Island Biodiversity: Impact of Climate Change on of Small Islands

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Introduction

Climate change has been the most talked global environmental discourse. The international community and Bodies like U.N, UNFCCC, and IPCC have taken serious initiatives to curb the menace of climate change. However the debate on climate change has also divided the world in to two segments. One segment strongly feels that climate change is a real threat and the global efforts needs to be further strengthened in order to mitigate the threats of climate change, the other segment feels that the projections are more perceived than real. Similarly another global debate and in fact quite controversial one is between the developed and developing nations regarding the emission of green house gases. Developing countries strongly feel that they are paying the heavy price of development of developed countries as the major contributors of green house gases (GHG) are developed nations. Developed countries robustly advocate GHG emission cut norms for developing countries even to the extent of hurting their industrialisation. This is somewhat similar to Nuclear disarmament policy in which developed countries advocate for disarmament after stockpiling of all kinds deadly weapons. However it is ironical that the ill consequences of climate change are going to be more pronounced and drastic on developing and underdeveloped countries because of their large population, financial constraints, technological barriers, inadequate climate change mitigating skills, environmental and geographical vulnerabilities.

The discussion in this paper is concentrated around the impact of climate change on island that too on small islands as the small islands are much more susceptible to the ill impacts of climate change. The threats of climate change and sea-level rise to small islands are very real. Indeed, it has been suggested that the very existence of some atoll nations is threatened by rising sea levels associated with global warming. While such scenarios are not applicable to all small island nations, there is no doubt that on the whole the impacts of climate change on small islands will have serious negative effects especially on socio-economic conditions and bio-physical resources although impacts may be reduced through effective adaptation measures. Climate change is likely to heavily impact coral reefs, fisheries and other marine-based resources. Sea level rise and increased seawater temperature are projected to accelerate beach erosion, and cause degradation of natural coastal defences such as mangroves and coral reefs. Increasing sea surface temperature and rising sea level, increased turbidity, nutrient loading and chemical pollution, damage from tropical cyclones, and decreases in growth rates due to the effects of higher carbon dioxide concentrations on ocean chemistry, are very likely to affect the health of coral reefs and other marine ecosystems which sustain island fisheries. Small islands have characteristics that make them especially vulnerable to the effects of climate change, sea level rise and extreme events.

This papers theme has been drawn from the Fourth Assessment Report 2007 (AR4) and Fifth Assessment Report (AR5) consisting of three Working Group (WG) Reports and a Synthesis Report. The Second Working Group on Impacts, Adaptation and Vulnerability Report was published on March 2014. The impact climate change on small islands has been touched upon through analysing the impact on coral reefs and coastal wetlands, island biodiversity and water resources, on human systems and human health, and on agriculture which has been discussed and elaborated in this paper.

Climate change: Role of UNFCCC and IPCC

United Nations Framework Convention on Climate Change (UNFCCC) in its Article 1 defines climate change as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. The UNFCCC

thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes.

The UNFCCC entered into force on 21 March 1994. Today, it has near-universal membership. The 195 countries that have ratified the Convention are called Parties to the Convention. The UNFCCC is a "Rio Convention", one of three adopted at the "**Rio Earth Summit" in 1992**. The Intergovernmental Panel on Climate Change (IPCC) is the international body for assessing the science related to climate change. It was set up in 1988 by the World Meteorological Organization and the United Nations Environment Programme to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

Small islands

The small islands are principally sovereign states and territories located within the tropics of the southern and western Pacific Ocean, central and western Indian Ocean, the Caribbean Sea, and the eastern Atlantic off the coast of West Africa, as well as in the more temperate Mediterranean Sea although these small islands nations are by no means homogenous politically, socially, or culturally, or in terms of physical size and character or economic development. It is virtually certain that global mean sea-level rise rates are accelerating superimposed on extreme sea-level events (*e.g.* swell waves, storm surges, ENSO) present severe sea-flood and erosion risks for low-lying coastal areas and atoll islands.

Small islands do not have uniform climate change risk profiles. Rather their high diversity in both physical and human attributes and their response to climate-related drivers means that climate change impacts, vulnerability and adaptation will be variable from one island region to another and between countries in the same region. Given the inherent physical characteristics of small islands there is increasing recognition of the risks to small islands from climate-related processes originating well beyond the borders of an individual nation or island. The impact of climate change on small islands has been discussed under as under following:

Impacts on island coasts and marine biophysical systems

Coastal regions are some of the most at-risk areas for the impacts of climate change in the region due to their prevalence and high population density. Mangroves and coral reefs across the region are two key coastal ecosystems that are expected to be significantly impacted by climate change. Many coastal areas are already degraded by pollution, sediment-laden runoff, and destructive fishing practices. Climate change-related destruction and degradation of mangroves and coral reefs will only exacerbate these effects, and result in long-term economic repercussions, since these agriculture, fishing, and aquaculture industries. Impacts on coastal regions are interrelated with sea level, river deltas, natural disasters, water resources, agriculture, forests, and human livelihoods and infrastructure. The area's coastal regions are also susceptible to inundation associated with sea level rise and destruction of infrastructure from flooding and storm surges, which are likely to increase as a result of future climate change.

Impacts on coral reefs and coastal wetlands

Coral reefs are an important resource in small tropical islands and wellbeing of many island communities is linked to their on-going function and productivity. Reefs play a significant role in supplying sediment to island shores and in dissipating wave energy thus reducing the potential foreshore erosion. They also provide habitat for a host of marine species upon which many island communities are dependent for subsistence foods as well as underpinning beach and reef-based tourism and economic activity .Increased coral bleaching and reduced reef calcification rates due to thermal stress and increasing CO_2 concentration are expected to affect the functioning and viability of living reef systems.

Impacts on island biodiversity and water resources

Climate change impacts on terrestrial biodiversity on islands, frequently interacting with several other drivers (Blackburn *et al.*, 2004; Didham *et al.*, 2005), fall into three general categories namely: (a) ecosystem and species horizontal shifts and range decline; (b) altitudinal species range shifts and decline mainly due to temperature increase on high islands; and (c) exotic and pest species range increase and invasions mainly due to temperature increase in high latitude islands.

Due to the limited area and isolated nature of most islands, these effects are generally magnified compared to continental areas and may cause species loss especially in tropical islands with high numbers of endemic species.

Fresh water resources on all island nations in the region are especially vulnerable to any variability in precipitation because many rely on rainwater collection for their supply of fresh water. The management of water issues is one of the most challenging climate-related issues in the region, as it is central to health and sustainable development. The impacts of climate change on water resources are interrelated with impacts on agriculture, river deltas, forests, coastal ecosystems, diseases and human health and national security. Due to adverse living conditions in islands located at lower altitude, many species are migrating to islands located at higher latitudes. It is anticipated that mid-latitude and high-latitude islands are likely to be colonized by invasive species. This will pose a threat to species already living there. Another resource that may be seriously compromised due to climate change is water. Most of these islands have limited water supply and climate change will result in increased water stress. Sea level rise will severely impact these small islands, leading to coastal inundation, thereby reducing the already limited land area. Also, the threat from sea level rise is likely to be amplified by changes in tropical cyclones.

Impacts on human systems and on human health

Traditional settlements on high islands in the Pacific were often located inland; the move to coastal locations was encouraged by colonial and religious authorities and more recently through the development of tourism (Barnett and Campbell, 2010). Population drift from outer islands or from inland, together with rapid population growth in main centres and lack of accommodation space drives growing populations into ever more vulnerable locations. Additionally, without adequate resources and planning, engineering solutions such as shoreline reclamation also place communities and infrastructure in positions of increased risk many of the environmental issues raised by the media relating to Tuvalu, the Marshall Islands and Maldives are primarily relevant to the major population centre and its surrounds. Globally, the effects of climate change on human health will be both direct and indirect, and are expected to exacerbate existing health risks, especially in the most vulnerable communities where the burden of disease is already high. Extreme weather and climate events such as tropical cyclones, storm surges, flooding, and drought can have both short- and long-term effects on human health, including drowning, injuries, increased disease transmission, and health problems associated with deterioration of water quality and quantity. Climate change is projected to exacerbate health problems such as heat related illness, cholera, dengue fever, and bio toxin poisoning, and would place additional stress on the already over-extended health systems of most small islands.

Impacts on agriculture

Assessment of the specific impacts of climate change on agriculture is challenging because it is difficult to reliably simulate the complicated effects of future variations in temperatures, precipitation, and atmospheric CO_2 concentrations on crop growth. Temperature increases associated with climate change could result in a northward expansion of growing areas and a lengthening of the growing season. Rising atmospheric CO_2 levels are expected to stimulate plant photosynthesis, which would result in higher crop yields. But the studies show that the beneficial effects of CO_2 on plants may be offset by average temperature increases of more than 2°C, however. Overall, it is likely that future crop yields will vary by region and by crop, with yield increases in some locations but decreases in others.

It is imperative that environmental and agricultural institutions join forces and catalyze support to further increase resilience against climate change impacts. Systematic observation, adaptation programmes, improved institutional frameworks for disaster risk management and partnership at all levels is essential elements for any strategy to enhance livelihoods and local capacities to cope with climate change in the food sector.

Conclusion

The small island states are extremely vulnerable to global climate change and global sea-level rise. A range of adaptation strategies are theoretically possible. On some small low-lying island states and atolls, however, retreat away from the coasts is not an option. In some extreme cases, migration and resettlement outside of

national boundaries might have to be considered. Climate change is already affecting the planet and society and will continue to do so for generations to come. The physical and chemical changes of human activities are being felt in natural ecosystems on land and at sea, on farms and ranches, and in cities and suburbs, but the changes are not happening uniformly. The poles have already seen the greatest warming, and will continue to warm more rapidly than other areas. Already we're seeing record losses of ice in the Arctic. That melting ice contributes to rising sea levels, affecting the entire planet.

In addition, warm water expands, so sea levels will rise as the atmosphere warms. As climate change causes the ocean to rise, increased atmospheric carbon dioxide is also changing ocean chemistry. When carbon dioxide dissolves in water, it makes water more acidic. Warmer ocean water also contains less oxygen. These changes harm marine ecosystems, destroying coral reefs that shelter much of the ocean's biodiversity, and harming many other species. Climate change especially droughts and desertification is likely to increase the demands on those water supplies even as they fade away.

The frequency of extreme weather events is increasing through the warming and moistening of the atmosphere. Hot days are becoming even hotter and more frequent, and both drought and heavy rain and snow will continue to occur more often. Because hurricanes draw their strength from the heat of water on the ocean's surface, a warmer climate means hurricanes have been getting stronger. Researchers work to understand how these changes to the weather affect coastal populations, not to mention shipping, fishing, and other industries in those waters. Changes in rainfall and temperature will alter where various plants and animals can live, forcing some species to migrate, disrupting delicate ecosystems, and increasing the rate of extinctions globally. At this point it is interesting to discuss the latest report by the Intergovernmental Panel on Climate Change (IPCC) published on 13 April 2014.

The report highlights that global emissions of greenhouse gases have risen to unprecedented levels despite a growing number of policies to reduce climate change. Emissions grew more quickly between 2000 and 2010 than in each of the three previous decades. The report, entitled Climate Change 2014: Mitigation of Climate Change, is the third of three Working Group reports, which, along with a Synthesis Report due in October 2014, constitute the IPCC's Fifth Assessment Report on climate change. As per Ottmar Edenhofer, Co-Chairs from Germany "Climate policies in line with the two degrees Celsius goal need to aim for substantial emission reductions,"."There is a clear message from science: To avoid dangerous interference with the climate system, we need to move away from business as usual."

The future of our planet needs to be secured through robust policy framework, better technological solutions, reducing the green house gas emissions, improved coordination among the world community, the international organisations and true commitment to address the issues of climate change. The critical challenges confronting island governments and communities needs to be addressed to mitigate the threats of climate change and ensuring the better future not only for small islands but also for the entire world. For this the vulnerability of small islands should be given the urgent priority to save their existence and preserve their rich socio-cultural heritage and biodiversity.

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