Study the flooding risk in assessing ecosystem services supply in Blagoevgrad district

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Introduction

- Changes in land cover and use are the main reason of increased risk of natural qualitative disturbances.
- Soil erosion and flooding are serious disturbances which are of a special importance for the whole territory of Bulgaria.
- Blagoevgrad district is one of the most affected areas at national level from flooding disservice.
- During the recent years Struma and Mesta rivers and their tributaries damaged urban areas and infrastructures, forest territories and population.

This implies the necessity of defining preventive measure and to take necessary actions and investigations on erosion processes, flood risk and the potential of urban green infrastructure to support the capacity to supply such ecosystem services.
Purpose of investigation - region in focus

To assess the flood risk on the territory of the bigger urban territories in Blagoevgrad region in relation to their condition for further definition of measures in increasing the relevant capacity of these ecosystems to provide ES.
The present study is conducted in Blagoevgrad district, which covers 16593.6 ha of southwest part of the country.

Object of investigation is the potential risk of high water formation, flooding and its connection with relevant ecosystem services.

Here we propose the approach for assessment of ES, which are directly related with the demand of lower flood risk.
Materials and methods

- The policy on water management is focused on development and implementation of the Plans for River Basin Management as a main planning document for integrated water management.

- Flooding risk assessment and identifying areas with potential significant flood risk are made by methodology of Ministry of Environment and Water of Bulgaria, according with European Water Directive 2000/60/EU.


- Analyses on available dataset and information were used to define the algorithms for assessment the ES of urban ecosystems at regional and national scales.
TUNESinURB methodical approach

Assessment of potential flood risk for every single settlement followed the steps:

- Determination of the main water current or water currents, that run/s through the settlement depends on the following indicators: constant water current, watershed area, forest cover. It is possible the water current to be an intermittent.
- For every single area (polygon) (J1, J2...) is determined: degree of flooding risk in scale from 1 to 5.
  1) around the water current flooding risk is determined together with the area of potential flooding.
  2) percentage of the area that could be affected.
- In some cases one polygon may have more than 1 or 2 estimates. It depends of the polygon and experts' opinion!

<table>
<thead>
<tr>
<th>Disturbance regime</th>
<th>Parameter</th>
<th>Assessment scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Score 1 (very bad)</td>
</tr>
<tr>
<td>Floods</td>
<td>% endangered areas of the total area</td>
<td>Score 2 (bad)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Score 3 (moderate)</td>
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<tr>
<td></td>
<td></td>
<td>Score 4 (good)</td>
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<tr>
<td></td>
<td></td>
<td>Score 5 (very good)</td>
</tr>
<tr>
<td>&gt;15</td>
<td>5-15</td>
<td>2-5</td>
</tr>
<tr>
<td>0-2</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Assessment of potential flooding risk on administrative level followed the steps:

- Flood risk assessment in every single area (polygon) (J1, J2,....), for all settlements (villages and towns) in the province;
- Flood risk assessment in every single area (J1, J2, .....), only for cities in the area or settlements with more than a certain number of population (1000 or 2000, depends on the purpose of the study).
## Flood risk in Blagoevgrad district

<table>
<thead>
<tr>
<th>Risk assessment</th>
<th>Area</th>
<th>Blagoevgrad district total assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ha</td>
<td>% of Blagoevgrad district total area</td>
</tr>
<tr>
<td>1 - Very bad</td>
<td>1210.07</td>
<td>7.29</td>
</tr>
<tr>
<td>2 - Bad</td>
<td>95.69</td>
<td>0.58</td>
</tr>
<tr>
<td>3 - Moderate</td>
<td>551.34</td>
<td>3.32</td>
</tr>
<tr>
<td>4 - Good</td>
<td>5.63</td>
<td>0.03</td>
</tr>
<tr>
<td>5 - Very good</td>
<td>14730.82</td>
<td>88.77</td>
</tr>
<tr>
<td>Total area</td>
<td>16593.6</td>
<td></td>
</tr>
</tbody>
</table>

- In the following investigation, flood risk assessment is made of the total area of Blagoevgrad district and separately for settlements with more than 2000 people population and only for cities.
- Blagoevgrad district total flooding risk assessment is 2- bad.
- 11.2% is the territory in risk.
The data for settlements with more than 2000 people is sufficient for complete evaluation on province level.

In this case, the reliability of the result is sufficient, because investigated areas in these settlements is about half the total area of the province.
Flooding risk assessment from data for settlements with more than 2000 people population is “bad” which is the same with assessment for Blagoevgrad district. This shows us that the sample of data for these settlements is sufficient for complete assessment on regional level.
The regions with significant potential flood risk in Blagoevgrad district according to Basin directorates are Blagoevgrad, Simitli, Kresna, Strumiani, Sandanski, Iacoruda, Razlog and Bansko.

The results from TUNESinURB methodical approach are almost the same. Blagoevgrad, Sandanski, Iacoruda and Bansko are with assessment 1- very bad, and Simitli, Kresna and Razlog are with assessment 2-bad. This shows that there is not a significant differences between the both methodical approaches.
Considered ecosystem services in urban areas dependent on flood risk: demand & services

- Mitigation of soil erosion (2211, 2212 CICES 4.3) - Soil retention is closely dependent of vegetation, but in urban ecosystems additional factors need to be considered
- The methodological approach for MAES of urban ecosystems developed for national methodology was applied

**Indicators - assessment the urban ecosystems condition**

- Soil sealing (F1)
  - For sub-type J10 the area of water body is reduced
- Index of spatial structure - % green infrastructure (F7)
- Sediment yield (F3)

**Assessment the capacity of urban ES to regulate soil erosion**

\[(F1+F2+F3)/3\]

**Scoring:**

- 0 – J7, J8 & J9
- From 1 to 5 – J1, J2, J3, J4, J5, J6 & J10

**Mapping**
The capacity of urban ecosystems in Blagoevgrad region to regulate soil erosion is assessed from medium (3) to relevant (2).

The data obtained confirmed that the regions with high demand have low relevant capacity to supply this ES – score 1.

Regions with higher risk of flooding form higher demand of regulation of soil erosion ES – these regions needs of elaboration and implementation of specific measures;

In general demand of regulation of soil erosion cover bigger territories than those of studied urban ecosystems – the elaboration of measures related with the improvement the relevant capacity of urban ecosystems to regulate soil erosion should cover broader territorial coverage incl. surrounding peri-urban zones.
Water flows maintenance and flood protection (2221, 2222 - CICES 4.3);

The methodological approach for MAES of urban ecosystems developed for national methodology is proposed.

Indicators - database

- Soil type properties – JICA and national data and maps
  - Anthrosols and Technosols
- Water retention capacity and maximum water holding capacity (F1)
- Infiltration rate of soil (cm/sec) (F2)
- Index of spatial structure - % soil sealing
- Vegetation canopy cover (F3)
- Urban Runoff Coefficient (F4)

Indicators - assessment the urban ecosystems condition

- [(F1 + F2/2) / F4] x F3

Assessment the capacity of urban ES to maintain waterflows and to protect flooding

Scoring:
- 0 – J8 & J9
- From 1 to 5 – J1, J2, J3, J4, J5, J6, J7, J10

Mapping
A method for flooding risk assessment in settlements, based on expert assessment for the potential danger of flooding area is developed. It is applicable on watershed and on administrative levels.

The potential danger of flooding is greatest ("very bad") for six of the towns of Blagoevgrad district and for two of the larger settlements, and other nine are in "bad" degree. The total flood risk assessment for all settlements in the district is "bad", which indicates a high demand of relevant ES. This assessment is confirmed by the data for settlements with more then 2000 people population, which show that the sample of data for these settlements is sufficient for complete assessment at regional level.

Ecosystem service demand in terms of mitigation flood risk in urban areas is specific for different sub-types of urban ecosystems and is time-dependent.

Ecosystem services supply linked to regulation of soil erosion are related to this specific demand.

The supply of ecosystem services in bigger cities in Blagoevgrad district is assessed from medium to relevant, which suppose that the local population cannot fully meet its demand due to many factors including green infrastructure.

The proposed approach in assessing the ES workflow regulation and mitigation of flooding needs considers the main factors and related indicators and could be applied at regional and national scale.

Practical application and implementation of the proposed set of indicators for MAES in Bulgaria has already begun. A first assessment of the recommended supply indicators has been prepared on the basis of available spatial and qualitative data.

The process of MAES in terms of the ES demand at different scales is ongoing.
Thank you for your attention

The study is elaborated within the project TUNESinURB, FM of EEA 2009-2014. 
www.tunesinurb.org