# Sea level rise in Kenya

## Trends and vulnerabilities

*This review aims to summaries some key findings from literature to provide an overview of sea level rise trends and vulnerabilities in Kenya. However, as its scope is limited by time and available resources, the review will not cover all trends and vulnerabilities of sea level rise in Kenya.*

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# 1. Introduction

Sea-level rise (SLR) is primarily driven by ocean warming and the melting of glaciers and ice sheets, both of which are direct consequences of climate change. Since 1880, global mean sea levels have risen approximately 20–23 centimetres, with the rate of increase over the past decade exceedingly twice that observed during the first decade of satellite records (1993–2002). Sea level rise in Kenya is projected to increase by 0.5 to 0.96 meters by 2100, and under scenario SSP3-7.0, by 0.75 meters (Climate Change Knowledge Portal, 2021; Tomalka et al., 2021). Sea level rise specifically presents a risk to the five coastal counties Kwale, Mombasa, Kilifi, Tana River, Lamu and their populations (Climate Change Knowledge Portal, 2021).

## Geography and economy

The Republic of Kenya is located in East Africa and borders the Indian Ocean, with around 536 kilometres of coastline (CIA, 2025). It has a population of approximately 56,4 million (in 2024), with rapid urbanisation projected to increase from 27% to 46% by 2050 (World Bank, 2021, 2025). Kenya is characterised by low laying areas at the coast, such as Mombasa, and plateau and high lands inland (Tomalka et al., 2021). The geography of Kenya creates key differences in vulnerability to climate change impacts within the country, where some parts are more affected by drought, and others by storms, flooding, and SLR (Trisos et al., 2022).

Kenya's economy is the largest in East Africa, which is classified as lower-middle income, and is highly dependent on agriculture and services, particularly tourism and shipping (World Bank, 2021). The agricultural sector contributes about 28% to GDP and employs over 70% of the rural population, primarily through smallholder farms reliant on rainfall (World Bank, 2025). Coastal tourism contributes approximately 12% to GDP and 27% of foreign exchange earnings (Detelinova et al., 2023). Marine fisheries (mostly small-scale) contribute to over 95% of the national marine catch. However, they face substantial declines in productivity and species richness due to warming waters and ocean acidification (World Bank, 2021).

Kenya's coastline, home to critical infrastructure and vital economic parts, is increasingly vulnerable to climate change impacts including sea level rise, saline intrusion, and coastal flooding (Nying'uro et al., 2023). As climate extremes intensify, Kenya's socio-economic vulnerabilities are expected to worsen (Nying'uro et al., 2023; Trisos et al., 2022).

# 2. Sea-level rise and associated risks

Kenya faces significant and growing risks from sea-level rise, primarily due to its coastline, its growing population, and heavy dependence on climate-sensitive sectors, such as agriculture, tourism, fisheries, and port-based trade (Wilson et al., 2021; World Bank, 2021). As mentioned above, sea-level rise poses significant risks for the coastal counties. In particular danger is the city of Mombasa, "with an estimated area of 4-6 km2 likely to be submerged with a rise in sea level of only 0.3 meters," which is Kenya's second-largest city and East Africa's biggest port (World Bank, 2025).

## 2.1 Environmental risks

SLR compounded by global warming, intensifies coastal hazards such as storm surges, tsunamis, and flooding (Trisos et al., 2022). Kenya's coastal region is already significantly influenced by marine weather phenomena, particularly tropical cyclones (Nying'uro et al., 2023). Sea level rise in combination with extreme weather events are likely to intensify flooding in most of the coastland, including key tourism areas (World Bank, 2021). On the coastline, cities, ports, and infrastructure are low-lying, which creates a risk with increased runoff and flooding that affects transport networks, ports, and energy infrastructure (Tomalka et al., 2021).

Continuing, Kenya's coastline is consisting of mangroves, coral reefs and sea grass (Brown et al., 2010). The mangrove trees in Kenya represent approximately 3% of natural forest cover, covering more than 60,000 hectares. Around 60% of the mangroves occur in Lamu County (Muratha, 2024). Mangroves are rich in biodiversity; they serve as nursery grounds for fish and shellfish, while their roots act as a filter for sediment, cleaning up waterways. Similarly, coral reefs are all along the entire coast of Kenya (Obura et al., 2000). SLR and changes in sea temperature and acidity make mangroves and coral reefs vulnerable, which have further implications for food security as well as storm surges (Detelinova et al., 2023).

More intense cyclones and rising sea levels caused by climate change directly threaten coastal communities and intensify erosion in coastal areas. Erosion can further undermine foundations and disrupt transportation and communication networks, limiting access and increasing repair costs (Campbell et al., 2023).

SLR in combination with flooding can lead to saltwater intrusion. SLR undermines the long-term persistence of freshwater-dependent ecosystems on the island, mainly due to saltwater intrusion (Campbell et al., 2023). Saltwater is moving into freshwater, which causes the salinity of the groundwater to increase (Ghirardelli et al., 2025). These changes are likely to worsen water availability and affect coastal plains, islands, wetlands, and estuaries, leading to increased salinity and degradation (Detelinova et al., 2023).

## 2.2 Infrastructure

Sea level rise also endangers vital infrastructure on the Kenyan coast. Coastal cities like Mombasa and cities in the Kilifi and Lamu region face heightened risks of the consequences of SLR. Coastal infrastructure, such as schools, hospitals, roads, bridges, ports, and power supply systems, is at risk of damage or disruption, threatening essential services.

Rising sea levels risk, for example, of damaging and destroying ship docking ports and industries located on the coast (World Bank, 2021). High precipitation amounts can lead to flooding of transport infrastructure (Tomalka et al., 2021), strong winds, storm surges, and erosion can damage roads, electricity infrastructure, coastal aquifers, urban settlements, low-laying hospitals (such as the Mombasa hospital and Langoni Hospital), schools, and so on (Nying'uro et al., 2023).

Sea Level Rise typically does not directly affect hydropower the way it affects coastal systems. However, indirect effects from climate change and SLR can still impact hydropower. In 2020, more than 40 percent of Kenya's power was sourced from hydropower (Detelinova et al., 2023; International Energy Agency, 2020). Changes in rainfall patterns, glaciers melting, and temperature, create unpredictable river flows, which in turn reduce hydropower generation capacity (International Energy Agency, 2020). SLR and storm effects on erosion can also lead to an increased sediment load, which can reduce the efficiency of hydropower generation (International Energy Agency, 2020).

## 2.3 Economy

SLR effect on Kenya's coastal plains, islands, beaches, wetlands, and estuaries will have significant economic implications for tourism and critical infrastructure (Detelinova et al., 2023).

Tourism and shipping are the highest contributions to the coastal economy (World Bank, 2025). The tourism sector contributes 10% of the country's national Gross Domestic Product (GDP) after a strong rebound following the COVID-19 period (Detelinova et al., 2023; Onyango & Ongoma, 2014). Much of the coastal tourism is dependent on sandy beaches, historic and cultural monuments and several hotels, industries and port facilities which would be negatively affected by SLR (Cynthia Brenda Awuor et al., 2008).

Furthermore, Mombasa has the largest seaport in East Africa, serving not only Kenya but also many landlocked countries and the north of Tanzania (Cynthia Brenda Awuor et al., 2008). Damages to the city's infrastructure could also affect other sectors, including trade in the East African region (Detelinova et al., 2023). This is compounded by the fact that rising temperatures and sea levels in Kenya's coastal areas are projected to strengthen coastal winds and storms, which will affect ship navigation and port operations (Detelinova et al., 2023).

## 2.4 Social and health risks

SLR can create the loss of livelihoods, especially for communities dependent on agriculture, fishing, or tourism. As previously mentioned, saltwater intrusion can lead to increased soil salinity and degradation, which worsens the quality of soil for agriculture (in particular for the coast of Kenya, production of mango, cashew, and coconut) (Detelinova et al., 2023).

Coastal informal settlements, such as those in Kilifi and Mombasa, host significant populations that face considerable socioeconomic and environmental vulnerabilities. While it is difficult to get the exact numbers, Kilifi has 11 informal settlements housing approximately 65,000 people (UN Habitat, 2020) while nearly 50% of the population in Mombasa resides in informal settlements across areas including Kisauni, Likoni, Main Island, and West Mainland (Ren et al., 2020). These settlements are characterised by high population density and limited access to essential services such as water, sanitation, waste management, public transportation, formal employment, and healthcare. Consequently, residents are highly susceptible to climate change impacts, including SLR (UN Habitat, 2016).

SLR will further have a negative impact on the marine ecosystem, such as mangroves and coral reefs, which is bound to have a negative effect on the local people who depend on fishing

(Cynthia Brenda Awuor et al., 2008). Fishing is a vital livelihood for many coastal communities in Kenya, providing food security, employment, and contributing significantly to the local and national economy (Wilson et al., 2021). Marine fisheries contribute 2% to agricultural GDP, and 95% of marine catch is small-scale, making the sector critical for both economic sustenance and cultural heritage (World Bank, 2021). Reduced fish stocks and increased operational challenges threaten the income and food security of thousands of small-scale fishers who rely on coastal waters for their livelihoods (Tomalka et al., 2021).

Additionally, the health of coastal populations is at risk as saline intrusion affects coastal aquifers that can compromise drinking water and irrigation, and the permanent inundation of low-lying areas renders them uninhabitable (World Bank, 2021). Like previously mentioned, the coastline of Kenya has areas with insufficient water and sanitation, especially in informal settlements. Poor or insufficient water, sanitation, and infrastructure management can exacerbate saltwater intrusion in those coastal areas (Detelinova et al., 2023; Ghirardelli et al., 2025).

# 3. Adaptation measures

Finding relevant research on adaptation measures to SLR in Kenya has proven difficult. However, authors emphasise the need for adaptation and mitigation measures to SLR to reduce vulnerability (Oppenheimer et al., 2022; Tomalka et al., 2021; Trisos et al., 2022). In the absence of adaptation, more intense and frequent risks are projected to occur, such as erosion, flooding, and salination (Oppenheimer et al., 2022). However, while ambitious adaptation cannot eradicate the entire SLR risk, it can help to buy time in many locations (Oppenheimer et al., 2022).

Among various strategies, the government states the need for strengthening enhanced early warning systems (Republic of Kenya, 2025). Monitoring high tide levels in Kenya is also stated to be important for mitigating the impacts of coastal flooding, erosion, and saltwater intrusion, which are coordinated through the KMS for the Western Indian Ocean Region (Nying'uro et al., 2023; Shilenje & Ogwang, 2015).

Kenya has national-level policies and institutional measures such as Kenya National Adaptation Plan 2015-2030 (2016) that highlights coastal risks from SLR and proposes strengthening resilience of coastal communities; the Climate Change Act (No. 11) (2016) which supports climate risk assessment and mandates integration of climate change risks into national and county development plans; and National Climate Change Action Plan (NCCAP) III 2023-2027 which highlights climate-resilient development in coastal zones (Government of Kenya, 2023).

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