

Adapting to Sea Level Rise: Real Lessons from Examples of Land Subsidence in Japan, Indonesia and the Philippines

Esteban, Miguel (1); Takagi, Hiroshi (2); Mikami, Takahito (3); Jamero, Laurice (1); Nguyen, Thao (4); Onuki, Motoharu (1); Yamamoto, Lilian (5); Achiari, Hendra (6)

1: The University of Tokyo, Japan; 2: Tokyo Institute of Technology; 3: Waseda University;
4: Ho Chi Minh City University of Technology; 5: Sao Paulo University;
6: Bandung Institute of Technology

E-Mail: esteban.fagan@gmail.com

Sea level rise (SLR) is likely to be one of the major challenges of the 21st century, requiring many coastal areas around the planet to undertake a range of adaptation measures. The actual consequences of this SLR have been the subject of much discussion, though many authors believe them to be mostly hypothetical, given the relative scarcity of actual examples described in literature. However, such examples actually exist, as a number of places have experienced relative SLR due to ground subsidence, some of which are higher than the maximum ranges of SLR given in the IPCC 5AR for the 21st century. These areas can be used as a proxy to study the consequences of SLR, learning from the range and types of adaptation strategies that have already undertaken. Examples include Tokyo during the middle of the 20th century (where land subsidence in excess of four metres has left large parts of the city under water levels), which the authors will compare to the case of Jakarta, currently experiencing rapid rates of ground subsidence, in the order of 9.5 to 21.5 cm/year. Further comparisons between the Tohoku area in northern Japan (the 2011 Tohoku Earthquake Tsunami not only devastated this coastline, but the earthquake also caused significant land subsidence, and is requiring ports and other installations to be elevated to compensate) and the Pondok-bali coastline, also experiencing rapid subsidence, will also be made. Finally, adaptation strategies in low-lying coral islands will be outlined, using as a proxy the case study of the Danajon Bank in the Philippines, where subsidence due to the 2013 Bohol Earthquake left many of these islands underwater during high tides. The authors have in the past carried out numerous field studies in each of these areas, conducting surveys of the adaptation measures and defences implemented, questionnaire surveys of the awareness and thoughts of the local population regarding the effect that the relative increase in sea level has had on their lives, and the influence this has on disaster management. All of these results will be integrated and presented systematically, outlining the sequence of adaptation strategies that coastal settlements will go through. These usually start with the construction of small dykes or the planting of mangroves, progressing to the installation of pumps, building houses on stilts and rainwater harvesting, and the eventual reinforcement of the dykes to make them more permanent. Then, large scale reclamation projects are envisaged, which actually result in an encroachment on the sea, contrary to what would be expected. At the very last stage large-scale land elevation projects, in the form of super-levees with housing on their top (Tokyo) or even the elevation of entire communities (Tohoku) are put in place. This sequence is actually likely to be observed in other areas of the planet, and learning from it now can undoubtedly help to plan for the future in other regions.

Keywords: sea level rise, land subsidence, real lessons, adaptation