STRATEGIES TO COMBAT COASTAL EROSION AND INUNDATION IN VULNERABLE LOW COASTAL LAND

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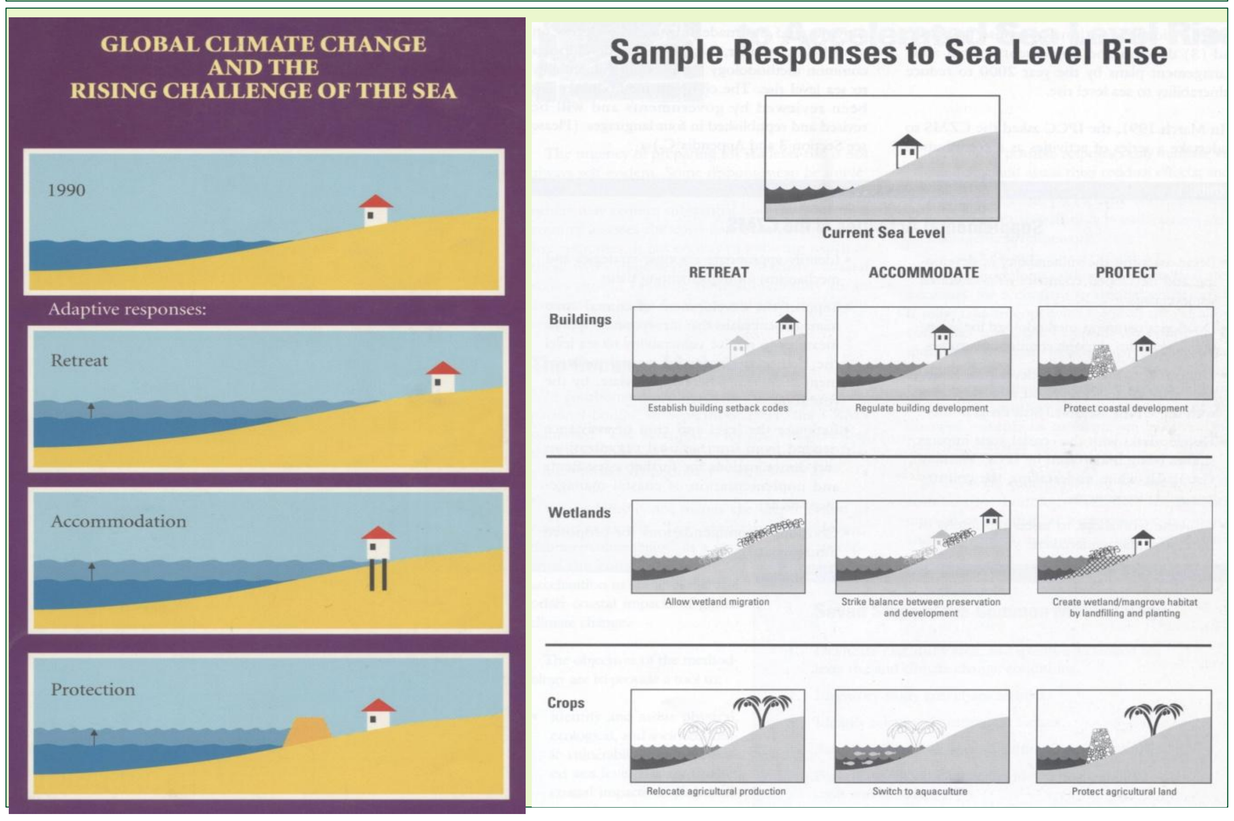
ABSTRACT

World populations are becoming more concentrated in coastal areas, and many parts of the coasts, in addition to the existing permanent and intermittent wetland, have low elevation and very resilient to coastal erosion and inundation, particularly during high water level from rivers as well as during extreme high tide. Global warming and climate change that cause sea level rise will subsequently and incrementally give more frequent and severe impacts in terms of environmental damages and more particularly the human life.

There are many studies to counter measure the impacts in the forms of general conceptual designs. The Intergovernmental Panel on Climate Change (IPCC, 2000) proposed three adaptive responses, i.e. retreat, accomodation and protection. The Eurosion Consortium which was managed by the Directorate General of Environment of the European Commission (Eurosion 2004) proposed the five generic policy options including do nothing, managed realignment, hold the line, move seaward, and limited intervention. Then coming the USACE (United States Army Corps of Engineers, 2008) concept with the four adaptive responses compose of accomodation, protection, beach nourishment, and retreat.

This paper introduces the nine responses of Ongkosongo (2011) which compose of practically do nothing, escape (give-up), business as usual, adaptation (accomodation), modification or adjustment, protection, confrontation (Dutch solution), nourishment (replenishment), and polder system, to be more deeply discussed.

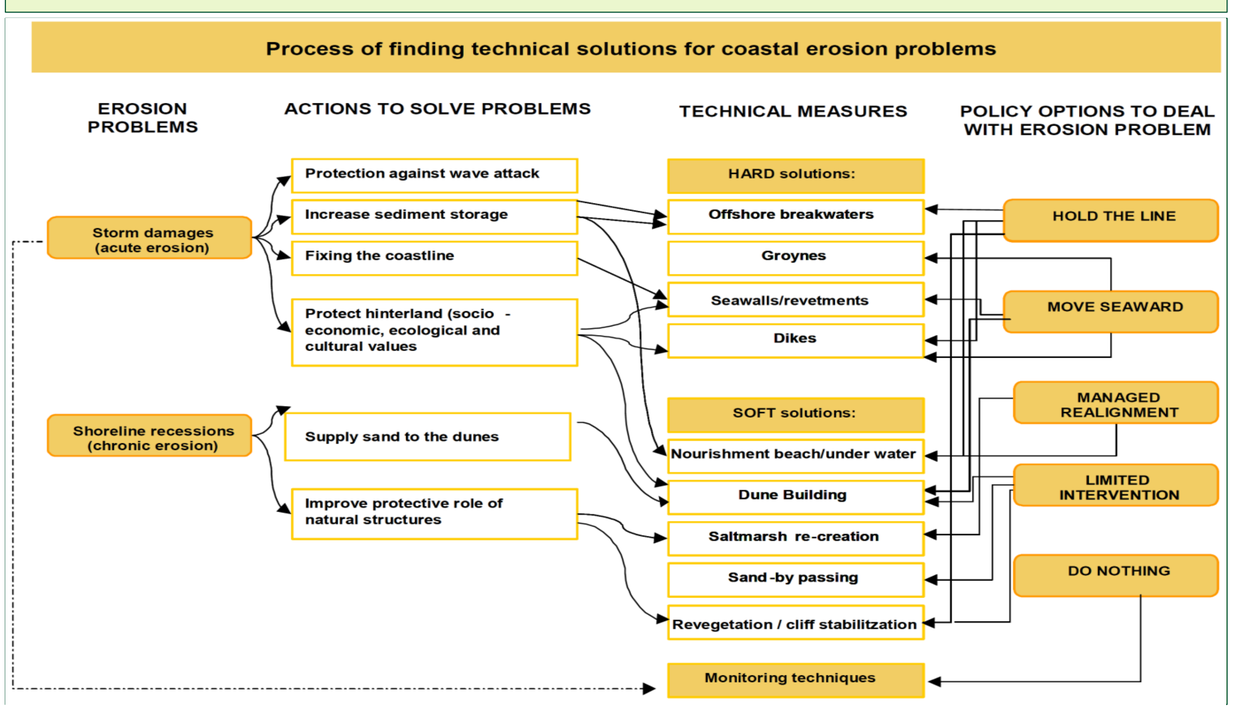
Figure 1. The IPCC (1990) concept to combat the rising of the sea level (left), and the three sample responses of IPCC (2000) which differentiate the three main affected components, i.e. buildings, wetlands, and crops (right).



INTRODUCTION

World population occupation and settlements in coastal areas, including in the vulnerable lowland in the coastal plain, at a distance of less than 100 km from the coastlines, have increased and reached around 40 % (http://sedac.ciesin.columbia.edu/citations). Moreover, most of the word's megacities with more than 2.5 million inhabitants are in the coastal area, some of wich are vulnerable permanent or temporary wetlands. Many of these lowlands suffer frequent flash flood during heavy rains, either in upstream alone or together with the local rains, besides high tides and storm weather. When these simultaneously happen, the coast may be severely eroded. The subsequent impact of the population blooms may also evident in coastal land subsidence that accumulate the worsened problems. These have been widely and long discussed and anticipated by many researchers and organizations, that this poster cited some of them. As the coasts are eroded, the former land and the flooded areas are subsequently widened.

Figure 2. The Eurosion (2004) concept to combat the coatal erosion problems in Europe.

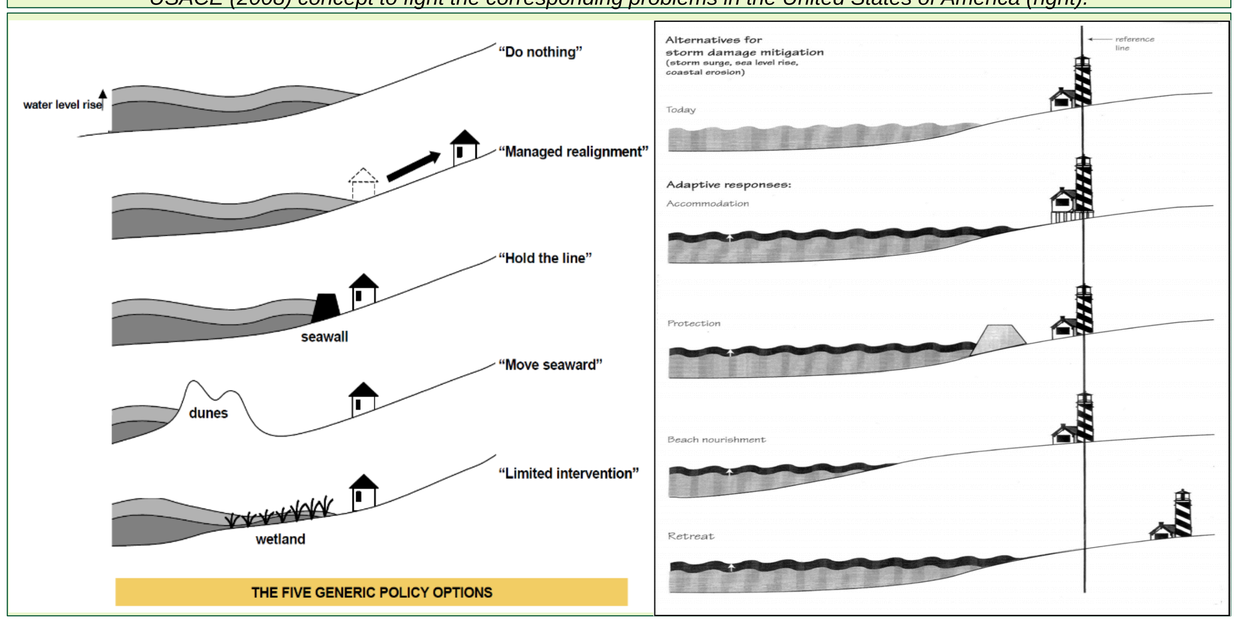


COUNTER MEASURES

More than 70 % of world coastlines are eroded (Bird 2000). In solving these persistent problems, the IPCC (1990) has proposed three alternative option concepts composing of retreat, accommodation, and protection (Figure 1).

The Directorate General of Environment of the European Commission composing of 22 countries in solving the acute or chronic erosion has proposed five generic option concepts, composing of do nothing, managed realignment, hold the line, move seaward, and limited intervention (Figure 3). Six main actions are identified which include protection against wave attact, increase sediment storage, fixing the coastline, protect the hinterland, supply sand to the dunes, and improve protective role of natural structures, The technical options include hard solution such as offshore breakwaters, as well as the soft solution such as nourishment of the eroding beaches (Eurosion 2004).

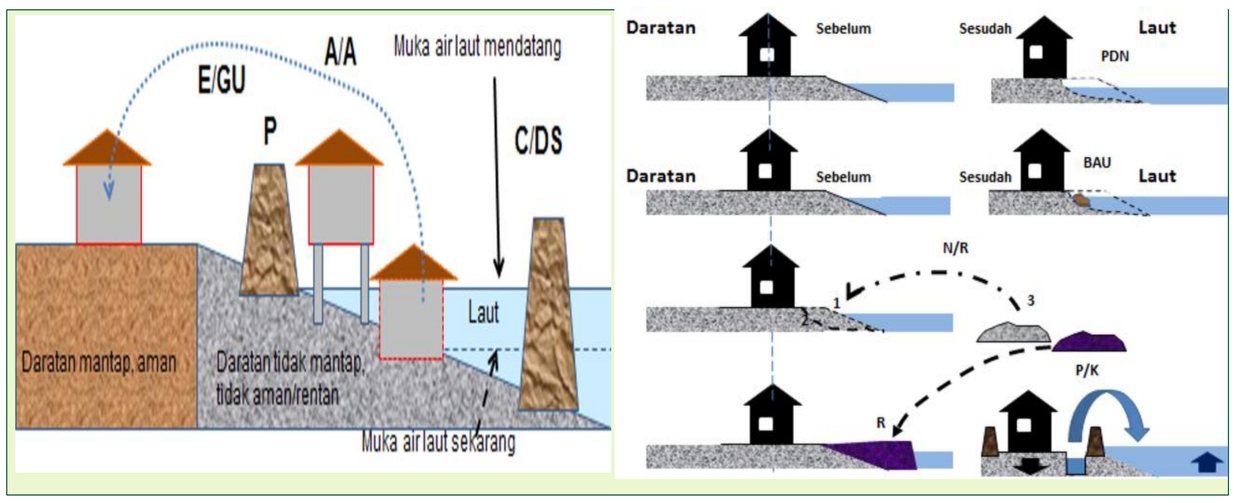
Figure 3. The five generic policy options of Eurosion (2004) to combat the coatal erosion problems in Europe (left), and the USACE (2008) concept to fight the corresponding problems in the United States of America (right).



American solution options may be represented by the USACE (United States Army Corps of Engineers, 2008) in preparing a concept on storm damage mitigation as result of storm surge, sea level rise, and coastal erosion. There are four options principally composed of accomodation, protection, nourishment, and retreat.

By learning the aforementioned examples, Ongkosongo (2011), in his report on strategies to mitigate the disaster risks due to global warming and global climate change, exposed nine strategic options for solving the inundation, flood, and shore erosion in the coastal plain. These options include practically do nothing (PDN), especially for areas without any urgent needs of solution including the unpopulated or less populated regions. As also mentioned by other reports, the second option is escape or give-up (E/GU) which means that the important settlements or activities should be moved further upland. The third is business as usual (BAU), which especially due to budget limitation, the unideal solution but may temporarely will solve the problems is choosen. The fourth is adaptation or accommodation (A/A), which will refitting the housing, for example, has higher pillars to support the housing as such that it is safe from the floods and erosion. The next is the modification or adjustment (M/A), that may comprise of upstream (solving the cause agent) or downstream (solfing the affected things) approach. The examples of upstream approach may cover river divertion, construction of dams, while the downstream approach is by enforcement or elevating the existing structures. The sixth is protection (P) which covers construction of shore protection (coastal defence) which may include seawall, revetment, bulkhead, groin, jetty, shore-connected breakwater, or offshore breakwater. The seventh option is confrontation or Dutch solution (C/DS) which may construct structures that basically will frequently close a water basin and systematically control the in and out water flow. The eigth is the nourishment or replenishment (N/R) which its main activity is supplying sand or gravel to the coast in deficit state. The ninth option is polder system (P/K) of which the elevation of the land may be lower than the sea level, but by a precised integrated and overall water management system the land may be free from inundation, flood, and erosion. The K here is an abbreviation of kapal (ship), which philosophically gives ideas that although the most rooms have lower elevations compared to the sea level, however, the rooms are dry and free from direct disastrous unwanted water effect.

Figure 4. The eight alternative concepts to fight the erosion, inundation, and flood in coastal areas especially in the very vulnerable low coastal plains, in addition to the ninth concept of practically do nothing (Ongkosongo 2011).



CONCLUSSIONS

From the above discussions, it may be concluded that the nine solving options for coastal erosion and also inundation and flooding problems of the coasts, especially in the vulnerable low elevation coastal plains as proposed by Ongkosongo (2011), are more holistic and comprehensive and may be more detailly implemented. The options, however, may require further more detail analysis and descriptions in order to get easier rational explanations in the implementation in the field, particularly due to the fact that every problem solving is very local dependent and site specifics.

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