ENVIRONMENTAL LOSS EVALUATION APPROACH FOR COASTAL FLOOD RISK ANALYSIS

Dilani R. Dassanayake, dilanirg@gmail.com
Hocine Oumeraci, Technische Universität Braunschweig, h.oumeraci@tu-braunschweig.de

INTRODUCTION

Flood risk is generally defined as the combination of the probability of a flood event and the potential losses. Flood losses might be divided in two categories, namely tangible and intangible depending on whether or not the losses can be assessed in monetary values. Tangible losses are evaluated in monetary values and hence commonly incorporated in flood risk analysis. Intangible losses, especially environmental losses, are mostly not incorporated in flood risk analysis due to the lack of appropriate and generally accepted evaluation methods. This research focuses on the development of a new approach to evaluate environmental losses due to coastal floods.

Environmental losses due to coastal floods can be wide-ranging: from destruction to flora and fauna, and damage to rare or endangered species, natural recreational resources and scenic resources. Although the assessment of environment losses is not considered as important as other flood losses few studies on environmental impacts due to flooding have been carried out in the recent past (e.g. Rouquette 2013). When assessing the losses, it is difficult to consider the whole environment at once. Therefore, the environment should be divided into sections where the losses in each section can be evaluated separately. In this context, the ecosystem services approach (e.g. Costanza et al. 1997, Elliff and Kikuchi 2015) is suitable.

A new approach is proposed for the qualitative assessment of environmental losses by estimating the changes/ losses of ecosystems and their services. This paper describes the basic concepts of this method and the related steps using an exemplary case study from a North Sea coast, which might be useful for future flood risk analysis studies.

PROPOSED METHOD

The proposed method for the evaluation of environmental losses illustrated in Figure 1 mainly consists of two steps.

First, the available ecosystems in the study area are identified using land use data. For example, coastal areas may comprise beaches, dunes, salt marshes, coral reefs, mangroves, etc. The prevailing services of each ecosystem are then identified. For example, beaches and dunes mainly provide coastal protection as a regulation service and recreation and tourism as a cultural service.

Second, the changes of each ecosystem are assessed by incorporating flood data and inundation models. Based on the estimated changes, the level of changes of ecosystem services is determined using ecosystem service damage criteria.

An Ecosystem Services Damage Assessment (ESDA) table for beach and dune ecosystem services is newly developed to define the damages of ecosystem services based on the ecosystem damages. Here, the level of the ecosystem service damages (three levels: no damage, minor damage and significant damage) and its effective duration (as short-, medium- or long term) are considered.
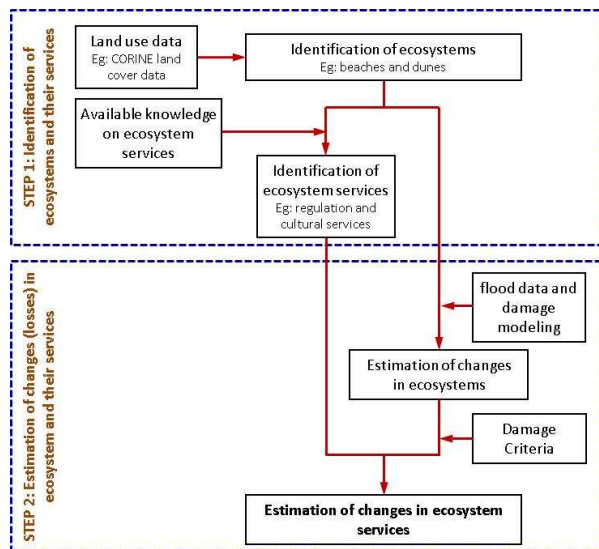

Figure 1 - Steps of the proposed method for the evaluation of environmental losses

CASE STUDY

A case study is performed for damage assessment of beach and dune ecosystem and hence the losses of two associated ecosystem services: coastal protection as a regulation service and recreation as a cultural service, in the Island of Sylt, Germany.

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