

Climate change and coastal ecosystems

Coastal Ecosystems



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There is now a solid body of evidence that human activities are resulting in the warming of our planet, faster than any time in the past 10,000 years. During the last century, global temperature increased by about 0.8°C - measured as the largest increase in thousand years. The five hottest years on record are in the last decade and this one, with 2005 as the hottest year.

Associated with this global warming are profound changes such as melting glaciers and an attendant rise in sea level. In 2002, NASA confirmed that the extent of Arctic ice had lessened; glaciers in the European Alps have decreased by approximately half their extent since the mid 1800s and one fifth of their remaining volume since 1980.

Melting glaciers in turn, result in sea-level rise. The current rate of sea-level rise is three times the historical rate and sea levels have already risen by 10-20cm in the last century. The IPCC predicts that global sea levels will rise between 0.09 to 0.88m by 2100. An increased sea level rise will lead to sea water intrusion into freshwater bodies and aquifers. Melting glaciers also have substantial impacts on rivers flows and water availability downstream.

Also associated with global warming is altered precipitation, which has significant impacts on world water and food security. In 1995, 1400 million people lived in areas with inadequate water supplies. Projections with different climate change scenarios predict an increase of 364 to 1661 million people living under conditions of water stress by 2020.

Global warming is also affecting the oceans, changing ocean currents, triggering localised cooling in some areas leading to depletion of ocean oxygen. At the same time, the amount of carbon dioxide dissolved in

the oceans is making them increasingly more acidic. Global warming also influences wave climates, which in turn can change shoreline stability.

Global warming and its resultant climate change is, therefore, overpoweringly affecting world weather patterns, altering ecosystems, damaging human-well being, destroying livelihoods and undermining sustainable development, overlaid with terrifying economic impacts.

The social impacts of climate change – policies that are driving the marginalised and the poor further below the poverty line – are not commonly discussed in climate change rhetoric.

This newsletter examines the impacts of climate change on coastal ecosystems, natural disasters and the poor, revealing yet again, the taut interconnection between ecosystem well-being, human well-being.

Photograph: Southern coast, Sri Lanka ©Gehan de Silva Wijeyeratne. Thumbnails Top: ©Nadeera Weerasinghe; middle ©Sriyanie Miththapala, bottom ©Nishan Perera

Impacts of climate change on coastal ecosystems

Asian coastal ecosystems encompass some of the most extensive and biodiverse, tropical coastal and marine ecosystems in the world. These rich and fragile ecosystems are stressed by overpopulation, unsustainable resource use, habitat change and degradation, pollution and the spread of invasive species. Climate change adds an external stress on the beleaguered coastal ecosystems of Asia.

Effect of Climate change	Impacts on ecosystem well being	Impacts on human well being
Higher temperatures	Higher temperatures cause coral bleaching. The 1998 El Nino event caused wide scale bleaching in the Asia region, damaging as much as 75-100% coral in the Philippines. It leads to reduced species diversity and greater susceptibility to pathogens and diseases. Higher temperatures also change patterns of phytoplankton growth, affecting productivity and ecosystem balance. They will also lead to increased eutrophication in lagoons and estuaries damaging the quality of the water. Both these changes will affect provisioning services. Coral bleaching also affects cultural services	Increased coral mortality and eutrophication in lagoons and estuaries causes a reduction in fish yields. This affects food security and livelihoods. Bleached coral has affected coastal tourism.
Increased precipitation	This can retard growth, productivity and seedling survival in mangroves. Decreased precipitation and increased salinity could favour more salt tolerant species and change species composition, affecting their provisioning services. It will increase flooding of sand dunes, lagoons and estuaries and reduce their regulatory services. Increased precipitation will alter river flow patterns affecting the transport of eggs and larvae inland to the sea.	Changes in species composition could affect goods provided by mangroves - such as food, firewood and other non timber forest products. This in turn affects security of resource access and livelihoods.
Increased storms/ monsoonal variability	Physical damage to reefs will increase, and re-growth may not be able to replace this damage. It will also damage mangroves. In the Caribbean, there has been mass mortality of mangroves species as a consequence of increased frequencies of hurricanes. It will aggravate the erosion of dunes and beaches and increase flooding, and exacerbate flooding in lagoons and estuaries. All these will reduce the protective and regulatory functions of coral reefs, mangroves, sand dunes, lagoons and estuaries.	Reduced protective and regulatory services from coastal ecosystems will leave coastal communities more vulnerable to natural disasters.
Sea level rise	This will affect coral growth and reduce the reef's abilities to protect the shoreline. It will also alter the salinity regime in mangroves, favouring some species while damaging others – ultimately changing the species composition of the community. Land occupied by mangroves will also be lost, affecting not only the provisioning services but also the protective services provided by mangroves. Salinity in lagoons and estuaries will increase and affect species composition, and in turn, affect the provisioning services of these ecosystems. Rising sea levels can also inundate lagoon banks and coastal wetlands.	Changes in species composition could affect goods provided by mangroves - such as food, firewood and other non timber forest products (NTFPs). This, in turn, affects security of resource access and livelihoods. Loss of protective and regulatory functions of coral reefs, mangroves, lagoons and estuaries will leave coastal communities more vulnerable to natural disasters.
Increase of CO ₂ in the oceans	Increased CO ₂ dissolves in the oceans forming the weak carbonic acid, making them more acidic. It has been estimated that the precipitation of calcium carbonate has already fallen by an average of between 6 and 11% since the industrial revolution and projected that if atmospheric CO ₂ levels double to what it was in pre-industrial times, that calcium precipitation will fall by a further 8 to 17%. This affects the availability of carbonate atoms for building reef exoskeletons, with it, reducing reef calcification. This, in turn, slows down a reef's ability to grow vertically to keep up with sea-level rise, again, affecting its protective services. Ocean acidification will likely undermine marine food webs. Deep sea fish and squid are predicted to be especially vulnerable. Acidification will ultimately affect provisioning.	Reduced coral reef growth and reduced protective function will leave coastal communities more vulnerable to natural disasters. Changes in marine food webs as a result of acidification will decrease food security and affect coastal livelihoods.
Changing wave climates	These will increase coastal erosion and damage mangrove habitats and reduce their protective and provisioning functions. They will aggravate erosion of dunes and beaches and increase flooding, in turn, reducing their protective and recreational services. The pattern of flows into and out of lagoons and estuaries can be changed and lagoon mouth stability might be affected.	Damage to mangroves could affect goods provided by mangroves - such as food, firewood and other NTFPs. This in turn affects security of resource access and livelihoods. Increased erosion of sand dunes and increased flooding affects coastal tourism. Changes in lagoon structure will affect lagoon fisheries.
Sea water intrusion	This will alter the salinity regime in mangroves, sand dunes, lagoon and estuaries. It will favour salt tolerant species and change the species composition of each community. It could also affect freshwater aquifers. Saltwater intrusion into rivers will damage freshwater ecosystems. This, in turn, will affect the provisioning services provided by these ecosystems.	Changes in species composition in mangroves, lagoons and estuaries will affect coastal fisheries as well as agriculture. Changes in sand dunes affect tourism.

Climate change will have overarching impacts on ecosystem services and disproportionate effects on coastal communities, the marginalised and the poor. It will weaken rural livelihoods, social welfare, equity, and sustainable development.

Because of global warming, changes are occurring in global weather patterns, resulting in climate change and increasing the frequency of natural disasters. Snow cover is decreasing and glaciers are retreating, resulting in an increase in sea levels. More carbon dioxide dissolving in the oceans is resulting in the oceans becoming more acidic. Ocean currents are also changing because of global warming. Rainfall patterns are also changing and the effects of El Niño and La Niña episodes are worsened, resulting in increased cyclones, flooding and landslides. Lakes and rivers are also warming, and while wet areas are often becoming wetter, dry areas are becoming dryer. The world's hydrological systems will be rearranged, causing changes in seasonal flows. Generally, the quality of freshwater habitats would be degraded by higher water temperatures and will affect downstream supplies. Lack of water will affect crops, in turn, leading to famine and increased wildfires. It will also increase pest attacks, and favour the spread of invasive alien species which are often better able to survive in harsh conditions. Changing weather patterns are also affecting the distribution and range of species and disrupting the natural balance of many ecosystems. When some species – such as disease vectors – change their geographical range as a result of global warming, diseases also spread.

In short, climate change is increasing the frequency of natural disasters. On average, from the 1970, there has been a four-fold annual increase in natural disasters.

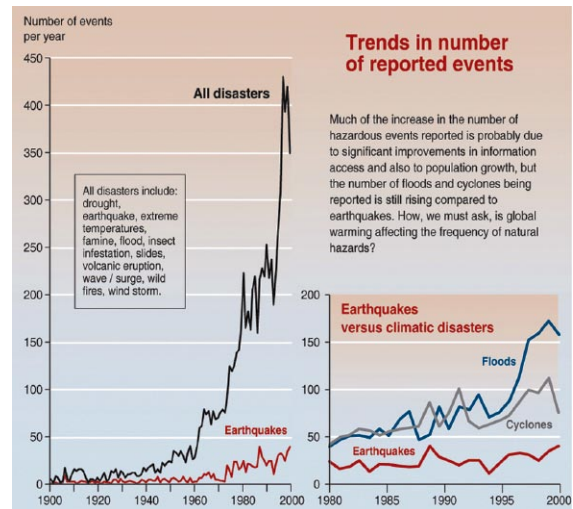
It is estimated that during the last few decades, an average of 250 million people have been affected each year, with nearly 58,000 deaths as a result of natural disasters. In 2004 alone, natural disasters impacted the lives of about 140 million people.

These disasters not only wreak physical and social damage but also astronomical economic damage. It is estimated that total global economic losses from natural disasters for the two years 1997 and 1998 reached 120,000 million USD, representing, (while allowing for inflation) an eightfold increase since the 1960s.

These natural disasters will have far reaching global effects, but disproportionate impacts on Asia. In fact, Asia is the world's most disaster prone region, having suffered about half of the world's major disasters over the past fifty years, 67% of the casualties and 28% of the economic losses. Each year, natural disasters impoverish millions of people. However, only 0.2% of economic losses were covered by insurance policies, because many of those affected are the marginalised and the poor. Asia is also the home to over 70% of the world's poor, many of whom live in coastal areas and depend on an easily disturbed natural resource base for their survival.

In addition, coastal communities will also be extremely vulnerable to increased natural disasters. Over half the world's coastal population lives in Asia. A one metre rise in sea level could inundate 17% of Bangladesh and completely flood the Republic of Maldives, reduce Bangladesh's rice farming land by half and affect millions of livelihoods.

An increase in natural disasters will have overarching impacts on ecosystem services and the global economy but it will cripple Asia, already stressed with overpopulation, poverty, internal conflict, resource overuse and spread of disease.



Source: Peduzzi (2004)



Floods in the Bicol Region, Philippines © Efen E Mariano CARE

Social impacts of climate change - the invisible poor

Global warming and climate change is going to affect everyone, but not equally. With more than a billion people at risk of increased water scarcity and hundreds of millions at risk of sea-level rise, the poor are, as always, the most at risk. In addition, the poor are usually directly dependant for their subsistence on natural resources, agriculture, and fisheries. Therefore, any negative change in these areas has direct impacts on the well-being of impoverished communities.

The latest report by the Inter-governmental Panel on Climate Change estimates that by 2020, between 75 and 250 million people in Africa alone will be exposed to increased water stress due to climate change. According to a report, the floods this summer in Southwest China displaced 24 million. The 2007 floods of South Asia displaced around 20 million people and caused an estimated damage of over one billion dollars. Tragically, at the forefront of all these events are the poor.

In developing countries, the marginalised and poor are already deprived of adequate food, clean drinking water, sanitation, health care etc. In most cases, it is this section of society who is also forced to live in low lying and other hazard prone areas and so are usually the first to be hit by floods, mudslides and cyclones. Mostly neglected by their respective governments, they have the fewest resources to deal with these recurrent shocks and stresses. Therefore, the negative consequences of climate change make them less capable of developing any coping, preventing, and mitigating mechanisms.

Amongst the poor, it is the women and children who suffer the most in any disaster. Out of the 1.4 billion people in the developing world who live below the poverty line, 70% are women. After the tsunami, a shocking statistic revealed that the number of deaths of women and children were disproportionately larger than that for men. Vulnerability to disasters depends on control of financial, physical, natural, human and social assets. Compared to men, women in the poor developing countries traditionally have limited access and control over these assets.

Against this backdrop, it is crucial that the conventions and initiatives in the field of climate change not only emphasise scientific and technological attributes, but also make explicit provisions for marginalised communities such as the poor and women.

Development and other aid agencies must make their projects 'climate proof' and 'climate neutral' and develop adaptation strategies that are designed to reach all strata of society. It is heartening to note that many organisations, including the private sector, are investing in climate change projects. What is imperative is that these projects and pro-

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grammes are mainstreamed into their daily programmes and operations. Otherwise, there is a danger that beneficiaries' lives and livelihoods could be placed at risk by having non-climate sensitive programming. As a result, while aid agencies keep on responding to emergencies through planned and resourced initiatives, they will be omitting one of the most grave and pressing dangers currently impacting the earth i.e. climate change.

Meanwhile, environmental and related organisations, focus on adaptation and mitigation, and largely ignore the social impacts of climate change. Neglecting this could further drive the poor below the poverty line, resulting in strengthening the vicious cycle of the poverty-environment nexus. In other words, both become the cause and effect of increasing poverty and degrading environment. Therefore, the vision of sustainable development could fast become a pipedream as a result both of climate change impacts and the lack of pro-poor responses to it.

Climate change is, ultimately, a matter of life and death, predominantly for the poor in the short-term and for all in the long run.

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