FLOOD RISK MANAGEMENT ON DANUBE RIVER, CALAFAT - BECHET SECTOR

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All countries from the Danube River Basin have executed embankment works on the Danube River.

### LENGTH OF DYKES EXECUTED ON THE DANUBE RIVER

<table>
<thead>
<tr>
<th>No. crt.</th>
<th>Country</th>
<th>Dyke Length (km)</th>
<th>River length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Germany</td>
<td>370</td>
<td>580</td>
</tr>
<tr>
<td>2</td>
<td>Austria</td>
<td>300</td>
<td>350</td>
</tr>
<tr>
<td>3</td>
<td>Slovakia</td>
<td>230</td>
<td>222</td>
</tr>
<tr>
<td>4</td>
<td>Hungary</td>
<td>454</td>
<td>447</td>
</tr>
<tr>
<td>5</td>
<td>Croatia</td>
<td>44,7</td>
<td>N.D.</td>
</tr>
<tr>
<td>6</td>
<td>Serbia</td>
<td>410</td>
<td>538</td>
</tr>
<tr>
<td>7</td>
<td>Bulgaria</td>
<td>471</td>
<td>N.D.</td>
</tr>
<tr>
<td>8</td>
<td>Romania</td>
<td>1200</td>
<td>1200</td>
</tr>
</tbody>
</table>
There are 87 localities prone to flooding in the Romanian Danube flood plain, totally or partially situated in 26 agricultural precincts. The defense works protect against floods:

- 274000 hectares of agricultural land;
- 150000 households and households annexes;
- 163 production centers;
- 389 animal husbandry complexes;
- 85 km of railway;
- 350 km of surveyed roads.
After the disastrous floods held in Europe in the last decades the problem of a new approach in setting water courses became imperative:

- more room for rivers;
- living with floods;
- the limitation of the anthropic intervention in the natural processes, compensation and avoiding the human intervention in the future;
- restoration of the natural areas for flood water retention and flood mitigation.

After the 2006 floods on Danube River, resulted with some dikes breaks, two specialist opinions are put face to face:

- destruction of dykes on the Danube and the protection of localities by using perimetral dikes and the floodplain recovery to its original state;
- the repair, the maintenance and the continued use of the Danube dykes both for flood protection and for the use of the resources of the areas behind the dykes.
Proponents of “destroying the dykes” solution believe that:

- the dykes do not provide sufficient flood protection;
- the destruction of dykes could lead to the attenuation of flood waves on the Danube.

Proponents of “maintaining the dykes” solution have as arguments:

- there is no absolute protection against floods, but only a certain degree of protection can be assured;
- before carrying on the Danube impoundment of Drobeta - Turnu Severin - Calarasi sector the floodplain storage capacity was about 5 ckm;
- the flood wave volume produced in 2006 was about 93 ckm, so the sector mentioned above practically could not to produce a significant attenuation.
The destruction of dykes by the 2006 floods was not produced by the dykes spill over but by the mechanical suffusion which produced breakdowns and landslides of dykes slopes.
THE AGRICULTURAL, HYDROLOGICAL AND ECOLOGICAL POTENTIAL OF THE DANUBE RIVER FLOOD PLAIN CAN BE SUSTAINABLY USED WITHOUT THE DESTRUCTION OF THE CURRENT DYKES.
REHABILITATION – aims at the restoration of only certain aspects which, through adequate measures, can lead areas from the flood plain to a situation closer to the original one, through:

- realization of lakes and ponds linked to the river through engineering infrastructures and forestations without destroying the dykes.

RECONSTRUCTION – admits the fact that the flood plain has changed so much that the initial conditions cannot be reached anymore. Consequently, for the sustainable use of the flood plain potential, other objectives have to be set, which should take into account the following:

- achieving an efficient agriculture;
- development of pisciculture by arranging nurseries for inseminations in the rivers and systematic hatcheries with directed feeding and wintering pools for breeders;
- extension of forest areas;
- increasing the ecological potential of the flood plain;
- development of tourism.
Managing flood risk by dikes and nature protection can go “hand in hand” following the “as gentle as possible, as hard as necessary “ principle. As a case study the Calafat - Bechet sector was selected, in the most part embanked, for which is presented a solution that can bring the Danube valley, in the sector, at a situation as close as possible from the original one.

The proposed solution in this case is the realization of some engineering infrastructures with reversible operation.
The gates are permanently lowered and the water of the river enters by the back of dykes from upstream to downstream as if it there were no dykes, the water exchange between floodplain and the river being permanent.

When the water level behind the dykes reaches values that can endanger the localities situated on the terrace, then the gates are closed until the flood passage.

The area behind the dykes may not remain only a simply pool so it is necessary to make different arrangements to put in value its ecological potential.
To identify the necessary arrangements to be made the following indicators were used:

- **Terrain segregation index**

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TSI = \frac{\text{agricultural surface}}{\text{population}} - \frac{\text{aquatic surface}}{\text{population}}
\]

- **Natural index**

\[
NI = \frac{\text{forest surface}}{\text{agricultural and constructed surface}}
\]

- **Agricultural productivity index**

\[
API = \frac{\text{total production value (lei)}}{\text{agricultural surface (ha)}}
\]
Terrain segregation index TSI – for the Calafat – Bechet sector the resulting value was 4,38 ha/inh that mean a very reduced value of this indicator.

**MEASURES**

- The abandonment of agricultural land use.
- Necessity to increase water surfaces against weakly productive agricultural surfaces, without destroying the dykes.

**Agricultural Productivity Index API** - according to the INCDDD 2008 study – for crops with important market share (wheat, barley, oats, corn, sunflower, soy, rape) – the value of this indicator on Calafat – Bechet sector is of 1284 lei/ha, value which is situated under the national average who is 1975 lei/ha.

**MEASURES**

- It is necessary to introduce afforestations and the formation of water surfaces.
Natural Index NI – used to assess the anthropogenic impact upon landscape

In accordance with the INCDD study, calculated on counties, this index has the following values:

- > 0,60 – **LANDSCAPE WITH ECOLOGICAL EQUILIBRIUM CLOSE TO THE INITIAL ONE**;
- between 0,45 and 0,60 – **landscape with relatively stable equilibrium**;
- between 0,30 and 0,45 – landscape with weakly affected ecological equilibrium;
- between 0,20 and 0,30 – landscape at the limit of ecological equilibrium;
- between 0,10 and 0,20 – landscape with heavily affected ecological equilibrium – *Dolj NI = 0,11*;
- < 0,10 – very heavily affected landscape.

**MEASURES**

- Increase in forested areas without dyke destruction.
STAKEHOLDERS INVOLVEMENT

- Involving local the people and respect their constitutional approach.
- Respect for cultural and spiritual needs of people in the area.
- Involving community members on a "cover expenses“ principle.
- Taking into account the vulnerability of the population face to a new social, economic, cultural and spiritual life.
- Conservation of trust and of the public interest in the project and ensure that the project results will be beneficial to it.
CONCLUSIONS

- Sustainable use of agricultural, ecological and hydrological potential of the Danube River flood plain. The protection of significant social and economic values is possible without the destruction of the existent dykes.

- The ecological state of certain areas from the Danube River flood plain can be improved through the realization of landscapes with stable ecological equilibrium by increasing water surfaces and forestations.

- In the Danube River the cultivated surface is 273375 hectares, that is 4,5% from the cultivated surface of Romania – the agricultural productivity index being of 1793 lei/hectare compared to the country average of 1975 lei/hectare.

- However there are areas, which has a productivity index of 2579 lei/hectare.

- Taking into account the world crisis in the agricultural product prices, the agricultural use of the flood plain has to be continued, and measures of introduction of valuable crops must be adopted and agro-technical measures must be improved.