

## ERA-NET CRUE Funding Initiative

# Flood risk management strategies in European Member States (FLOOD-ERA)

*A methodology to evaluate the effectiveness and efficiency of mitigation measures  
with regard to different risk perceptions*

Jochen Schanze<sup>1</sup>, Gérard Hutter<sup>1</sup>, Edmund Penning-Rowell<sup>2</sup>, Hans-Peter Nachtnebel<sup>3</sup>, Volker Meyer<sup>4</sup>, Alan Werritty<sup>5</sup>, Tim Harries<sup>2</sup>,  
Hubert Holzmann<sup>3</sup>, Beate Jessel<sup>6</sup>, Philipp Königler<sup>6</sup>, Christian Kuhlcke<sup>4</sup>, Clemens Neuhold<sup>3</sup>, Dennis Parker<sup>2</sup>, Anne Schildt<sup>4</sup>



### Abstract

([www.FLOOD-ERA.ioer.de](http://www.FLOOD-ERA.ioer.de))

**FLOOD-ERA** is dealing with the evaluation of structural and non-structural measures as part of flood risk management strategies. Structural measures (SM) focus flood control, non-structural measures (NSM) exceed structural works and also address the societal vulnerability. **FLOOD-ERA** puts emphasis on the methodological challenges of evaluating non-structural measures in comparison to structural measures. Moreover it tries to identify context conditions of decision makers, like legal regulations, planning systems, risk perception, which may influence the choice of non-structural measures as alternative or additional options for risk reduction.

### Objectives

- 1) To systemise structural and non-structural measures
- 2) To develop a methodology for the evaluation of the effectiveness and efficiency of structural and non-structural measures
- 3) To analyse context conditions of decision makers with a potential to influence the choice of structural and non-structural measures
- 4) To identify the site-specific effectiveness and efficiency of such measures and the influence of context conditions on their choice
- 5) To derive recommendations for the improvement of flood risk management strategies

### Approach and Results

**FLOOD-ERA** follows a normative and a descriptive approach. The normative approach addresses the question *how* to evaluate and compare SM and NSM. The descriptive approach explains *why* decision makers use certain measures considering their context conditions. Empirical work is carried out in 6 case studies based on hydraulic and damage modelling, GIS analyses and expert interviews (Figure 1).

Table 1 Proposed systematisation of SM and NSM with examples of measures and underlying instruments

Functional group	Type of measure	Measure (Examples)	Underlying instrument
<b>Structural Measures</b>			
Flood control	Flood water storage	Flood polder	Flood protection standard; investment programme
	River training	By-pass channel	
	Flood protection	Dike	
	Drainage and pumping	Urban sewer system	
<b>Non-structural measures</b>			
Flood control	Adapted land use in source area (catchment of the headwater)	Conservation tillage	Restriction of land use in source areas; priority areas "flood prevention"
	River management	Dredging of sediments	Investment/maintenance programme
Use and retreat	Land use in flood-prone area	Avoiding land use in flood prone areas	Restriction of land use in flood zones; building ban; hazard and risk map; insurance premium
	Flood proofing	Adapted construction	Flood forecasting and warning systems; civil defence or disaster protection act
	Evacuation	Evacuation of human life	
Regulation	Water management	Restriction of land uses in flood plains and source areas	
	Civil protection	Civil protection and disaster protection act	
	Spatial planning	Building ban	
Financial stimulation	Financial incentives	Investment programmes (e.g. for river works)	
	Financial disincentives	Insurance premium according to flood zone	
Information	Communication/Dissemination	Information aware	
	Instruction, warning	Hazard and risk map	
Compensation	Loss compensation	Insurance payments	

Table 2 Comparison of the effectiveness of SM and NSM in the 6 FLOOD-ERA case studies

SM	Compared NSM	Effectiveness of NSM compared to SM (case study; boundary conditions)
Diversion channels	- Flood forecasting and warning as basis for the evacuation of inventory	- 4.46 to 11.06 % based on public response and depending on the warning time compared to 100 % of the channels (Thames River; design level 100 yrs, recurrence intervals up to 100 yrs)
	- Emergency response	- "medium" to "high" (but not tested) compared to 100 % of the channels (Thames River; see above)
Dikes and/or flood walls	- Community based flood protection measures	- "uncertain" compared to 100 % of the channels (Thames River; see above)
	- Flood proofing	- "uncertain" compared to 100 % of the channels (Thames River; see above)
	- Floodplain spatial planning controls	- "high" (but only curtailing the development of the floodplain in the future) compared to 100 % of the channels (Thames River; see above)
	- Flood insurance	- "high" (but not universal) compared to 100 % of the channels (Thames River; see above)
- Public response	- "low" compared to 100 % of the channels (Thames River; see above)	
Dikes and/or flood walls	- Resettlement (hypothetical)	- 100 % compared to 100 % of ring site (Mulde River - Erlin; design level 100 yrs, recurrence intervals up to 100 yrs)
	- Local warning system	- 2.1 % compared to 100 % of flood wall (Mulde River - Grimma; see above)
Defence systems (dikes, flood walls, flood polder)	- Flood proofing and evacuation of inventory	- 64 % compared to 94 % of protection line (Elbe River; design level 100 yrs, recurrence intervals up to 100 yrs)
	- Spatial planning	- 25.6 % (due to effects for urban development of the last 10 yrs only) compared to 91.3 % of SM portfolio (Raab River; design level 100 yrs, recurrence interval 300 yrs)
- SM + spillway	- 95.5 % compared to 91.3 % of SM portfolio (Raab River; see above)	

Table 3 Conclusions on the influence of context conditions on the change of balancing SM and NSM

Context condition	Overall conclusion with regard to intended change
Human agency	Risk perception It is unlikely that risk perception is a major limiting context conditions for change
Perception of Responsibility	Change requires a broad understanding of responsibility among politicians and officials (e.g., responsibility as accountability and commitment).
Beliefs about measures	Change requires unlearning that only "big solutions" in terms of large-scale engineering work can solve "big problems" like severe consequences of major flood events.
Response repertoire	Significantly enlarged response repertoire will probably develop only over a considerable time span.
Leadership and networks	Change requires multi-level networks with relationships between different policy fields.
Social structures (in a broad sense)	Availability of guidelines, indicators and methods Change requires new guidelines, indicators, and methods to reduce uncertainty of measurement the effects of NSM relative to the evaluation of SM (see Chapter 5 of this report).
Funding	Change requires new funding mechanisms that are more suitable for NSM.
Formal institutions	Decentralisation within the public sector could facilitate change.
Informal institutions	Informal institutions are difficult to change (e.g., expectations of the public based on flood experiences). Cultural change as the outcome of changing informal institutions is to be expected in the long run, if at all.

**FLOOD-ERA** provides (i) a consistent typology of SM and NSM (Table 1), (ii) an outline evaluation methodology for comparative evaluation of SM and NSM, and (iii) an analysis of context conditions of decision-making with respect to balancing SM and NSM. Empirical results from the case studies show for the comparative evaluation that NSM in terms of effectiveness, cost-effectiveness and benefit-cost ratios can reach higher and lower values than SM (Table 2). Even no clear tendency can be found for one NSM under different circumstances. Context analyses indicate that decisions about SM and NSM can be improved through an evaluation methodology. However, balancing SM and NSM needs further policies on important context factors like funding mechanisms, formal institutions, and local leadership (Table 3).

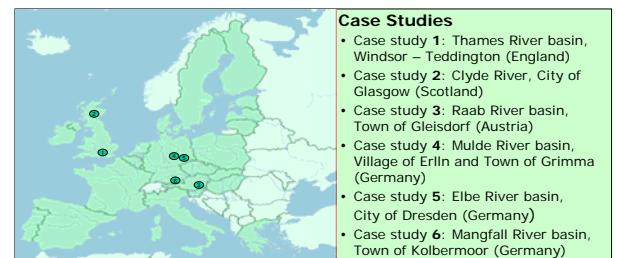


Figure 1 FLOOD-ERA case studies in European Member States

