).

4. Impact on security

Discussions in the previous section have shown the likely impacts of climate change on coastal communities. Since the impact is on humans, it is natural for them to resort to competition and, hence, conflict, which would eventually impact security at the local, national, regional, and international level. Important amongst these are maritime, coastal, resource, social, and economic security, as seen in **Figure 4**.

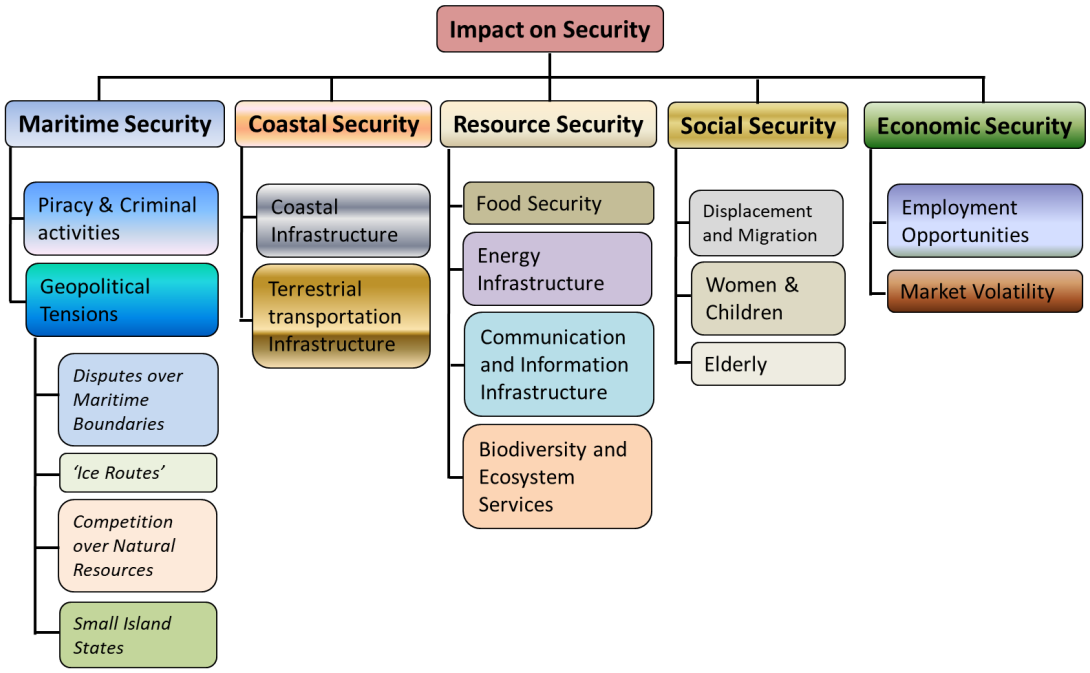

Figure 4 Impact of climate change on security (Source: Authors).

4.1 Impact on maritime security

Maritime security refers to the protection of oceans, seas, and coastal areas from various traditional and non-traditional threats, including piracy, smuggling, terrorism, and environmental hazards. It encompasses a range of activities aimed at ensuring safe and secure navigation, protecting marine resources, and safeguarding maritime infrastructure, which is increasingly affected by climate change. Since traditional threats are addressed adequately by nation states, and are discussed in detail elsewhere, this paper limits our discussion to non-traditional threats.

4.1.1 Piracy and criminal activity

Destabilization of economies and societies due to climate impacts can lead to increased piracy and maritime crime (Phayal et al., 2024). From current times, the agrarian society of Somalia is a perfect example of climate change impact on human security. Because of prolonged droughts and erratic rainfall, this agrarian community turned to fishing. This shift initially seemed promising; however, the situation worsened when foreign industrial fishing vessels began to exploit their waters, depleting local fish stocks and harming traditional fishing practices. In addition, dumping of radioactive and toxic waste by foreign ships made fishing dangerous and unprofitable. As a result, some individuals resorted to piracy for survival. The cycle of environmental degradation, loss of traditional livelihoods, and rising piracy highlights the complex interplay between climate change, resource management, and socioeconomic stability in Somalia (Barla & Agarwala, 2020; Asharful,

2024). Yet another impact of economic instability caused by climate change is weak governance. Such weak governance has allowed groups like the Islamic State of Iraq and the Levant (ISIS) to exploit power vacuums. Prolonged droughts in Syria, intensified by climate change, contributed to resource scarcity and migration, which in turn helped fuel the social unrest and instability that ultimately played a role in the rise of ISIS in the region (Schwartzstein, 2024). As a result of such events, smuggling increases, while enforcement reduces, thereby facilitating illicit activities. In an environment of illegal activities, displaced populations become vulnerable to radicalization, providing opportunities for recruitment and the growth of extremist organizations (Sperling, 2024).

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4.1.2 Geopolitical tensions

The impacts of climate change can exacerbate geopolitical tensions in several ways. As climate change affects sea levels, weather patterns, and resource availability, it intensifies existing disputes among nations and creates challenges. A few challenges likely to arise in this regard are discussed.

4.1.2.1 Disputes over maritime boundaries

Sea level rise can shift baselines, potentially altering the extent of a nation's territorial waters. This can lead to disputes over maritime boundaries and the sovereignty of maritime zones. Examples of this case are the shifting coastlines of the Sundarbans region between India and Bangladesh, which have a complicated delineation of territorial waters, particularly around disputed islands like New Moore. This situation is exacerbated by the potential of increased migration and claim of resources as territories change (Ali, 2024). Such changing claims are a cause for future conflict and, hence, a security concern for both nations. As sea temperatures rise, marine biodiversity is affected and disrupted, thereby increasing disputes over areas rich in fish stocks, as seen between India and Sri Lanka (Raghavan, 2019).

4.1.2.2 Ice routes

Melting polar ice can open new shipping routes (such as the Northern Sea Route, the North-West Passage, and the Transpolar Sea Route) and access to previously inaccessible resources (such as oil, minerals, and fish) in the Arctic, leading to increased competition and, hence, possible conflict among Arctic and non-Arctic states over control and rights in these areas (Mahmoud et al., 2024). For instance, the Northern Sea Route (NSR), which runs along the Russian coast from the Barents Sea in the west to the Bering Strait in the east, provides a shortcut between Europe and Asia, potentially cutting shipping times by as much as 40 %. However, this route passes through Russian territorial waters, leading to significant geopolitical and economic implications. Russia has increasingly emphasized its control over the NSR, viewing it as a critical economic and military corridor. In 2019, Russia passed a law requiring foreign ships to seek permission to use the route, essentially asserting sovereignty over these waters. Moscow has invested heavily in infrastructure to protect and control the route, including icebreakers and military installations along the Arctic coast. Russia also conducted large-scale military exercises in the Arctic, showcasing its ability to secure the NSR (Holland, 2024). Such power projection can be a cause for concern for other nations of the region and force increased military sending, thereby becoming a security concern for the region (Agarwala, 2021).

4.1.2.3 Competition over natural resources

As ocean temperatures rise, fishes will tend to move either deeper into the ocean or move north. In both cases, the availability of fishes will be impacted. This would lead to competition and possibly conflict for reduced resources. For example, cod stocks in the North Atlantic have declined due to warmer waters, pushing fishing fleets to seek alternatives further north, which intensifies competition among nations like Canada and Norway (Kjesbu et al., 2023). Similarly, the decline of

herring stocks in the Baltic Sea has led to increased tensions among EU member states vying for dwindling resources (Amanda, 2023). Unexplored natural resources in the Arctic will further add to competition among countries for exploitation rights.

4.1.2.4 Small island states

Small island states are particularly vulnerable to sea level rise and extreme weather events. Their struggle to secure international support and adaptation assistance can lead to geopolitical tensions with larger, more powerful nations or regional actors (Jon & John, 2020). These small island states may advocate for stronger climate action and support, which can lead to diplomatic conflicts with countries that are resistant to climate policies, or whose interests are threatened by such advocacy. For instance, the Maldives has pushed for ambitious global climate agreements, clashing with fossil fuel-dependent nations like Australia (Mycoo, 2020). Similarly, Pacific Island nations have criticized inadequate climate commitments of the US, straining relations despite historical ties (Melnik, 2023). These tensions reveal unequal distribution of responsibility and fuel a growing global focus on climate justice.

4.2 Impact on coastal security

Coastal security refers to the protection of coastal areas that include maritime boundaries, ports, and marine resources from various threats both traditional and non-traditional, such as illegal fishing, smuggling, human trafficking, and potential terrorist activities. Coastal security plays a vital role in responding to climate change impacts, such as rising sea levels and extreme weather events (Malla & Bandh, 2024).

4.2.1 Coastal infrastructure

Existing coastal defences, such as sea walls and levees, may become inadequate due to rising sea levels and increased storm intensity (Tran et al., 2021). Damage to these facilities can impact port operations by delaying cargo handling and increasing shipping costs, which would have a ripple effect on industries dependent on timely delivery and thereby disrupting global supply chains and local economies (Liang & Liu, 2020). These delays would impact economic growth and, hence, the economic security of a nation which, in return, would impact national security due to reduced economic might. This thus demands that coastal defences need to be reinforced to withstand climate change to ensure that the security of the nation is not impacted. The Port of Manila is one of the busiest in Southeast Asia. It is located in a region frequently impacted by typhoons and coastal flooding due to climate change. Typhoons like Haiyan (2013) and Ondoy (2009) have caused extensive damage to infrastructure, particularly at ports and logistics hubs. Damages caused by these typhoons to port facilities led to severe delays in both import and export shipments, impacting the world economy (Fauzi, 2021) and the Malaysian economy to a large extent.

4.2.2 Terrestrial transportation infrastructure

Terrestrial transportation networks in coastal areas, such as roads, railways, and bridges, can suffer from erosion, flooding, and damage caused by extreme weather events (UNECE, 2020). This can disrupt transportation routes, leading to delays, increased costs, and reduced accessibility. Coastal railways are most vulnerable to flooding and storm damage, which can affect freight and passenger services and demand significant investment to adapt to changing conditions. Similarly, airports located in coastal areas face a risk from flooding and storm surges, impacting flight operations, safety, and connectivity. ‘Hurricane Katrina’, in 2005, severely damaged the transportation infrastructure of New Orleans, with flooding rendering major highways and railways unusable. This led to significant disruptions in evacuations and supply chains (Staes et al., 2021). Superstorm Sandy of 2012 caused widespread flooding that damaged roads, bridges, and public transit systems in New York and New Jersey. Frequent landslides and coastal erosion due to climate change caused closures and repairs

along Highway 1 of California in 2017 (Gonzalez, 2021). Kansai International Airport of Japan, located on an artificial island in Osaka Bay, was inundated by storm surges caused by Typhoon Jebi. The airport's only connecting bridge was damaged by a drifting tanker, cutting off access to the mainland. This severely disrupted flight operations and passenger movement for days (Hiraishi et al., 2020). Damaged infrastructure can lead to reduced access to remote regions, disallowing relief and protection to these regions. This impacts the security of people and property living in these regions, making them vulnerable to agitation due to prolonged indifference.

4.3 Impact on resource security

Resource security refers to the availability and sustainable management of natural resources essential for human well-being that include food, water, and energy (Muhamad et al., 2023). Since coastal ecosystems are known to contribute extensively towards food, water, and energy, the threat to this environment due to climate change will have a direct impact on resource availability and, hence, resource security. As the global population grows and climate change intensifies, ensuring resource security has become a key challenge. Accordingly, authorities have been forced to adopt measures to address resource security both in coastal and inland regions. California has adopted water conservation measures to address frequent droughts; drought-resistant crops are being used in Sub-Saharan Africa to ensure food security, while India is moving to renewable energy to address energy security (Dubey et al., 2023).

4.3.1 Food security

Agriculture in coastal areas can be adversely affected by saltwater intrusion, flooding, and shifting climate patterns (Bedasa & Deksisa, 2024). Regular flooding due to sea level rise has caused a significant reduction in rice production in the Mekong delta of Vietnam (Phuong et al., 2024), thereby threatening food security, while coastal areas of Bangladesh face crop damage due to floods as a result of changing monsoon patterns and reduced rice yield due to higher temperatures, both resulting from climate change. Similarly, decreased production of rice, wheat, and other crops has been observed due to saltwater intrusion in the fertile delta of the Nile (Abd-Elaty et al., 2021). In the sea, increasing temperature and ocean acidity affect fish populations, leading to reduced catches and so threatening food security and reducing the income of coastal communities. Such increasing temperature has forced cod and haddock to migrate northward, away from their traditional fishing grounds in the North Sea. As a result, fishers in the southern parts of the North Sea have seen reduced catches, which threatens both local food security and the income of fishing communities (Talbot et al., 2024).

4.3.2 Energy infrastructure

Coastal power plants, including those that use sea water for cooling, are at risk from sea level rise, saltwater intrusion, and storm damage. Disruptions, if any, can have wide-reaching effects at both the local and national levels as power supplies form the backbone for ensuring clean water and healthcare (Meregillano et al., 2023). In 2022, Hurricane Fiona left Puerto Rico without power for several weeks, highlighting the vulnerability of Caribbean energy systems to extreme weather events. This serves as a stark example of how climate change is intensifying extreme weather events and exposing vulnerabilities in critical infrastructure. As a Category 1 storm, Fiona brought torrential rains, flash floods, and destructive winds that overwhelmed the island's already fragile power grid. With over 30 inches of rainfall in some areas, landslides and severe flooding devastated communities, while the entire island suffered a complete blackout (Sobhaninia, 2024).

4.3.3 Communication and information infrastructure

Coastal areas may experience disruptions in telecommunication networks due to storm damage and flooding (Tsaimou et al., 2024) which can impact emergency response and everyday

communication. In 2022, changing climate led to severe flooding in large parts of Thailand, including the capital of Bangkok. These floods disrupted communication networks, including internet and telephone services, due to submergence of critical infrastructure. A notable case was the flooding of a major data center facility that led to temporary outages for several international companies that had data storage in Thailand. This event raised concerns about the vulnerability of data centers to rising sea levels and increased precipitation, both of which are linked to climate change (Yokying & Promkhambut, 2024). Such events make a nation vulnerable to internal and external aggression and can become a serious security concern for security agencies.

4.3.4 Biodiversity and ecosystem services

Coastal ecosystems like mangroves, wetlands, and coral reefs provide essential services such as coastal protection, water filtration, and habitats for marine species. Climate change threatens these ecosystems, diminishing their ability to support biodiversity and protect coastal areas (Baharin & Kamarudin, 2025). The Great Barrier Reef has experienced repeated coral bleaching events, particularly in 2016, 2017, and 2020, due to rising sea temperatures caused by climate change. Corals, which are highly sensitive to temperature increases, expel the algae that provide them with food, leading to bleaching. These events result in the loss of biodiversity in the reef, as many species depend on corals for shelter, food, and breeding grounds. The ongoing degradation of the reef impacts local economies that depend on tourism and fisheries (Byrne et al., 2024). In addition to economic loss, degradation of corals would alter the biota of the ocean space, and even result in increased coastal wave impact to increase erosion or deposition, thereby changing the coastal ecosystem drastically. Such changes would lead to be a security threat due to the resulting inaccessibility of the altered coastal space.

4.4 Impact on social security

Climate change undermines social security systems by increasing demand for assistance due to health issues, disabilities, and forced displacement. Extreme weather events and climate-induced displacement can strain government resources, reduce tax revenues, and increase the number of people seeking social support, threatening the sustainable maintenance of social security (Ebi, 2021). This various impacts on social security demand a closer look.

4.4.1 Displacement and migration

Climate-induced extreme weather events force displacement of local populations. These displacements are more visible in coastal areas, as sea level rise and frequent cyclones force coastal communities to be displaced forcibly inland. Inhabitants of small island nations like Kiribati are an example of those affected by forced displacement leading to potential geopolitical and humanitarian challenges (Kupferberg, 2021), increased pressure on inland areas, and potential conflicts over resources. Those forced to migrate often face a host of difficulties, including inadequate access to basic services such as healthcare, food, water, education, and housing. Such transitions can be fraught with obstacles, including legal and bureaucratic barriers, cultural differences, and a lack of social networks (Draper, 2024). Sometimes the resulting impact can be accentuated by anthropogenic activities. Jakarta is a classic case, wherein the city is sinking at an alarming rate primarily due to excessive groundwater extraction and rising sea levels. These combined events have made coastal areas of Jakarta vulnerable to flooding, displacing thousands of people driven by government support (Farida, 2021). When displaced, social security is as risk.

4.4.2 Women, children, and the elderly

Women are often more vulnerable to the impacts of climate change due to socioeconomic disparities and gender roles (Swaminathan, 2024). In many regions, women are responsible for household food production, water collection, and caregiving. Since climate change disrupts

agricultural yields and water availability, it becomes harder for women, especially those who are residing in coastal areas, to fulfil these roles. In 2023, in regions of East Africa, severe droughts and coastal erosion displaced fishing communities, leaving women without income and children malnourished. With food insecurity worsening, many families struggled for clean water and healthcare, increasing the vulnerability of pregnant women and infants (Mokwena & Maphaka, 2025).

Similarly, children are vulnerable to the effects of climate change, as they impact their physical and emotional well-being. Intensified storms and king tides of 2024 in Pacific Island Nations damaged shelters and schools, forcing children, especially girls, to drop out. Women in these communities faced rising cases of gender-based violence in overcrowded and unsafe evacuation centers (Lewis & Kelman, 2025). Like children, the elderly are dependent and are equally impacted when climate change related devastation occurs. Since the major section of the society that includes, women, children, and the elderly are impacted by climate change, social security for the community is impacted, and can lead to unrest and conflict.

4.5 Impact on economic security

Economic security involves the economic stability of a nation and its ability to provide livelihood for its citizens. Climate change is a critical threat to economic security, as it has the potential to disrupt economies at both local and global levels. Extreme weather events, such as floods, hurricanes, and heatwaves, can devastate infrastructure, displace populations, and halt food production. Some major threats to economic security are discussed.

4.5.1 Employment opportunities

Climate change affects job security across various sectors. In 2022, the fishing industry in the Philippines was heavily affected by typhoons and rising sea levels that damaged boats, destroyed fishing grounds, and reduced fish populations, leaving thousands of coastal fishers unemployed. Many struggled to find alternative livelihoods, forcing them into urban migration or informal labor (Contreras & Ancog, 2025). Similarly, Hurricane Idalia caused extensive coastal damage, leading to temporary closures of resorts, restaurants, and tour agencies. With beaches eroded and infrastructure damaged, thousands of workers in the tourism sector lost jobs or faced reduced incomes (Shi et al., 2025). A study estimates that the economic damages for the US due to climate change-related weather events could lead to a 2 % reduction in their national GDP by 2100, with agriculture and other outdoor industries being the worst hit (Fei et al., 2023). Another study shows that, in developing countries, shifts in rainfall pattern due to climate change have caused widespread job losses in rural communities (Waqas et al., 2024). Such events can force those from the weaker section to indulge in criminal activities, thereby creating increased stress on security agencies.

5. Discussion

The impact of climate change on coastal communities the world over is increasing on a daily basis. It is leading to the destruction of assets and a heavy loss of human lives. Flooding in Spain in 2021 caused hundreds of deaths and damages, far surpassing all known previous records, because of a phenomenon known as ‘Cold Drop’, or *gota fría*, which is attributed to climate change and causes intense rainfall and flooding (Gimenez, 2021). Scientists opine that the severity of ‘Cold Drop’ has increased due to climate change. The global community has witnessed numerous climate change events in the recent past, bringing to fore the eminent danger that looms over us. These events have impacted numerous lives. With a major percentage of humanity residing near coasts, it is natural to see that a major section of those affected are coastal communities. History has shown that the resulting impact of climate change can have an impact on security. Piracy off Somalia and the rise of ISIS are some living examples of these impacts that continue to threaten global security even today.

As climate related events increase, coastal communities continue to face the brunt of increased loss of livelihood, forced displacement, economic loss, and more as the immediate effect of climate change is felt by them (Mendelsohn et al., 2024). Damage to coastal infrastructure and facilities due to climate change has a cascading economic impact on coastal populations (Abdulaziz et al., 2024). While the effect of such events impacting the security of a nation may not be openly visible, they have an adverse and long-lasting impact on it, as discussed in this study. Climate induced migration has a maximum impact and is an emerging security challenge at the national, regional, and international levels. Internal displacement leaves a vacuum in the otherwise seamless coastal security architecture, which can be exploited to the advantage of inimical minds (McLeman & Gemenne, 2011). If displacement is external to a nation, the receiving nation faces security challenges of food and water availability, increased economic and social demands, and demographic changes.

It is expected that, since climate change will make existing marine resources scarce, competition for accessing these resources is likely to increase substantially. The depletion of fisheries and the opening of new maritime routes due to melting ice in the Arctic have already led to increased tensions among nations vying for control over exclusive economic zones (EEZs) and access to valuable marine resources, such as oil, gas, and fisheries. Nations with competing interests over these resources are likely to engage in disputes, or even conflict, over rights to exploit marine resources. These tensions are expected to escalate when access to resources becomes the central issue in the future geopolitical landscape. This can lead to geopolitical instability, as countries with strategic interests in a region clash over territorial claims and exploration rights (Alam et al., 2024).

While climate change in itself does not impact security, it exacerbates sociopolitical and socioeconomic causes that encourage and threaten security. A study by Silke and Morrison (2022) has examined the complex relationship between climate change and Non-State Armed Groups (NSAG). The report shows how climate change acts as a 'threat multiplier' by creating additional pressures on existing security arrangements that enhance the possibility of violent conflict. When these NSAG are represented by terrorist groups such as Al Qaeda, ISIS, or *al-Shabaab*, human security becomes an area of concern. Of greater concern to security is that events that helped the rise of these NSAG are now becoming twice as likely as earlier years as the result of the direct consequence of human interference in the climate system.

While climate change adversely affects people due to food insecurity, heat-stress, water-stress, loss of arable land due to desertification or rise of sea level, and rise in salinity of ground water, it also increases the vulnerability of affected communities to be eventually recruited by NSAG to create security threats. One notices that in Chad, the recruitment of affected communities has a direct correlation with the increasing shrinkage of Lake Chad. Similarly, the rise of the *al-Shabaab* terrorist group in Somalia that brought piracy to the Horn of Africa is seen to be directly related to heat-and-water stress in the region.

Water scarcity due to climate change events is also a cause of armed conflict between countries that share the same river. Egypt, Ethiopia, and Sudan, over the rivers that feed the Nile, Turkey and Iraq over dams on the Tigris, Israel and its neighbours over the waters of Jordan, and India and Pakistan over the Indus are some examples where water can be 'weaponized' and become a cause for serious conflict.

What stands out as a matter of concern is that, even though the impact of climate change has been known to humanity for years, not much effort has been taken to reverse the impact to date. These efforts have tended to be derailed even further when the governments of developed nations decide to withdraw from climate change agreements, like the recent withdrawal of the US from the Paris Agreement. In effect, if humanity has to meet the set global targets of 2 °C by 2030, a political will is essential. It would be apt to point out that the impact due to achieving 1.5 and 2 °C is drastic, as seen in **Table 1**, and has a direct bearing on coastal communities and national security as a whole.

This demands that greater scholarship and focus be provided to studies on climate change and security related issues, which otherwise have been neglected so far.

Table 1 Increased impact of climate change in a 1.5 and 2 °C scenario (Source: Authors' compilation).

	Impacts	**1.5 °C scenario**	**2 °C scenario**	**Increased impact**
Direct	Extreme heat	14 %	37 %	2.6 times
	Ice-free Arctic	In 100 years	In 10 years	10 times
	Sea level rise	0.4 m	0.46 m	0.06 m
Species	Loss of vertebrates	4 %	8 %	2 times
	Loss of plants	8 %	16 %	2 times
	Loss of insects	6 %	18 %	3 times
Land	Ecosystem	7 %	13 %	1.86 times
	Permafrost	4.8 million km^2	6.6 million km^2	38 %
	Crop yield	3 %	7 %	2.3 times
Ocean	Coral reefs	70 - 90 %	99 %	29 %
	Fisheries	1.5 million tons	3 million tons	2 times

6. Way ahead

Mitigating the impacts of climate change on coastal communities and security involves a multifaceted approach that integrates adaptive strategies, infrastructure improvements, policy measures, and community engagement at the national, regional, and international levels. Some mitigation measures to address the challenges posed by climate change are discussed below.

6.1 Adaptive strategies

Adaptive strategies are measures implemented to prepare systems such as communities, infrastructure and ecosystems against the impacts of climate change, enhancing resilience and reducing vulnerabilities. These strategies include managed retreat, climate-smart agriculture, and ecosystem restoration, all aimed at mitigating risks and fostering sustainability in the face of changing environmental conditions (Meenakshi, 2020). In some areas, retreating from high-risk zones may be the most effective adaptation strategy. Managed retreat involves the planned relocation of communities and infrastructure away from vulnerable coastal areas after careful planning (Osland et al., 2022). Climate-Smart Agriculture (CSA) is an approach designed to help farmers adapt to, and mitigate the impact of, climate change, while ensuring food security and sustainable development. It can help address conditions of saltwater intrusion, increased flooding, and altered growing season (Nkumulwa & Pauline, 2021). Restoring and conserving natural barriers such as mangroves, wetlands, and coral reefs is an ecosystem restoration technique. Such coral conservation and restoration efforts will help to prevent shoreline from erosion (Allison, 2023). Yet another mechanism that has been successfully experimented in China is the development of 'sponge cities' that focus on creating a landscape environment for accumulation, filtration, and purification naturally. Such cities can deal with water risks such as floods and drought caused by climate change (Zwvenbergen et al., 2018). Realising the negative impact of a liner manufacturing policy, economies are slowly shifting to Circular Economy to achieve cradle-to-cradle economy in place of a cradle-to-grave economy (Agarwala, 2023). This Circular Economy, when operated with Nature Based Solutions, will help greater adaptation, resilience, and sustainability without causing serious environmental damage, thereby addressing increased carbon emissions.

6.2 Infrastructure improvements

Infrastructure improvement involves upgrading or redesigning physical structures to better withstand climate-related impacts of flooding and rising sea levels. These improvements help protect communities against climate vulnerabilities and contribute to long-term environmental sustainability. To withstand extreme weather events, critical maritime infrastructure must be made climate resilient. This can be done by building or upgrading existing sea walls, dikes, and levees that protect coasts against storm surges and rising sea levels by reducing wave energy incident on the coastline (Verschuur et al., 2024). Constructing buildings near seacoasts incorporating flood-resistant materials and designs minimize damage from flooding. The experience of Ujunggebang village in West Java provides several valuable lessons like community participation in mitigating the effects of climate change and collaborations among various stakeholders for other rural coastal communities facing coastal erosion and climate-related challenges (Setyawan, 2022).

6.3 Policy measures

Climate change is a global, systemic issue that requires coordinated action across all sectors of society, including energy, transportation, agriculture, and industry. Without clear and enforceable policies, individual efforts may not be enough to drive large-scale changes necessary to limit global warming and its associated impacts. Some such policy measures may include the strengthening of the legal framework of a nation in line with international agreements on climate change (Cruz-Ramírez et al., 2024), improving emergency response systems through a legal framework to clarify and highlight the roles of various agencies during a disaster (Bera et al., 2021), creating response plans that include evacuation routes, emergency shelters, and resource allocation, and encouraging effective resource management through sustainable management practices to protect ecosystems, avoid over-exploitation of resources, and ensure the resilience of coastal communities (Dey et al., 2024), to name a few. There is also a need to ensure that policies that look at developing coastal zones and the Blue Economy are looked at closely to create resilience mechanisms for coastal communities. Activities such as Environmental Impact Assessment (EIA) should be undertaken diligently, and waivers to overrule shortcomings should not be permitted.

6.4 Community engagement

Community engagement for developing adaptation and mitigation strategies is critical to mitigate the effect of climate change, as local communities are the first to experience these impacts. This allows solutions to be relevant to local contexts and fosters ownership, resilience, and long-term sustainability. This can be achieved by creating public awareness through activities such as conservation projects, beach clean-up drives, training and capacity building, and others (John & Lara, 2021). It is important that, whenever any development or activity is planned for coastal areas, coastal communities of the region should be associated in the planning and execution stages to ensure that native plants are used and undue damage to the coastal zones is avoided.

6.5 Actions at the international level

Since the impact of climate change is not limited to a nation or a region, mechanisms at the international level need to be developed. However, addressing climate change through international policies requires coordinated action among nations. Such collaboration would help in setting shared goals, creating frameworks for collective action and mobilizing resources to reduce greenhouse gas emissions, promote sustainable development, and build resilience in vulnerable regions. Some areas of collaboration are coastal management, climate resilience, the reduction of carbon emissions from shipping, and collaborative research and development (Agarwala et al., 2021). Advances through research and innovation can provide new technologies, methodologies, and strategies that, in effect, will help track environmental changes, monitor coastal conditions, and assess risks (Suratini et al., 2024), thereby enhancing coastal security amidst the challenges of climate change (Stelvia et al.,

2022). When undertaken at the international level, these will leverage diverse expertise and resources in coastal security research. Some critical areas of research that need to be supported include flood risk management, ecosystem restoration, and infrastructure resilience (IPCC, 2021). In doing all this, the use of Big Data to develop prediction and resilience models is feasible only if the collected data is accessible to researchers, policymakers, and the public alike (Reed & Tress, 2019).

7. Conclusions

Climate change presents a multidimensional challenge for coastal communities and security. For coastal communities, the risks are stark, as they are the first to face the impact of extreme events, such as sea level rise and erosion that brings about the loss of land and homes and jeopardizes freshwater resources and agricultural productivity. Such changes contribute significantly to socioeconomic pressures, community resilience, and their well-being. The resulting security implications are equally significant. The displacement of populations can lead to increased migration and potential conflicts over resources. Coastal infrastructure, crucial for economic and national security, is vulnerable to damage from climate-related events, while shifting maritime boundaries and resource access due to changing coastlines can heighten geopolitical tensions, complicating international relations and security dynamics.

To address these challenges, a comprehensive and proactive approach is considered essential. Strengthening coastal defences, implementing integrated management strategies, and investing in resilient infrastructure are essential steps. Enhancing surveillance, improving emergency response systems, and fostering international cooperation will further bolster coastal security. Public awareness, engagement with coastal communities, and robust policy frameworks are critical in adapting to the evolving risks posed by climate change, as discussed in this paper.

The impact of climate change on coastal communities and security underscores an urgent need for concerted efforts to mitigate and adapt to these challenges. By prioritising resilience, collaboration, and innovation, coastal communities can be better safeguarded and long-term stability in the face of a changing climate ensured. The path forward requires a united global effort, blending scientific research, technological advancements, and proactive policies to address the complex interplay between climate change and coastal security.

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