



River Elbe flood regulation options with ecological benefits, Germany

Compiler of the case: Marc Teichmann und Augustin Berghöfer mainly based on Grossmann et al. (2010)

Short title: River Elbe flood regulation options with ecological benefits, Germany

Key Message: Cost-Benefit-Analysis of several ecosystem services reveals polder flood retention areas to provide cost-effective protection against flood damage, with additional ecological benefits.

Suggested citation: TEEBcase River Elbe flood regulation options with ecological benefits, Germany, mainly based on Grossmann et al. (2010), compiled by Teichmann, M. and Berghöfer, A. (2010), available at: TEEBweb.org.

Reviewer: Volker Meyer

What is the problem?

At the beginning of August 2002 heavy rainfall in the Erzgebirge caused disastrous floods in Germany and the Czech Republic. The water-levels of the river Elbe and its tributaries increased dramatically, causing direct economic costs of flood damage in Germany of around 9 billion EUR. This challenged the traditional system of flood protection, mainly by means of dykes, and called for a more integrative approach of flood risk management.

Which ecosystem services were considered? And how?

Flood risk management focuses on reducing the hazard itself and the vulnerability to it, that is the human exposure to this hazard and the kind of intensity of damage it can cause. It takes various risk reduction measures into account and evaluates them by considering their economic costs and benefits and also their environmental impacts.

In response to the 2002 floods, an assessment by Grossmann and colleagues (2010) compared various flood protection options for the river Elbe:

- a. to relocate selected dykes, thereby permanently enlarging the river bed
- b. to establish flood polders, specially designated flood retention areas which can be opened for flooding upon demand
- c. a combination of a) and b).

The study applies an extended cost-benefit analysis (CBA) in order to evaluate the three options. Besides typical monetary costs (for example flood protection infrastructure maintenance) and benefits (annual average damage avoided), two other areas are included, in which benefits accrue. These are (i) the ecosystem service of nutrient retention of natural floodplains, that is their water purification function by biological decomposition, and (ii) the

composite ecosystem service of biodiversity and restored riparian habitat (for example floodplain forest).

The project costs include planning-, construction- and communication costs, but also compensation payments to people who would have to be resettled as a consequence of dyke relocation. These costs depend on the length of the dyke to be established and / or the size of the polder or the floodplain to be created. The maintenance is likewise depending on the length of the dyke. The annual average damage avoided is estimated on the basis of flood probabilities and flood damage valuations derived from damage figures of former floods. The monetary assessment of the nutrient retention is achieved by using the 'replacement cost method' (cost of a wastewater treatment plant in case this ecosystem service were lost). The biodiversity value to the population of the Elbe region was measured by their willingness to pay for the restoration of riparian habitat.

As dykes are built for a long-term use, all costs and benefits were transformed into a net present value, assuming a project lifetime of 90 years and a discount rate of 3%.

This cost-benefit framework allows to compare policy options with regard to (i) their maintenance costs, (ii) the annually avoided flood damage (based on previous flood incidences), (iii) their biodiversity value and (iv) their nutrient retention value.

Table 1: Three flood protection options and their different benefits, net present value (NPV) in Euro over 90 years and a discount rate of 3% (extracted and adapted from Grossmann et al. 2010).

Flood protection options	Project costs (with saved maintenance compared to current dyke length)	Annual average damages avoided	Restoration of riparian ecosystem (willingness to pay for biodiversity value)	Nutrient retention (potentially saved costs on waste water treatment)	Sum of benefits
Dyke relocation	-407	177	926	488	1184
Polder	-42	415	0	0	373
Polder with regular flooding and limited dyke relocation	-124	427	202	54	559

When comparing the three policy options, only considering their respective potential for flood risk reduction (column two and three) then 'dyke relocation' would have a negative net present value of - 230 Mil. €, while building polders would achieve the highest net present value, 373 Mil. €. However, when including the environmental benefits into the assessment: dyke relocation has the highest net present value of 1184 Mil. €, whereas the 'polder' option offers no additional ecological benefits. The third option, 'polder with regular flooding and limited dyke relocation' generates a net present value of 559 Mil. €.

If high initial investment costs are considered to be a primary obstacle, then those options with low initial investment and still a considerable return appear economically attractive and politically feasible. In the Elbe context, the first option ('dyke relocation') would probably be ruled out for prohibitively high investment costs. The polder option would appear most attractive, but only if ecological benefits are not recognised as of substantial importance. In that case, the third option seems more appealing.

How did this information support policymaking?

The study by Grossmann et al. (2010) shows that results of a CBA of flood risk management options can change, when other ecological benefits are included. While the study is too recent to have been proven supportive in river basin planning, it clearly shows the potential to inform and enlarge debate on flood protection measures. Traditionally a domain of water infrastructure agencies, flood protection management can shift focus to simultaneously aim for ecological benefits. An analysis of selected ecosystem services shows that integrated solutions can be highly cost-effective. However, they also require sound collaboration across a broader range of stakeholders.

References:

Grossmann, M., Hartje, V., Meyerhoff, J. (2010) Ökonomische Bewertung naturverträglicher Hochwasservorsorge an der Elbe. Naturschutz und Biologische Vielfalt 89, Bundesamt für Naturschutz: Bonn.

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2008) Kosten-Nutzen-Analyse von Hochwasserschutzmaßnahmen. Dessau-Roßlau, August 2008.