
DANUBE FLOODRISK PROJECT – Cooperation for Hazard and Risk Maps Atlas production along the Danube and its continuation in RO by FLOOD CBA Project

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Presentation Content

- Danube Floodrisk Project – hazard and risk mapping
- Pilot activities planning flood prevention measures in high risk areas
- Methods for determining socio-economical priorities
- Cohesion and structural funds grants
- CBA analysis “receipt “ for such applications
Context that generated the project idea

• At the end of 2007 was approved and published 2007/60/EC Directive on the assessment and management of flood risk.

• In accordance with the provisions of this Directive, Member States have the obligation to make flood hazard and risk maps until the end of 2013.

• Achievement of these maps imply the allocation of large financial resources and activities.

• Floods occurred in the last 10 years along the Danube River have shown that these maps are needed to be made by trans-national river basin states, by linking existing information in order to be integrated into a common strategy of cooperation in flood risk assessment.
Problem: Borders are barriers for risk management

- Different elevation levels and models
- Different risk definitions
- Different hydraulic models
- Different planning systems

Flood Risk Area
Taking into account that each country works with different criteria for assessing flood risk, different methods for such assessments and different projection systems, after a workshop organized by the ICPDR Expert Group of Flood Prevention, in September 2008 in Budapest, was defined by the participants and the riparian states, a common position on this project idea.

Project results
Project results: Harmonized hazard maps

Flooding border

1D coupled with 2D model (Sobek, MIKE etc.)
Output: Stakeholder involvement

What do you need?

- Municipalities
- Spatial planning
- Rescue services
- Emergency management
- Insurances
- NGOs
- ...

→ Demands on map content!
→ At the European level for Sharing good practices (WGF workshop)
Schematic diagram of the integrated model for risk estimation.

1. **Questionnaires survey & Historical Data**
2. **Detailed land cover/use information**
3. **DHM supplies flood data on each grid (distribution, depth and duration)**
4. **Damage Classification**
5. **Development of vulnerability (or stage-damage) functions**
6. **Establish damage estimation model for each land cover/use feature**
7. **Flood Damage estimation in each grids using established models for each type of damage**
8. **Output: estimated distributed flood damage**
Additional risk information

- Effected population (one symbol per NUTS 2 or 3 region)
- Elements at risk
- Dikes
- Natural reserve areas (if too large to be displayed by symbol)

Hospitals (human health)
Airport
Main train station
Cultural heritage
Nature protection sites
Industrial sites and waste water treatment plant (IPPC)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Class</th>
<th>r</th>
<th>g</th>
<th>b</th>
<th>C</th>
<th>M</th>
<th>Y</th>
<th>K</th>
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<td>58</td>
<td>30</td>
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</table>
Atlas of hazard and risk maps production
Flood Hazard Maps is produced for extreme event scenario, with 1000 years return period (HS 1000).

LEGEND
Hazard Map
Water Depth
- > 4m
- 2m - 4m
- 0.5m - 2m
- < 0.5m

Search and Results
Disclaimer
Project Team
PILOTS IN HIGH RISK AREA

- Detailed risk flood maps
- Flood scenarios
- Integration in Spatial Planning

Method

\[ \text{RISK} = \text{function (HAZARD, VULNERABILITY)} \]
## Definitions of damages

### Flood damage categories and loss examples

<table>
<thead>
<tr>
<th>Tangible</th>
<th>Intangible</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary</strong></td>
<td><strong>Secondary</strong></td>
</tr>
</tbody>
</table>

### Direct

- **Tangible**
  - Primary: to building structures, facilities, properties, agriculture, and casualties directly from the floods
  - Secondary: Land and environment recovery
- **Intangible:** Some items such as value of a historical site or environmental quality are very difficult to identify their monetary values

### Indirect

- **Tangible**
  - Primary: induced by the direct damages (e.g. such as for cost for changing the traffic route, or shutting down business) - % from direct damages
  - Secondary: Impact on regional and national economy
- **Intangible:** Some items such as value of a historical site or environmental quality are very difficult to identify their monetary values

### Uncertainty damages

- Health, mental damage – people suffering from frequent flooding are willing to pay more insurance premiums than the expected annual losses – estimation involves social and psychological studies
Schematic diagram of the integrated model

Damage Classification
Development of vulnerability (or stage-damage) functions
Establish damage estimation model for each land cover/use feature
Flood Damage estimation in each grids using established models for each type of damage
Output: estimated distributed flood damage

Questionnaires survey & Historical Data
Detailed land cover/use information
DHM supplies flood data on each grid (distribution, depth and duration)

Distributed Hydrologic Model

Damage Estimation Model
Romanian pilot studies

Galati
Cernavoda
Giurgiu

Galati
Cernavoda
Giurgiu
Romanian pilot studies flood hazard maps

Galati

Cernavoda

Giurgiu
The method includes four major steps as:

A) Structuring a decision problem and selection of criteria *(decompose a decision problem into its constituent parts by criteria and sub criteria)*;

B) Priority setting of the criteria by pair wise comparison *(weighting - for each pair of criteria, the decision maker is required to respond to a question such as “How important is criterion A relative to criterion B?”)*;

C) Pair wise comparison of options on each criterion *(scoring - for each pairing within each criterion the better option is awarded a score, again, on a scale between 1 (equally good) and 9 (absolutely better))*;

D) Obtaining an overall relative score for each option *(the option scores are combined with the criterion weights to produce an overall score for each option)*.

Analytic Hierarchy Process (AHP) *(multi-criteria decision making technique, which provides a systematic approach for assessing and integrating the impacts of various factors, involving several levels of dependent or independent, qualitative as well as quantitative information)*
Romanian flood hazard extend map 1000y
Romanian flood hazard water depth map 1000y
Data collection

Detailed the Corine Land Cover (CLC) classes by digitize the buildings
Water depth map

GIS layers

Weight_1 = f (water depth)
Weight_2 = f (water depth)
Weight_3 = f (water depth)

Weight maps

Risk map
Galati
More Room for the Water in the Cat’s Bend Area

1. Sketch match
2. Hydraulic modelling / 3D GIS
3. Romanian REELD study
4. Dutch ‘Room for the river’ approach

Process
Effects
Basis
Principle
The meeting, attended by presidents of county councils Galati, Braila and Tulcea, prefects of these counties, mayors of municipalities and county government representatives directly involved in managing the crisis caused by floods, was chaired by the National Authority for Flood and Water Management (ANIMA), Dan Carlan, and State Secretary of Ministry of Interior, Michael Capra.
Galati flooding scenario (breach 50m, Q=50 m³/s)
### Hypothetical scenario of flooding - Galati 5th July 2010

- Flooded area in 24 hours = 333 ha
- Nr. of buildings = 706
- Area of flooded buildings = 54 ha

<table>
<thead>
<tr>
<th>Adancimea apei (m)</th>
<th>S(ha)</th>
</tr>
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<tbody>
<tr>
<td>0 - 0.5 m</td>
<td>32</td>
</tr>
<tr>
<td>0.5 - 1 m</td>
<td>12</td>
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<tr>
<td>1 - 1.5 m</td>
<td>8</td>
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<tr>
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<tr>
<td>2 - 3.5 m</td>
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Steps

- Vulnerability layers
- The data collection processing
- Set up the flooding scenarios
- Create the risk maps
Analytic Hierarchy Process (AHP)

Risk flooding map

Level 1
- Buildings
  - Material
  - Age
  - House levels
  - Function
  - Surface
  - Density
  - Age
  - Sex

- Population
  - Density

- Land use
  - Agriculture
  - Urban
  - Forest
  - Pasture
  - + Natura 2000

- Infrastructure
  - Roads
  - Railways
  - Gym/Stadiums

Level 2
- Socio-economic
  - Hospitals
  - Health Centre
  - Library/Museums/Cultural Heritage
  - Courthouse
  - Banks
  - Churches

Level 3
- Hazard flooding map
  - Water Depth

Water depth < 0.25 m

Water depth < 0.25 – 0.5 m

Water depth = 0.5 – 0.75 m

Water depth > 4 m

Level 1

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<th>Numerical rating</th>
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<td>9</td>
<td>Extremely preferred</td>
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<tr>
<td>8</td>
<td>Very strongly to extremely</td>
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<td>7</td>
<td>Very strongly preferred</td>
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<td>Strongly to very strongly</td>
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<tr>
<td>5</td>
<td>Strongly preferred</td>
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<tr>
<td>4</td>
<td>Moderately to strongly</td>
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<td>Equally to moderately</td>
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<tr>
<td>1</td>
<td>Equally preferred</td>
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<table>
<thead>
<tr>
<th>Buildings</th>
<th>Population</th>
<th>Land Use</th>
<th>Infrastructure</th>
<th>Socio-economic</th>
<th>Weight</th>
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<tr>
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<td>4</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>0.25</td>
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</table>

Weight_1 = f (water depth)
Corine Land Cover
Infrastructure
Level 2

- Material
  - Clay
  - Stone
  - Bricks
  - Iron
- Age
  - < 5 years
  - 5 - 10
  - 10 - 50
  - > 50
- House stories
  - 1
  - 2
  - 3
  - 4
  - > 4
- Function
  - Residential
  - Commercial
  - Administrative

Weight_2 = f (water depth)

Level 3

- Water depth < 0.25 m
- Water depth > 4 m

Weight_3 = f (water depth)

Water depth < 0.25 m

Water depth > 4 m

Level 2

- Material
  - Clay
  - Stone
  - Bricks
  - Iron
- Age
  - < 5 years
  - 5 - 10
  - 10 - 50
  - > 50
- House stories
  - 1
  - 2
  - 3
  - 4
  - > 4
- Function
  - Residential
  - Commercial
  - Administrative

Weight_2 = f (water depth)

Level 3

- Water depth < 0.25 m
- Water depth > 4 m

Weight_3 = f (water depth)

Water depth < 0.25 m

Water depth > 4 m
Buildings (type)
Buildings (number of storied house)
Population (number / house)
Phase 1 - Flood Risk Diminishing by Structural Measures

HAZARD & RISK MAPS

Phase 1 - Flood Risk Diminishing by Structural Measures

COSTS ?
An Integrated Flood Management System

Phase 2 – Early Warning System Development

- Meteorological Radars
  - Forecasting Meteorological Model (LAM):
    - GIS
      - Fenomena Localization and Characterization
        - Hazard Map
        - Thresholds System
          - ALARM
    - EO Images
      - Satellite Images: Automatic Flood Delineation
Phase 2 - Flood Risk Prevention

**AT-EVENT-TIME**

Assessment of estimate damages obtained by the intersection of flood extent with land cover/use, socio-economic data and statistics

Flood Database, including images, historical data, socio-economic information, land cover/use maps, infrastructures, transportation network, topographic layers, and all the intermediate and final product generated by the service.
Selection of destinations
Line ISDN
Database
Calling confirmation
More than 30 simultaneous pre-registered messages

Warning population,
Warning by mapping products,
Intervention decision
Activities of inspection and rapid intervention (experts data base)

- Planning/preparing actions (modeled scenarios)
- Training personal
- Adequate equipment
- Warning/Alarming Systems interconnected at the regional level

WATMAN Project 55 mil euro
Where benefit-cost analysis fits into the decision-making process

- a specific requirement for the EC to offer guidance on project appraisals, as embodied in the regulations of:
  - the Structural Funds (SF),
  - the Cohesion Fund (CF), and
  - Instrument for Pre-Accession Assistance (IPA)1.
• EU Cohesion Policy regulations require a cost-benefit analysis of all major investment projects applying for assistance from the Funds. The legal threshold for the definition of the ‘major’ investment is €50 million in general, but for environmental projects it is €25 million and for IPA assisted projects, €10 million.
• Cost Benefit Analysis is simply rational decision-making. People use it every day, and it is older than written history.

• Our natural grasp of costs and benefits is sometimes inadequate, however, when the alternatives are complex or the data uncertain. A formal techniques is needed to keep our thinking clear, systematic and rational. These techniques constitute a model for doing benefit-cost analysis. This includes a variety of methods:
Methods:

- identifying alternatives;
- defining alternatives in a way that allows fair comparison;
- adjusting for occurrence of costs and benefits at different times;
- calculating leu/euro values for things that are not usually expressed in euro;
- coping with uncertainty in the data; and summing up a complex pattern of costs and benefits to guide decision-making.
1. Examine needs, consider constraints, and formulate objectives and targets. State the point of view from which costs and benefits will be assessed. (See this chapter.)

2. Define options in a way that enables the analyst to compare them fairly. If one option is being assessed against a base case, ensure that the base case is optimized.

3. Analyze incremental effects and gather data about costs and benefits. Set out the costs and benefits over time in a spreadsheet.

4. Express the cost and benefit data in a valid standard unit of measurement (for example, convert nominal leu to constant euro, and use accurate, undistorted prices).
5. Run the **deterministic model** (using single-value costs and benefits as though the values were certain). See what the deterministic estimate of **net present value (NPV)** is.

6. Conduct a **sensitivity analysis** to determine which variables appear to have the most influence on the NPV. Consider whether better information about the values of these variables could be obtained to limit the uncertainty, or whether action can limit the uncertainty (negotiating a labour rate, for example). Would the cost of this improvement be low enough to make its acquisition worthwhile? If so, act.
7. Analyze risk by using what is known about the ranges and **probabilities** of the costs and benefits values and by simulating expected outcomes of the investment. What is the **expected net present value (ENPV)**? Apply the standard decision rules.

8. Identify the option, which gives the desirable distribution of income (by income class, gender or region - whatever categorisation is appropriate).

9. Considering all of the quantitative analysis, as well as the qualitative analysis of factors that cannot be expressed in lei/euro make a reasoned recommendation.
The report

• a description of the need, problem or opportunity;
• a description of the options with an explanation of why they were chosen and why it is fair to compare them;
• a statement of the point of view of the analysis;
• a statement of assumptions and scenarios;
• a deterministic analysis;
• a cost-benefit analysis and a risk analysis;
• a discussion of equity effects and other non-economic effects; and
• a ranking of the options.
GENERAL CONCLUSIONS on CBA in RO

• CBA can be applied to a wide range of decisions made by the Government of Romania

• Every CBA must state the point of view from which benefits and costs will be assessed.

• There is no cookbook for benefit-cost analysis, but a standard set of steps is mentioned under the Romanian legislation.