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Review Article

ENVIRONMENTAL CONCERNS IN SMALL ISLANDS WITH REFERENCE TO THE PHILIPPINES

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ABSTRACT
Most islands have very limited resources that consequentially also restrict their capacity to deal with long-term development and environmental goals. The major disadvantage of small islands is not only their geographic remoteness but also the fact that they are more susceptible to climate change and sea-level increase. By nature, small islands also have extensive coastal zones requiring sound sustainable development that in many islands is beyond their financial means. The more recent political development in the South and East China Seas demonstrates additional constraints many island governments have in executing the rights of their Exclusive Economic Zones. The environmental and global changes that are predicted span over a timeframe of years, even decades, and action to mitigate the anthropogenic impact on climate change faces hindrances mainly on the political level. Not many alternatives are left for the small islands for mitigation. Movement towards limiting coastal development as well as ~~a~~ retreat from the coast may probably be the only considerations left for governments in reducing future disasters.

Keywords: *Small Islands, Climate Change, Sea-Level Change, Exclusive Economic Zone, Coastal Zone Management, Population Dynamics*

INTRODUCTION
Most small islands are low-lying and their environmental challenges are similar with respect to resource constraints, population dynamics and exposure to natural disasters and global change. However, the magnitude of these changes may differ from island to island according to the geology and the geographic locations. In defining a coastal zone as an area that covers the surface within 60 to 200 kilometers of the shoreline, it would include geomorphological features such as coastal floodplains, coastal forests, marshes, tidal flats, beaches, dunes, and coral reefs (Creel, 2003). This description shows that small islands are dominantly coastal areas. Many are remotely located and vulnerable to extreme natural disasters.

The definition of what actually is a small island has been formulated at the international level through the United Nations Convention on the Law of the Sea (UNCLOS). In this Convention, *Regime of Islands*, Article 121 of Part VIII (UNCLOS, 1983), defines an island as a naturally formed area of land surrounded by water, which is above water at high tide. UNCLOS also provides a definition for those features that are related to islands, and state that the territorial sea, the contiguous zone, the exclusive economic zone and the continental shelf of an island are determined in accordance with the provisions of this Convention. Furthermore, it states that rocks that cannot sustain human habitation or economic life of their own shall have no exclusive economic zone or continental shelf.

A review on small islands and coastal regions by Kelman and West (2009) related climate change to vulnerability and adaptation. They categorized the issues according to the development of islands whereas, in a broader view of coastal hazards and vulnerability, Mukhopadhyay *et al.*, (2012) covered the major geophysical processes and their intensity with respect to global climate change. In the following, some characteristics that are common to many small islands are highlighted, and selected references will be made to the Philippines and their environmental concerns with respect to population issues and the anticipated impacts of global change, and in particular, of increasing temperatures and rising sea-level. The Philippines is composed of about 7,600 islands with an extremely high population density. Due to its geographic location, it is exposed to frequent typhoons and because of its tectonics settings, it is also

prone to earthquakes and volcanic eruptions. The Philippines have historically been subjected to natural disasters and have had to deal with a wide spectrum of environmental issues many of which are common also in other island countries.

General Characteristics of Small Islands

Most small islands are the outcome of larger tectonic events resulting from plate tectonics that include seafloor spreading, uplifting, and building of volcanic islands. Larger island chains are an outcome of interaction between major plates whereby a subducting plate underrides a continental margin as witnessed for example with Japan and the Aleutian island chains. Volcanism and biological processes can further modify the composition of the surface of small islands that includes the formation of low-lying coral islands with their fragile coral reef structures.

Small islands possess large coastal zones relative to their total surface area and, except for a few islands, most have very limited resources that explain also their restricted capacity to deal with global change. Many islands are now in the position to generate their major income through tourism as shown by the remotely located Maldives that developed international tourism within 30 years, increasing the number of resort islands from two in 1972 to 86 in the year 2000 (Domroes, 2001).

Population Dynamics

Coastal zones are highly populated and about half of the world population lives within 200 kilometers of the coastline (Creel, 2003). It can be anticipated that early in the twenty-first century population density in the coastal regions will further increase, particularly in atoll countries like Kiribati, Tuvalu and Maldives where they are facing population stress at their coasts (Nurse *et al.*, 2001; Turvey, 2007).

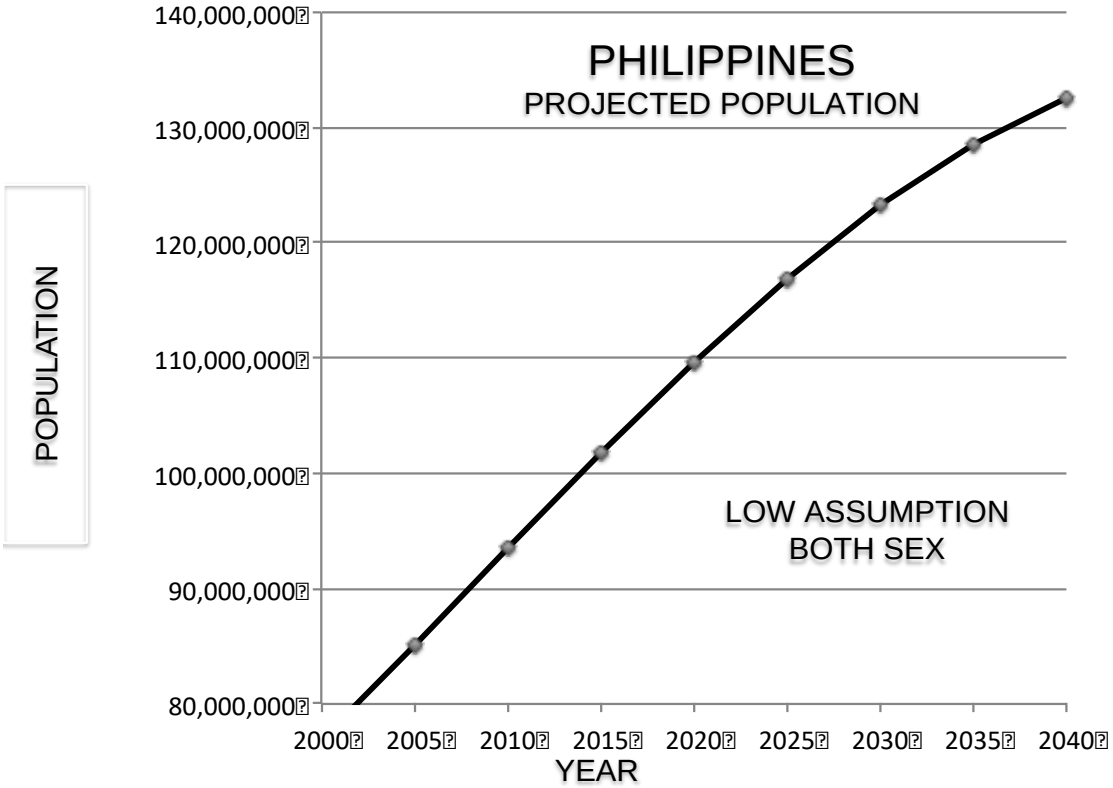

Figure 1: Projected Population in the Philippines Graphed from Tabled Data Published by the Philippine Statistics Authority (2014)

In Asia, the Philippines is the seventh most populated country with a current population of about 102,780,000 as of November 2016, based on the latest United Nations estimates (http://www.worldometers.info/world-population/philippines-population). Taking into account the surface

area of the Philippines, the population density in 2016 was approximately 338 persons km^{-2} whereas, according to the World Bank (data.worldbank.org, 2016) the United States had in the year 2015 about 35 persons km^{-2}.

The Philippine Statistics Authority (2014) estimated that by the year 2045, the Philippine population might increase to 142 million based on the latest 2010 census-based population projections, although the prediction shown in Figure 1 shows less with a slightly lower assumed growth rate. Around 50 million people would be added in a time frame of 35 years. This increase in number would take place even if the average annual growth rate were projected to decline significantly from 1.73 percent during 2010-2015 to 0.65 percent during 2040-2045.

The Philippine Statistics Authority (2016 a) showed that population grew 1.9 percent annually during the decade 2000-2010 and from the total population about 14 percent is based in the coastal low elevation area, defined by the Philippine authorities as the zone from the land water boundary up to the area at 10-meter elevation. The anticipated increase in sea level will further amplify the pressure on government planners and coastal managers to safeguard the population due to the loss of surface area by inundation and erosion of the coast. It can be expected as well that similar projections and trends can occur in most small islands.

Resource Base of Small Islands

A disadvantage of small islands is not only their geographic remoteness but also the fact that they are facing major impacts of climate change that may consequently hinder their aspects of sustainable development. As in many islands, the ground water is the primary source of drinking water occurring mostly in the form of shallow fresh water reservoirs and is a major concern in relation to sustainable development.

The small surface size of islands determines also the very limited capacity in the stored volume of water, and on many islands the apparent geology restricts its storage capacity. Most important, in connection with extraction of groundwater is the recharge capacity that depends on the climatic condition and the geographic location of an island. In particular, limestone islands like atolls and coral islands in tropical latitudes have moderate elevation, and accessibility to freshwater is a critical factor to be taken into account when projecting the impacts of global warming. Coral islands have their groundwater in the form of a freshwater lens and due to increasing demands, are subject to over-extraction and to further environmental stress (Singh and Gupta, 1999).

The United Nations Environment Programme (UNEP) (2014) reiterated that small islands are especially susceptible to climate change and sea-level increase. In many islands, the location of an aquifer is close to sea level, and small islands have reported their concern not only in loss of surface area through inundation and erosion, but also in the threat of reduced access to potable water by sea-level rise. In addition, the increase in tourism intensifies also the demands for water, and groundwater resources that have been extracted beyond their recharge capability are hard to replenish. The Philippine Statistics Authority (2016 b) estimated for the year 2014 the number of establishments in tourism and related industries at about 6,300 of which a significant majority is in hotel and restaurant business. As reported by UNEP (2014), tourism forms the foundation of small islands' economy, and it is anticipated that climate change will have an impact on the tourism industry due to loss of coastal properties caused by sea-level rise. Resorts will continue to be more vulnerable to frequent storm surges and other extreme weather events. Furthermore, tourism in small islands carries to a certain degree many risks because of their reliance on regional and international economic fluctuations that may reduce the benefits derived from tourism. Rapid development of tourism can also have significant adverse social and environmental impacts in small islands as was shown by the tourism penetration index by McElroy (2003). The UN Commission on Sustainable Development (UNCSD, 1996) pointed out that of particular significance is the social carrying capacity of small islands that may reach its limits of tolerance as the ratio of visitors to the local population rises. The Commission found moreover that intensive tourism development, particularly if not properly planned and managed, can very quickly cause irreversible environmental damages in small islands.

Vulnerability of Small Islands

The population of small islands is confined within a very fragile environment and the population is exposed to a high level of vulnerability. In categorizing vulnerability, hazards and environmental changes, Pelling and Uitto (2001) grouped the islands according to their intensity of occurring disasters and found that the more disaster prone islands are in the Greater Antilles, Cuba, Haiti and Jamaica, and in the South Pacific, they identified Papua New Guinea. Islands in the Lesser Antilles and most of the Pacific islands, Indian and West African islands are reported to have mid to low intensities of disaster.

The loss of life from natural events can have catastrophic dimensions in small islands and the arguments presented by the IPCC (Nurse *et al.*, 2014) indicate that the intensity of natural hazards may increase within the next decades. Increasing population density in the coastal zone and the increase in storm frequency may already be indicators for anomalies in future events and disasters. The governments of small islands have been following with great concerns the debates to globally reduce emission of greenhouse gases and to take steps in mitigating to avoid the consequences of climate modifications. In general, small islands play a minor role with respect to their emission of greenhouse gases and therefore contribute only marginally to the effects of climate changes (Tisdell, 1993). However, sustainable development issues and concerns that small islands face due to environmental and socio-economic changes as an outcome from climate variations pressure them to consider new strategies to address these changes. Douglas (2006) summarized that climate changes will affect social development, tourism, fisheries, energy and waste management, and therefore, impacts on the sustainable development of small islands. Furthermore, high population density in coastal areas results in more people being vulnerable to natural hazards. Inadequate forecasting of disasters also makes it difficult for government planners to take action to mitigate in appropriate ways.

The IPPC forecasted that climatic variability for the next decades would increase the frequency and severity of droughts and floods (Nurse *et al.*, 2014). Therefore, small islands will be exposed to more frequent meteorological disturbances that may include modified pathways of tropical storm systems. In particular, islands located in tropical regions will be more exposed to low-pressure weather systems that generate frequently large tropical storms. As an outcome from these meteorological anomalies, increase in disasters in the form of frequent droughts and floods can be anticipated in small islands (Lasco *et al.*, 2008). Climate and weather modification and related risks are of great concern in all small islands. In the Philippines, for example, it is predicted that the coastal regions will be at even greater risk due to temperature increase as forecasted by the IPCC for the projected 2080 climatic change (Nurse *et al.*, 2014). The combined risk to geophysical disaster is not homogeneously distributed throughout a given area as shown with risk assessment maps for the Philippines (Manila Observatory, 2005). That means that individual islands being part of an island chain or island group may need for each island a different approach for disaster mitigation.

The major loss of lives from natural disasters in the Philippines results from typhoons that occur approximately 20 times per year. One of the largest typhoons recorded in history was typhoon Haiyan that hit the Philippines in November 2013 and devastated part of the island of Palau. In Tacloban, Philippines alone, the casualties were estimated at around 10,000 and hundreds of thousands were left homeless (The Associated Press, November 10, 2013). The Philippines have frequent earthquake and volcanic eruptions as well. Plate tectonics explain the wide distribution of volcanoes and their frequent eruptions. Historical examples include the 1990 earthquake in Luzon that caused a high number of casualties. In 1991, the Mt. Pinatubo eruption was one of the most violent in the 20th century (U.S. Geological Survey, 1997).

Environmental vulnerabilities of small islands were addressed during the International Meeting to Review the Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States (United Nations, 2005). It was emphasized that many small island developing states share limited physical size, high population density, poor infrastructure and a lack of natural resources, especially freshwater resources, and are subjected to risks of sea-level rise, hurricanes, floods and tsunamis. Vulnerability of small islands has been defined in various ways. Turvey (2007) defined it as a country's susceptibility to physical and human pressures, risks and hazards in temporal and spatial

contexts whereas the Intergovernmental Panel on Climate Change defined vulnerability as "the degree of incapability to cope with the consequences of climate change and accelerated sea-level rise" (Dronkers *et al.*, 1990). It follows from forecasts of increased intensity and frequency of tropical storms that small islands have to be prepared for significant environmental changes. Erosion is one of the vulnerabilities of small islands, in particular, the tropical Pacific islands that are surrounded by coral reef. Many shoreline protection initiatives have failed and there is a need in coastal zone management to redefine the nature of the interactions between coastal inhabitants and coastal ecosystems and to pursue greater efforts towards sustainable development (Nunn, 2010). Coastal zone management in response to these threats would require additional engineering to protect the already limited coastal resources and prevent degradation of coastal habitats.

Global Climate Change Connected to Sea-Level Rise

The UNFCC (2005) estimated future sea-level rise on an average of about 5 mm per year. That is about two to five times the rate experienced over the last 100 years with an increase of 1.0–2.5 mm per year (Bijlsma *et al.*, 1995). The IPCC predicted that during the 21st century, sea-level rise is expected to be the reason for many small islands to lose significant proportions of their land and that sea-level rise is very likely to increase during the 21st Century relative to the period 1971–2010 (Nurse *et al.*, 2014). The IPCC also reported potential impacts of sea-level rise with increase of salinity in estuaries, influx of coastal saline water into freshwater aquifers, inundation of wetlands and lowlands and intensified storm flooding. Added to the complexity in accurate forecasting is the influence of sea-level change on the coastal regime, as shown in Figure 2, where observations indicate that sea-level at regional or local levels may not be identical or cannot be compared to the global averaged increase.

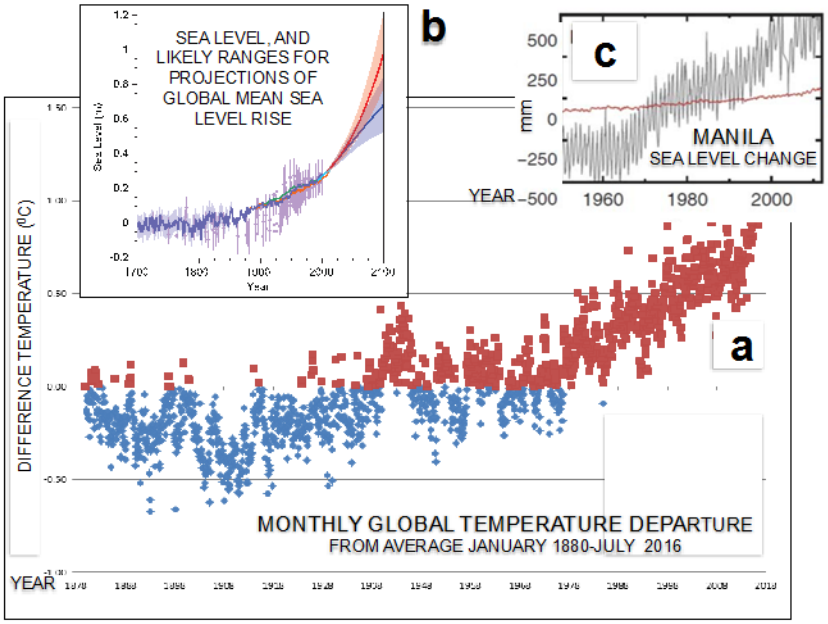

Figure 2: (a) Monthly Global Temperature Departure from the Average, January 1880 to July 2016, Modified from NOAA; (b) Sea-Level and Likely Ranges for Projections of Global Mean Sea-Level Rise; (c) Estimate of Global Mean Sea-Level Change (Red Lines) with Oscillations due to the Natural Climate Variability for Manila Bay; (b) and (c) are Modified from IPCC (Nurse *et al.*, 2014)

Nicholls and Mimura (1998) showed that impacts of sea-level rise in the future might have strong regional dimensions. Recent regional and local vertical land movements in the coastal zone also intensify the already serious impact of sea-level change. These changes can be quite large due to tectonic activity

and intensive groundwater extraction that can cause large and sometimes abrupt changes in relative sea level. Subsidence of urban coastal areas due to groundwater withdrawal has also been a significant problem in many locations, as can be demonstrated for example in Japan where 2.1 million people live in protected areas below high water (Bijlsma *et al.*, 1995). With regard to sustainability, climate change puts especially inhabitants of atoll nations at extremely high risk. Barnett and Adger (2003) pointed out that the potential abandonment of sovereign atoll countries could be used as the benchmark for the change that the United Nations Framework Convention on Climate Change tries to prevent.

At present, sea-level increase seems to be steady; however, predictions are affiliated with a large margin of error and the magnitude over various time frames presents greater uncertainties. Nevertheless, a one-meter rise in sea level could flood many coastal regions and would inundate many populated atolls including the Republic of Maldives, Cocos Island, Tokelau, Tuvalu, Kiribati, the Marshall Islands, and Torres Strait Islands (Warrick and Oerlemans, 1990).

The Unites Nations in 2015 adopted the Paris Agreement for an effective and progressive response to the present threat of climate change and the vulnerabilities of food production systems (UNFCC, 2015). In particular, Article 11 of the Agreement pays attention to countries with the least capacity to take appropriate action, and those that are particularly vulnerable to the adverse effects of climate change such as small islands. It also pointed out that increasing threats from climate change, natural disasters and unplanned economic growth have harmful implications for tourism and agriculture, as well as food security and nutrition. Earlier, the United Nations (UN) (2005) had already pointed out that adaptation to climate change is vital but will force difficult choices and tradeoffs in policy-making, involving, for example, further intensive coastal development.

International Aspects of Small Islands

Several small islands are still in the state of development and over the years became independent states of which the majority is now recognized as a distinct group in the United Nations as Small Island Developing States (SIDS). SIDS have internationally asserted their position with regional initiatives to address the issue of climate change. Due to their special geographic and environmental regimes, SIDS show a trend to seek affiliation with larger states for reasons of economic and social development as well as grouping around common resource areas such as fishing as well as other living and non-living resources.

To partially overcome the dependence of smaller island states on the larger developed countries, efforts are undertaken to form alliances for cooperation at a regional level and to use the international platform to communicate their concerns related to effects of climate change on sustainable development. This move was initiated during the United Nations Conference on Sustainable Development that took place in 1992 in Rio de Janeiro and addressed under its agenda “Agenda 21”, the item on Sustainable Development of Small Islands (UNCED, 1992).

Chapter17 under that agenda deals with “protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources” and the sustainable development of small islands. SIDS grouped and developed mechanisms to enhance in particular the use of their resource base. In 1994 the Barbados Programme of Action (BPoA) was adopted, reviewed and assessed in the United Nations General Assembly in 1999, that called for concerted efforts to support implementation of the BPoA. The special character of SIDS was reaffirmed by the World Summit on Sustainable Development (UN Sustainable Development Platform 1994; 1999; 2002). The advantage of grouping and the cooperation among SIDS is best documented with the effectiveness of the Alliance of Small Island States (AOSIS) under the aegis of the United Nations. The formation of AOSIS contributed to the increasing capacity to negotiate in international forums, primarily within the United Nations system, challenges of small island states with respect to their vulnerability and concerns impacted by global changes. However, funding for mitigating environmental changes and for disaster prevention is rather limited in most small island states, and financing has been mainly secured through loans and bilateral grants as is, for instance, in the case of the Philippines (Olsen and Christie, 2000).

Small islands have large offshore zones under their jurisdiction that are attractive for exploitation but demand high investment that is beyond the financial resources of many islands. The most recent events in the South and East China Seas demonstrates the constraints governments may have in executing their inalienable rights and privileges to harvest the benefits of their offshore resources. International law within the United Nations Convention on the Law of the Sea (UNCLOS, 1983) regulates the coastal states resource area by defining an Exclusive Economic Zone (EEZ) and sets precise definitions. It states in Part V, Article 55, the specific legal regime of the exclusive economic zone:

"The exclusive economic zone is an area beyond and adjacent to the territorial sea, subject to the specific legal regime established in this Part, under which the rights and jurisdiction of the coastal State and the rights and freedoms of other States are governed by the relevant provisions of this Convention".

The Law of the Sea explicitly determines that the EEZ starts at the seaward edge of its territorial sea and extends outward to a distance of 200 nautical miles from the baseline of the coastal country or island and follows the regulations as outlined in UNCLOS (see Figure 3b).

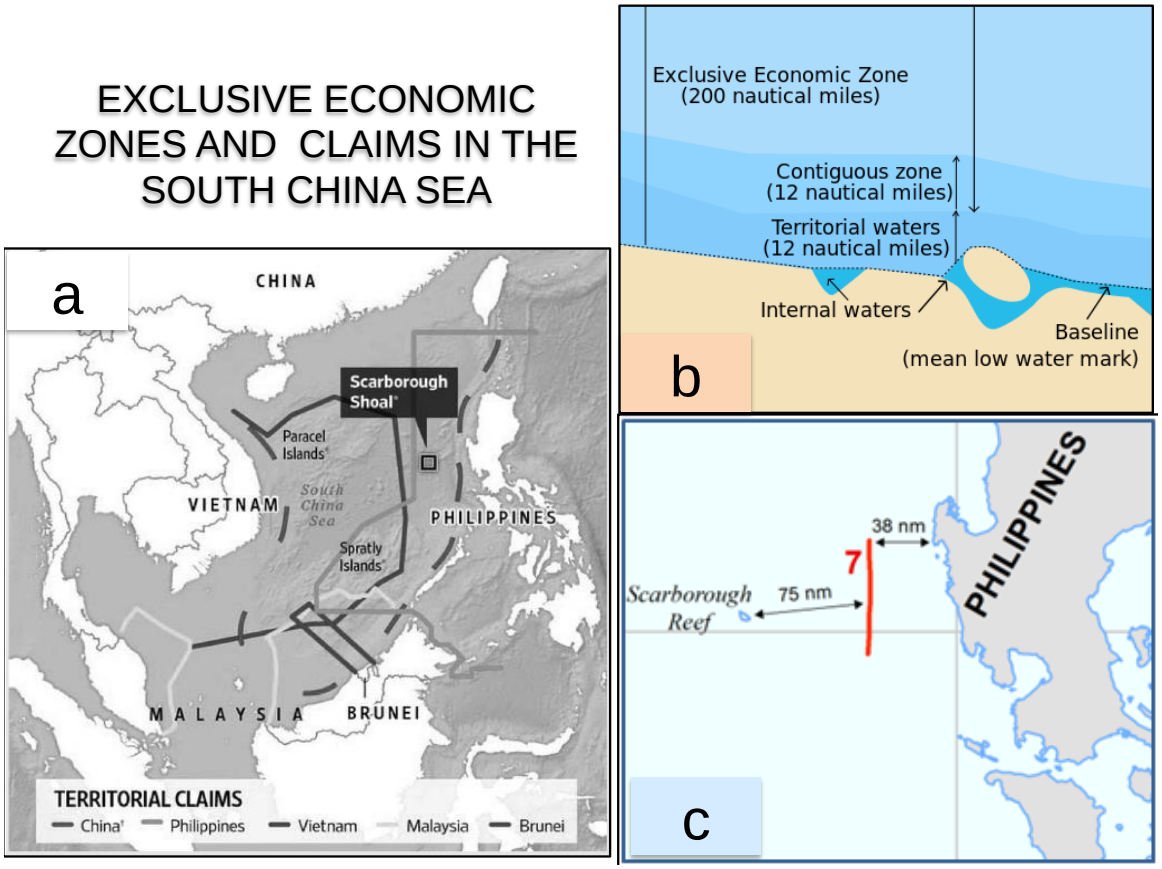

Figure 3: (a) China's Nine-Dash-Line Overlapping with the Exclusive Economic Zones (EEZs) of Coastal Countries and Islands in the South China Sea; (Source: Hearing before the Subcommittee on Asia and the Pacific of the Committee on Foreign Affairs House of Representatives July 23, 2015). (b) Marine Features Related to the EEZ based on UNCLOS; (c) Scarborough Reef within the Philippine EEZ; the Red Line and Red Number Refer to the Claim made by China 38 Nautical Miles off the Philippine Coast; (Source: U.S. Department of State, Office of Ocean and Polar Affairs Bureau of Oceans and International Environmental and Scientific Affairs, 2014)

The Law of the Sea also addresses the protection and preservation of the marine environment and encourages that the EEZ be executed according to national environmental policies. Under the regulations, states are obliged to safeguarding and controlling pollution of the marine environment laying therefore a

heavy burden on small islands. Furthermore, monitoring and managing the environment in the EEZ require ocean-going vessels, advanced laboratories and highly qualified marine scientists all of which are beyond the means of most islands. The Law of the Sea further specifies that states shall take all measures necessary to ensure activities under their jurisdiction or control. They are also obliged not to cause damage by pollution to other states and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights. In taking measures to prevent, reduce or control pollution of the marine environment, states shall refrain from unjustifiable interference with activities carried out by other states in the exercise of their rights (UNCLOS, 1983).

Notwithstanding the ratification of UNCLOS by island states and coastal countries, divergent interests and definitions have been issued that deviate significantly from the legal framework set forth in UNCLOS. For example, conflicts among countries in the South China Sea/West Philippine Sea over coastal resources were already recognized during the last century. Valencia (1979) pointe out the determining factors for present and future conflicts in this area that are based on competition over food and trade and during the last decades are enhanced by recreational, industrial and non-renewable resources development.

Coastal states have defended their territorial claims and their sovereignty and jurisdiction over their territorial sea against other claimants (Navarro, 2015). For instance, in 2015, the Permanent Court of Arbitration (2015) ruled against the Chinese claims of several islands and reefs in the South China Sea although China announced that it is not be bound by the decision, that "the tribunal's decision is invalid and has no binding force (New York Times, 2016). The future will show if the present internationally accepted regulations will hold, especially when it comes to safeguarding the marine environment and avoidance of destabilizing and degrading the fragile marine ecosystem over large areas. This environmental concern is amplified where overlapping claims exist as shown with the maps in Figure 3. In Figure 3c the U.S. Department of State (2014) documented China's claim of Scarborough Reef that lies within the EEZ of the Philippines. Although, international law specifies that a coastal country has the sole right to exploit the natural resources within the EEZ, such continuing unresolved dispute documents the problem smaller states may face when they encounter a weak position from which they have to negotiate over issues related to international law.

Final Remarks and Conclusion

The foregoing addresses only some of the major issues and challenges that small islands continually confront. The reduction of living areas and decreased access to natural resources brought about by an increase in population and an anticipated rise in sea level have drawn the attention of politicians and managers of coastal zones, in particular in those islands with low elevation regions where about 10 per cent of the world's population live (McGranahan *et al.*, 2007). It is with certainty, that should sea-level rise, as forecasted, habitats located in the lowlands will be lost, and increased hazards can be anticipated not only due to sea-level rise but also to changing weather patterns. Whatever, the adaptation process in small islands might be to mitigate the impact of global changes, one has to take into account the financial commitments that are required, that need to be viewed against the growing population density, the consequential negative impact on the physical infrastructure and the limited financial resources available.

As Olsen and Christie (2000) pointed out, the social, institutional, and political dimensions of coastal ecosystem change consume the financial resources of coastal managers. Required funding for retreat and relocation of settlements to less vulnerable areas at higher elevation surpasses in many islands their available resources. In the Philippines, Lasco *et al.*, (2008) reported that climate change impact has not been a priority and major development plans and policies have not emphasized adequately adaption to climate change. Although, the Philippine government recognizes fully the potential impact of climate change, in particular the threat of sea-level increase, the present national priorities consider understandably the disbursement of available resources mainly for near-future planning.

In addition, recent political events may introduce some restraints on efforts to focus in combatting impacts of global warming. Environmental and global changes span over a timeframe of years, or

decades, and action needed to mitigate the anthropogenic impact on climate change has hindrances mainly on the political level as has been demonstrated with prolonged debates and deliberations on climate change. The overall perception of climate change is to adapt to the changes, but it takes years to develop the appropriate action and political awareness. Warrick and Oerlemans (1990) pointed out that the capital required to work on an adaptive response to sea-level change alone include action and maintenance as well as protective measures for any cultural, environmental, and social changes that may result. Due to the specific and individual characteristics of small islands, there are no general concepts or policies that would allow them to protect human lives and their properties from future disasters. In small islands, not enough buffering capacity is available for the population to migrate inward because of lack of land to which people can resettle and because of limited financial resources. This leaves the small islands with few alternatives. Retreat from the coast and defensive measures to protect near-shore settlements are considerations as well as increasing the public and political awareness to coastal threats.

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