Chapter 5
Coastal Hazards Management: Hard Engineering Solutions along the Taiwanese and Vietnamese Coastline – Unintentional Consequences and Future Humanitarian Engineering Implications

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ABSTRACT

Both natural and anthropogenic forces could play significant roles in coastal erosion in Western Taiwan and Central Vietnam's coastlines. Intensive socio-economic development, sea level rise, more frequent and strong intensity of disasters are predicted to occur in a future of global climate change, which poses an urgent need for coastal hazard management strategies. This chapter describes main causes and discusses the applied engineering interventions to reduce coastal erosion at these sites. Hard engineering structures are often constructed in these areas, but they seem to be merely short-term costly solutions and have a negative impact on the coastal environment and its residents. Nature-based solutions and soft engineering approaches are proposed, which seem to be sustainable and less expensive than hard engineering options. These possible future solutions can be applied in coastal settings to meet the principles of sustainable and humanitarian engineering with multiple benefits to reduce the risk and negative impacts on both humans and the environment.

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INTRODUCTION

Although Vietnam and Taiwan are in different geographical zones in Asia, the future threat of coastal erosion hazards is similar. The coastal zones have rapidly evolved over the past few decades and these developments have resulted in numerous human interventions in the natural systems. Especially in Vietnam, the coastal zone has a high population density with people building very close to the shoreline. Coastal tourism, social-economic developments and industries all seek fortune and exploit resources in this area (Lin et al., 2017). Tourism numbers keep increasing, data from 2019 show that Vietnam received 16.3 million international tourists, which is an increase in 15.4% year-on-year (Ngyuen, 2019). As the tourism number keeps on growing, the number of constructions for tourism facilities along the coastline keeps rising. Simultaneously with this rapid economic growth, coastal sites have suffered severe impacts of global climate change resulting in an increasing number of coastal hazards like typhoons, more severe floods, saline intrusion and coastal erosion (Nguyen et al., 2019). Since the beginning of the last century, many places have been subject to erosion, causing coastline retreat. Countless beaches are already completely eroded, people become more vulnerable to hazards and an increasing number of people lose their houses. Local farmers are forced to exploit even more resources, or damage natural habitats like mangroves in search for adaptation strategies (Bruun, 2012). In response to these risks, diverse coastal engineering structures have been constructed, often focused on fast results, which is visible in the many 'hard solutions' along the coastline of Taiwan, such as tetrapods, cement seawalls and groins (Shih, 2016). Vietnam is now following the same path as Taiwan, by 'hardening' large parts of the coastline with artificial engineering structures. As the tourism and fishery industries grew, pressures of economic developments have also led to rapidly increasing artificial structures, which are causing an imbalance in the shape of the coast, ultimately leading to the erosion of local beaches (Hoang, 2020; Noshi et al., 2015). In many cases, these protective measures have been inadequate in dealing with strong waves, especially in case of higher storm surges. Even worse, such concrete structures negatively affect beach preservation in adjacent areas as well, due to effects of downdrift erosion (Saengsupavanich, 2020).

In the face of global climate change and increasing number of coastal hazards, coastal protection should adapt to these risks. What should be the strategy? And how to balance the development of environmental ecology and social economy and other issues? As an answer to these questions and challenges, humanitarian engineering methods can offer various co-benefits by stimulating integral and multidisciplinary approaches. An emerging theme in coastal management promotes working with nature, instead of working against it. These novel humanitarian strategies are underlined by the strong connections between human and nature, and restoration of coastal ecosystems, adaptive planning and soft engineering approaches are suggested as alternatives to hard structures (Gesing, 2019a; van Slobbe et al., 2013). These strategies require the inclusion and input of multiple stakeholders and bottom-up approaches are encouraged. Therefore, as people's awareness of coastal science and the consequences of climate change have risen, setting up traditional "hard" structures is no longer the only recognizable option. Restoration of coastal ecosystems will lead to a higher number of ecosystem services and more resilient settings. Moreover, more people are willing to adopt adaptive planning such as the setback zone approach, based on appropriate setback planning by the government. Adaptive "soft" engineering, such as re-building dunes is also welcomed, as landscape and ecology conservation are taken into consideration. Coastal communities in more developed areas, on the other hand, should be educated about the cause and effect of future coastal changes, and local residents or stakeholders should be allowed to have a chance to give active input for their own future (Seddon et al., 2021).