

Environmental Impact Report 5: Climate Change and Rising Sea Levels

1. Introduction

Climate change is no longer a distant threat—it's a reality unfolding in real time. From melting glaciers in the Arctic to record-breaking heatwaves across continents, the Earth's climate system is undergoing dramatic shifts, primarily due to human-induced greenhouse gas emissions. Among the many consequences of global warming, rising sea levels stand out as one of the most far-reaching and dangerous. Driven by the thermal expansion of seawater and the melting of ice sheets and glaciers, sea level rise threatens to redraw coastlines, inundate low-lying islands, and displace millions of people worldwide. This report explores the causes, current trends, and cascading effects of rising sea levels as a consequence of climate change, offering insights into what the future may hold for human civilization and the natural world.

2. Causes of Rising Sea Levels

Rising sea levels are primarily caused by three interlinked mechanisms: thermal expansion, melting glaciers and ice caps, and the disintegration of polar ice sheets.

Thermal expansion is a direct result of global warming. As ocean temperatures rise, seawater expands. This seemingly small change in volume has a profound effect when applied across the vast scale of the world's oceans. Scientists estimate that thermal expansion accounts for nearly half of observed sea level rise since the early 20th century.

Glacial melt contributes significantly as well. Glaciers around the world—from the Himalayas to the Andes—are retreating at alarming rates. These freshwater reserves, once stable, now release massive volumes of water into the ocean, elevating global sea levels. Likewise, the melting of the Greenland and Antarctic ice sheets—particularly the West Antarctic Ice Sheet—poses an even greater long-term threat. If fully melted, these could contribute several meters of sea level rise, permanently submerging coastal cities and entire island nations.

Additionally, land subsidence due to natural tectonic movements, groundwater extraction, and deforestation exacerbates relative sea level rise in certain regions. When combined with rising seas, these factors lead to even more severe consequences for vulnerable coastal populations.

3. Current Trends and Scientific Projections

Sea level rise is accelerating. According to the Intergovernmental Panel on Climate Change (IPCC), global mean sea levels rose by about 20 centimeters (approximately 8 inches)

between 1901 and 2018. However, the rate of rise has increased in recent decades—from 1.4 millimeters per year in the early 20th century to more than 3.6 millimeters per year between 2006 and 2015.

Projections suggest that if greenhouse gas emissions continue unchecked, sea levels could rise by up to one meter (around 3.3 feet) by the year 2100. In a worst-case scenario involving accelerated ice sheet disintegration, some models predict rises of over two meters. While this may seem modest, the impact is anything but—particularly in densely populated coastal regions.

Even a few centimeters of rise can significantly increase the frequency and severity of storm surges, king tides, and coastal flooding. Island nations like the Maldives and Tuvalu, as well as coastal megacities like Jakarta, New York, and Mumbai, are already experiencing the effects, and the threat is only expected to grow.

4. Socioeconomic and Humanitarian Impacts

The most immediate human impact of rising sea levels is displacement. Low-lying islands and coastal communities face the risk of becoming uninhabitable due to chronic flooding and saltwater intrusion. According to the World Bank, over 100 million people could be forced to migrate by 2050 due to rising seas, creating what are known as “climate refugees.” These populations, often among the world’s poorest and least responsible for global emissions, are the first to bear the burden.

Saltwater intrusion into freshwater aquifers renders groundwater undrinkable, impacting agriculture and potable water supplies. In places like Bangladesh, rice paddies are becoming saline, threatening food security for millions. Coastal erosion accelerates as protective mangroves, wetlands, and dunes are lost, increasing the vulnerability of inland areas to storms and flooding.

Economic losses are staggering. Rising seas threaten critical infrastructure such as ports, airports, power plants, and sewage systems. Insurance costs have skyrocketed in vulnerable areas, and entire sectors—like coastal tourism, fisheries, and real estate—face decline or collapse. In the U.S. alone, climate-related coastal flooding could cost hundreds of billions of dollars annually by the end of the century.

5. Ecological and Environmental Consequences

Beyond human societies, rising sea levels wreak havoc on marine and coastal ecosystems. Saltwater intrusion alters the delicate balance of estuaries, affecting breeding grounds for fish and birds. Coral reefs, already under threat from ocean acidification and warming, face additional stress from sedimentation and changing water levels.

Mangrove forests, which serve as vital carbon sinks and storm buffers, are being drowned as they are unable to migrate inland due to human development. Similarly, salt marshes and

coastal wetlands, essential for flood control and biodiversity, are disappearing at alarming rates.

The disruption of these ecosystems leads to a decline in fish stocks and biodiversity loss, which cascades through the food chain. In some regions, endangered species such as sea turtles, who nest on beaches now regularly washed over by tides, are losing critical habitat and reproductive success rates are plummeting.

6. Regional Case Studies

Several regions across the globe offer stark illustrations of the risks posed by rising sea levels.

In the South Pacific, nations like Kiribati and Tuvalu are already purchasing land in neighboring countries such as Fiji, in anticipation of their territories becoming submerged. Sea walls and land elevation efforts are proving insufficient in the face of increasingly powerful tidal surges.

Indonesia's capital, Jakarta, is sinking faster than any other city in the world—at some points over 25 centimeters per year—due to groundwater extraction and rising seas. The government has announced plans to relocate the capital to Borneo, highlighting the severity of the issue.

In the United States, cities like Miami, New Orleans, and Norfolk face chronic “sunny day flooding,” where streets flood not during storms, but during high tides. Billions of dollars are being spent on pumps, sea walls, and building elevations, but these are largely temporary fixes without emissions mitigation.

7. Global and National Policy Responses

Addressing rising sea levels requires both mitigation and adaptation. On the mitigation front, the Paris Agreement aims to limit global warming to below 2°C—and ideally 1.5°C—above pre-industrial levels. Achieving this goal requires rapid decarbonization through renewable energy, energy efficiency, and reforestation.

Adaptation strategies include building sea walls, restoring natural barriers like mangroves and wetlands, elevating infrastructure, and implementing early warning systems. In the Netherlands, a country largely below sea level, innovative approaches such as floating neighborhoods, water plazas, and “Room for the River” projects showcase how design and policy can work hand-in-hand to create resilience.

However, many countries, particularly in the Global South, lack the resources to implement large-scale adaptation plans. International funding mechanisms such as the Green Climate Fund and climate resilience grants are essential to ensure equity in climate adaptation efforts.

8. Recommendations

Tackling the challenge of rising sea levels demands coordinated global action. First and foremost, greenhouse gas emissions must be drastically reduced. Nations must uphold their climate commitments, transition away from fossil fuels, and invest in clean technology.

Simultaneously, governments should map and assess the vulnerability of their coastlines, prioritize climate-resilient infrastructure, and revise zoning laws to discourage high-risk development in flood-prone areas. Urban planners must integrate climate data into future development projects, ensuring cities grow upward, not outward, in flood-prone zones.

Public awareness and education are equally critical. Coastal communities must be equipped with the knowledge and tools to respond effectively to climate risks. Participatory planning, where residents are involved in shaping their future, strengthens social cohesion and preparedness.

Finally, nature-based solutions—like mangrove restoration, coral reef conservation, and dune reinforcement—should be integrated into national adaptation plans. These solutions not only buffer against storm surges but also enhance biodiversity and carbon sequestration.

9. Conclusion

Rising sea levels represent one of the clearest and most undeniable signals of a planet in crisis. It is a phenomenon that bridges science, economics, policy, and human rights, affecting not just coastlines but the very fabric of global stability. We cannot afford to view rising seas as tomorrow's problem—they are already shaping today's reality. Every centimeter of sea level rise comes at a cost, but every ton of carbon we avoid emitting brings us closer to a safer, more resilient future. The time to act is not next year or next decade—it's now.