

# **COASTAL COMMUNITIES IN ASIA-PACIFIC: VULNERABILITY AND ADAPTATION**

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## **Introduction**

The Asia-Pacific region encompasses the countries from the Korean peninsula to the Middle East including insular Southeast Asia, the islands in Pacific Ocean and Indian Ocean islands, but excluding Australia and New Zealand. Its coastal landscapes include some megadeltas, the world's two largest archipelagic nations of Indonesia and Philippines, and the island nations in the Indian and Pacific oceans. World Vision (2008) estimated that of the world's population living in coastal areas less than 10 m high, 75% are in Asia and they constitute the world's most vulnerable coastal communities. The coastal zone of Asia-Pacific has been under tremendous environmental and developmental pressures ranging from pollution, destruction of the coastal ecosystems, industrial development and urban sprawl.

## **Coastal zone management (CZM)**

While the coastal communities have their traditional practices in coastal resource management, modern CZM was introduced into the Asia-Pacific region through the pioneering work of the USAID programme in Sri Lanka and Thailand. Sri Lanka became the first tropical country to have a successful CZM programme. The PEMSEA programme, which started as a regional project to prevent and manage marine pollution, has developed into various ICM (integrated coastal management) programmes in East and Southeast Asia (Chua 2006). Within the region there are subregional and national differences in the ICM approach (Harvey 2006).

Despite the success of ICM programmes to alleviate their economic conditions, many countries in the Asia Pacific region still suffer from various negative impacts on the coastal environment. These include water and sediment pollution, ecological changes to mangroves, coral reefs and seagrasses, over-fishing, unsustainable tourism development and oil pollution. The environmental problems are primarily driven by population growth and economic development (Harvey 2006, Mimura 2008).

Nevertheless, some areas of successes in the management of coastal resources are evident. These include the creation of more protected areas for coral reefs and mangroves, the provision of alternative livelihoods, e.g. small-scale tourism enterprises, new development projects such port development, land reclamation to relieve pressure on shortage of coastal land, and ICM developing demonstration sites (Chua 2006). But overall, the Asia-Pacific region has a long way to develop a strong coastal management framework and mindset similar to that of developed countries.

## **Vulnerability to natural hazards and climate change**

Although dated, Kawata (2000) provides a good overview of the various types natural hazards (earthquake, tsunami, storm surge, coastal erosion, flood, cyclone, landslide, volcanic eruption and urban disaster) and their severity in 15 Asian countries.

Monsoon Asia itself is cyclone-prone and accounts for 42% of world's total tropical cyclones (also known as typhoons and hurricanes) which affect significantly India, China, Philippines, Japan, Vietnam and Cambodia (Cruz et al 2007). The coastal communities within the cyclone belt face potential damage and destruction and climate change seems to increase the intensity of cyclones in recent years. Increasing sea surface temperature (SST) has increased the number and proportion of hurricanes reaching category 4 and 5 (Webster et al 2005).

Many coastal communities are within the Pacific rim of fire and face the threat of earthquakes and tsunamis. The 26 December 2004 Indian tsunami was the most disastrous event to the coastal communities in the Asia-Pacific region with more than 228,000 deaths in 14 countries around the Indian Ocean, nearly 2.5 million people affected and the total damage was nearly US\$10 billion (TGLL 2009). Thailand, Maldives and Sri Lanka have significant coastal tourism development and the economic costs of tsunami to the tourist coasts of Thailand and Sri Lanka were estimated at US\$765 million and US\$200 million, respectively (Guy Carpenter 2005). The Maldives suffered US\$100 million on damages and another US\$250 million loss in business – the loss is significant as tourism accounts for 31% of the country's GDP (UNEP 2005).

The Indian Ocean tsunami wrought not only destruction to the coastal communities and coastal ecosystems but also created issues beyond what could be handed by CZM – the examples included the loss of land with subsequent problems in land tenure, the conflict between a safety zone for tsunamis and a buffer zone in CZM, and a focused attention on better integration of livelihoods with the rehabilitation of coastal ecosystems. A suggestion was made for coastal managers to study the development pathways in the post-tsunami recovery phase in some model villages (Wong 2009).

Great efforts have been made to provide a tsunami warning system for the Indian Ocean as this was non-existent prior to 2004. Up to April 2009 an interim warning system with tsunami-related information was provided to the countries in the Indian Ocean by the PTWC and JMA (UNESCO 2009). In future a coordinated regional warning system composing of a network of inter-operable Regional Tsunami Watch Providers and National Tsunami Warning Centres would be created for the entire Indian Ocean. Several issues still need to be resolved, including system integration and coordination, risk assessment and community resilience and sustainability, e.g. a significant number of tsunameters are not working for various reasons (IOC 2010).

Another major threat to the Asia-Pacific region is sea-level rise related to climate change. The IPCC predicted a global sea level rise of 18-59 cm by 2100 but this does not take into consideration the melting ice sheets. A much higher global sea level is now projected for the future. Vermeer and Rahmstorf (2009) estimated 75-190 cm above 1990 by 2100; the Dutch Delta Committee (2008) has projected a regional sea level rise 150-350 cm by 2100 and 2-4 m by 2200. Within the Indian Ocean higher sea levels can be expected for the mid-ocean islands, the coasts of Sumatra and North Indian Ocean (Han et al 2010).

The most vulnerable areas to a rising sea level in the Asia-Pacific region include the mega-deltas of Asia, low-lying urban coasts, and small island states in the Indian Ocean and Pacific Ocean. The Asian megadeltas contain not only communities and

cities at risk but have critical coastal ecosystems and vulnerable to storm surges and floods from rivers and exacerbated by ground subsidence, e.g. Bangkok, Shanghai (Nicholls et al 2007). Additional problems include saltwater intrusion on water supply, freshwater fisheries and agriculture and a decrease in sediment supply arising from damming.

Some small islands are already affected, resulting in abandonment of islands (World Vision 2008). An estimated 3000 islands in Indonesia are to disappear by 2100 (NIC 2010). The Maldives and Kiribati have proposed to buy land elsewhere for relocation of their population, although this may not be the proper solution and have serious implications (Michel 2010).

Sea level rise would also affect coastal tourism which is important in Southeast Asia and the islands in the Indian Ocean and Pacific Ocean. Coastal erosion from sea-level rise would lead to the loss of tourist beaches. Increasing SST and ocean acidification have negative impacts on coral reefs. In Asia, 24-30% of coral reefs are likely to be lost in the next 10-30 years (Cruz et al 2007).

### **Adaptation measures**

Traditionally, adaptation to sea-level rise is though a trilogy of generic measures of protection, managed retreat and accommodation (Nicholls et al 2007). This trilogy has been expanded to retreat, protection and attack, thus widening the options (Peel 2010). Netherlands, a country with a high percentage of land below sea level and a long history of keeping out the sea, has considered retreat, two levels of protection, and attack (Vellinga 2009). Protection, is now considered more in terms of the Chinese art of war of 'fight water with water'. 'Attack' is more than 'accommodation' in its more proactive perspective. New generations of planners and CZM managers need to develop new approaches to meet the rising sea level.

One adaptation strategy is to improve traditional practices of some coastal communities. For example, local population in the deltas of Bangladesh discovered that sediments brought down by rivers can be directed to fill low-lying depressions (called 'beels') which are floodprone or create land along the coast (Sengupta 2009). While this method is still tentative, 600 acres of land have been created, raised in elevation and used for rice cultivation at Beel Bhaina. This method is not designed as a measure for sea level rise but has some promise. Silt-infilling should be further assessed and improved by additional efforts to raise or to strengthen such isolated islands above the flood or sea level.

A second approach is to capitalize on existing technology. The strategy of using some islands as 'safe islands' in the Maldives could be expanded to 'save some than not to have any' by using the method to create islands in Dubai (Hansen 2005). In the 'rainbowing' process, sand is dredged from the seabed and shot out through the spray nozzle of a vessel. This method would be suitable for removing some unwanted islands and build up other islands in the atolls of the Maldives and other atoll nations in the Pacific Ocean which are imminent of being eroded completely or flooded by rising sea level.

The Indian Ocean tsunami 2004 brought attention to the importance of biobelts in protecting coastal villages. It was initially based on anecdotal evidence but the issue became controversial until more reviews were carried out. In their review, Cochard et al. (2008) noted that mangroves can reduce considerably the impact of tsunami waves less than 4 m high. Mangroves can be an effective bioshield against tsunamis, bearing in mind some of their effectiveness and limitations (Tanaka 2009).

In the Asia-Pacific region, mangrove planting is traditionally done by manual labour using individual saplings. One proposal is the deployment of a modular system so that various species can be established on coasts of various erosional conditions and various substrates (Wong 2010a, Wong 2010b). Mangroves are first grown to various heights in modules of hexagonal in shape which can be deployed rapidly at various locations of the intertidal zone by cranes or pontoons. Different species can be planted in modules making possible the maintenance of biodiversity of the biobelt. Sediments and nutrients are added to the modules as the plants grow. The modules are made of material that are self-destructive over time and become part of the substrate.

From both literature and field research, one particular species is suitable for modular planting on various coastal types. The *Avicennia marina* has the largest latitudinal range, an ability to adapt to a wide range of environmental conditions, is present at the seaward and landward sides of the mangrove belt ('disjunct' zonation) (Dahdouh-Guebas et al 2007), and is the only mangrove to grow in arid areas, e.g. Oman. In Southeast Asia, this species grows on sand, gravels, coral flats, intertidal limestone platform, lapies surface, and even on boulders of protection measures, e.g. breakwaters.

There are also other strong grounds for coastal communities in the Asia-Pacific region to plant mangroves as a measure for slowing down tsunami waves and against a rising sea level: familiarity with mangrove planting; available local skills that can be supported by the addition of technology for the production of the modules; mangroves for the improvement of livelihoods; mangroves as a carbon sink with the future possibility of obtaining funding. And planting mangroves would be a 'no regrets' measure and confirms to the 'precautionary principle'.

## **Conclusion**

Given the existing and future situation faced by the coastal communities in the Asia-Pacific region, CZM would continue to play an increasingly important role by taking an even more integrated approach to combine mitigation to natural disasters and climate change adaptation. New generations of coastal managers need to be knowledgeable about traditional practices, able to apply present approaches and work out new techniques, to meet not only the needs of CZM but also the increasing demands of coastal hazards and climate change.

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