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The Integrated Flood Management - The Karas River Case Study

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ABSTRACT: The concept of integrated flood management is illustrated by the Karas river case study which, through three design alternatives of passive and active flood control, promotes the up-to-date integrated flood management concept, particularly aiming at the preservation of the ambient quality of the stream corridor, thus upgrading possibilities for recreation and tourism.
KEYWORDS: flood management, active flood control, stream corridor preservation

Introduction

The Karas river is trans-boundary river, about 20% of its catchment area being in Serbia. The 1975 major flood endangered in the 32 km long river valley about 3000 ha of farmland, 7 villages with about 20 000 people, several industrial capacities (mills), and traffic infrastructure - roads and a number of road and railway bridges (Fig. 1).

The integrated flood management concept was applied for this river. Generally, this concept: (a) identifies all water-related problems in the potentially flooded area; (b) takes into account relevant local conditions; (c) achieves a number of objectives within the global water resources management strategy (flood protection, water supply, drainage, etc.); (d) makes an assessment of environmental impacts (water quality, ecosystem, ambient quality), and (e) considers public and social aspects of the proposed technical solutions.

Specifically, three alternatives of flood control were considered, with the following main objectives:

- protection of farmland, villages, mills, road and railway infrastructure;
- preservation of surface water and groundwater quality;
- preservation of the river ecosystem;
- upgrading possibilities for recreation and tourism.

The last two items were of particular importance, since the Karas river is the last river in the region with preserved ecosystems, and high ambient quality (Fig 2). For this reason, this river deserved a special attention and prudent river training measures.

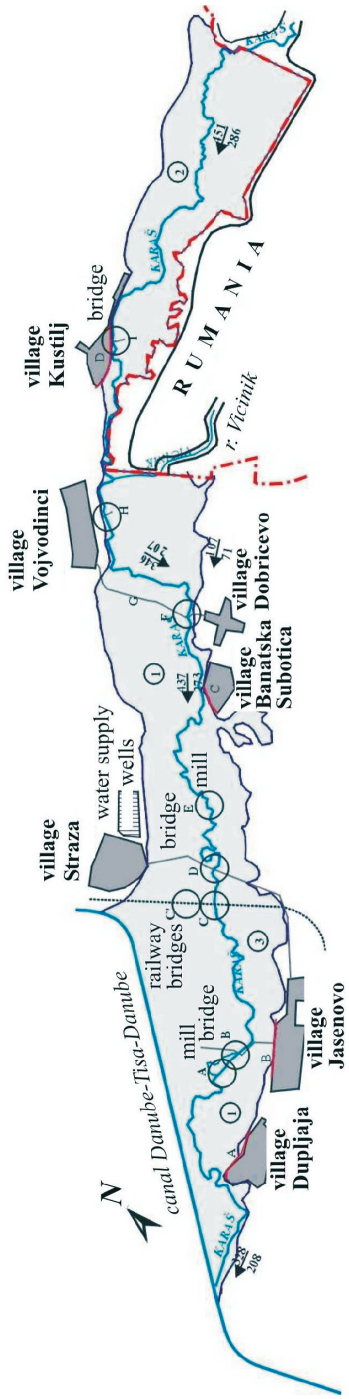

Fig. 1. The potentially flooded region of the Karas river valley

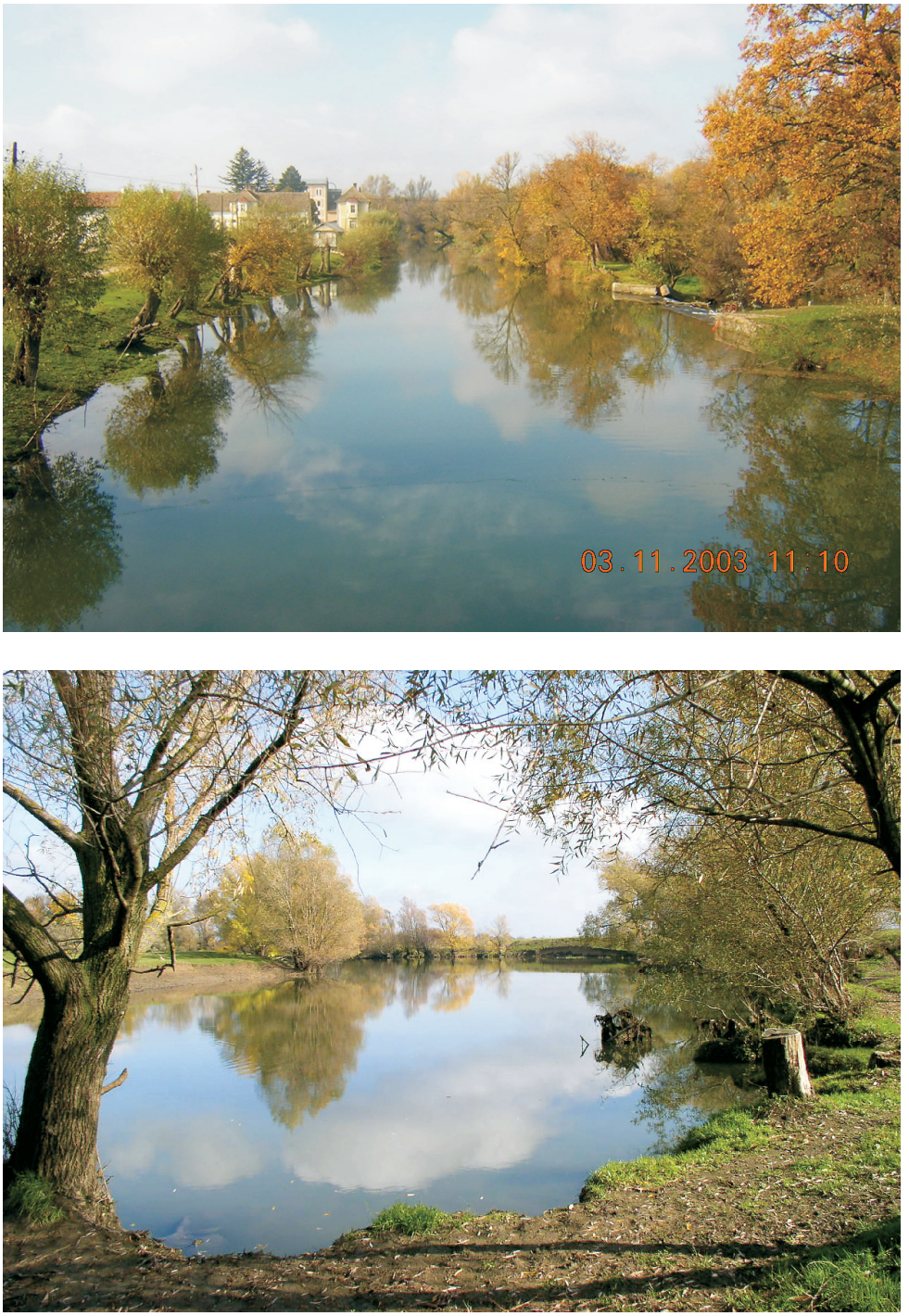

Fig. 2. Scenes from the Karas river (region of the villages Jasenovo and Straza)

Flood management strategies for the Karas river

The study of flood management for the Karas river (completed in 2000), considered three solution alternatives: A: classical passive flood protection by levees aligned with the main river channel, B: active flood control by a flood relief canal, and C: active flood control combining a flood relief canal and a retention polder (Fig. 3).

The alternative A stipulates levees along the main channel, protecting the endangered region against 100 years flood. The capacity of the main channel is about 70 m^3/s, and duration of excessive flow rates is 3-4 days in an average year. The alternative A has a number of disadvantages:

- limited expansion space for floods will increase velocities in the main channel;
- erosion potential of the main channel will be increased;
- negative effects for ecosystems can be expected in the main channel and the floodplain;
- new drainage systems will be required;
- reconstruction (elevation) of bridges will be necessary;
- extensive works will degrade the natural appearance of the stream corridor.

The alternative B, designed to eliminate some of the shortcomings of the alternative A, is based on the presumption that the downstream reach of the river channel should be preserved in its natural state. No levees should be built along this reach. For this reason, a flood relief canal (Fig. 3) is designed to accept all excess flood water, (above 70 m^3/s), which is expected to happen several times per year. The upstream reach will be protected by levees, as in the alternative A.

The alternative C goes a step further in respect to the previous alternative, increasing the safety margin for extreme flood events. A 415 hectares of land, less valuable for farming purposes, is reserved as a polder (retention basin) for flood water. Downstream from this polder, water is to be distributed between the flood relief canal and the river channel (Fig. 3). Upstream, levees along the river channel are to be applied, as in alternatives A and B.

The advantages of the alternative C over the alternative B is that:

- the safety of the trans-boundary region is increased, with no danger for Romania even if 100 years floods on rivers Karas and its tributary, the Vicinik river, were to coincide;
- a smaller flood relief canal is needed, and it will be in function once in 4 years, on the average.

However, this alternative requires two special discharging structures – a culvert, designed to direct water from the polder into the main river channel, and a structure connecting the polder with the flood relief canal (Fig. 3).

The alternative C is chosen to be justified through a feasibility study, and a much detailed technical documentation. The decision criterion in this case was not solely the economic one. In fact, the three alternatives are financially comparable (about 5 million EUR), but the alternative C has definite advantages in respect to hydrologic safety, environmental protection, and possibilities for recreation and tourism.

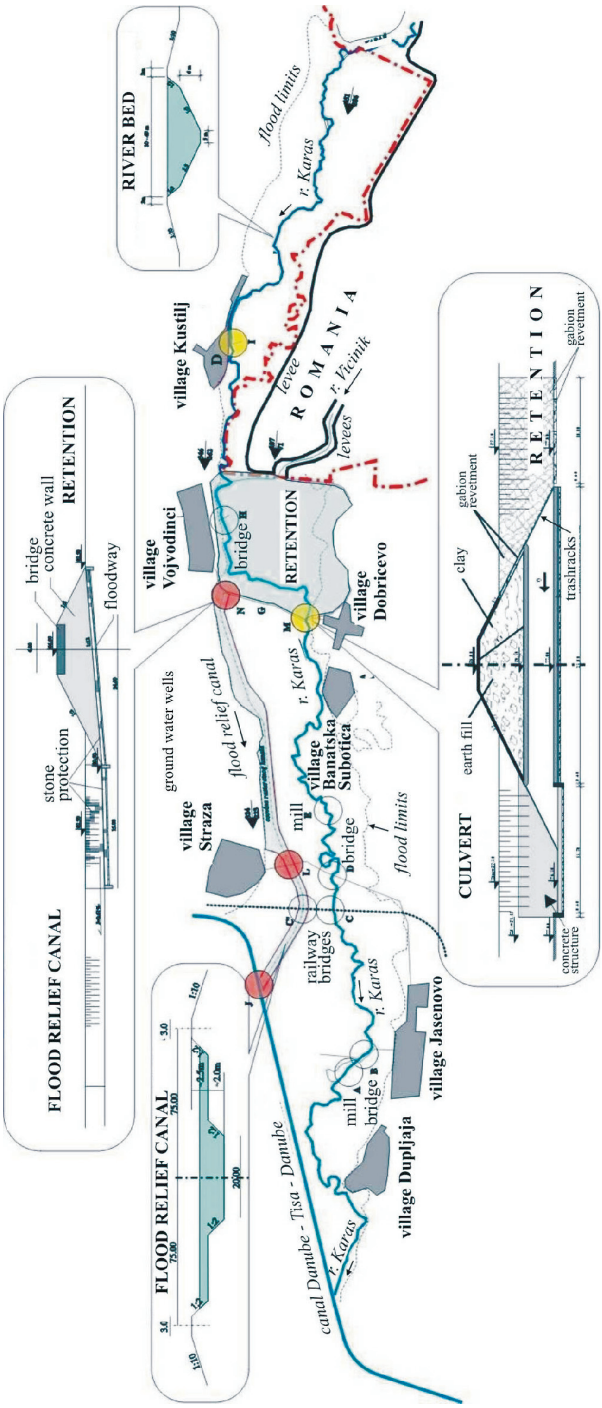

Fig. 3 The optimal flood management scheme for the Karas river (the algernative C) [1]

River training

Following the intention that the river channel should be preserved in its present state, a special attention is paid to the river training impact on the river ecosystem flora and fauna. Only sporadic interventions are considered, applying the following principles:

(i) The hydraulic and morphologic regimes of the river are to be fully investigated through extensive hydrologic, hydraulic, sedimentologic and morphologic analyses. This is prerequisite factor before any measures are considered within the stream corridor.

(ii) All meanders are to be preserved, and no channel enlargement is permitted. Cut-offs are likely to increase velocities above the tolerable limits for some species, depredating bio-diversity and stability of the ecosystem. Thus, the issue of the river sinuosity and dynamic equilibrium is not only an engineering issue, but also an environmental one.

(iii) Decreasing water levels due to meander cutt-offs or widening of the river channel can be detrimental to wild life (no pools and riffles), and can raise the question of the "sustainable minimum" acceptable for the ecosystem and recreational activities.

(iv) All river training measures along the river banks are to be extremely restrictive. Removal of the riparian vegetation reduces bank resistance to erosion, and can be harmful to the ecosystem (increases water temperature, reduces biologic material in the food-chain, etc.). Extensive excavation or removal of soil, in addition to various degrading consequences, disturbs the ambient quality.

Fig. 4. The side weir structure near village Jasenovo

In accordance with the above principles, the river training measures consist only of bank protection and control of the longitudinal bed slope. The bank protection by vegetation and stone, is applied only to the sharpest river bends. Two longitudinal slope grading structures are considered, similar to some existing ones (Figs. 4, 5). Not only that such structures have aesthetic value, but also contribute to the water quality, increasing the oxygen content.

Fig. 5. The ramp structure near village Straza

Social implications of the project

There are some important social implications of the Karas project. The first one is related to the acceptance of the technical solution by the public, and especially by the local decision-makers. In this respect the proposed technical solution should serve as the "judgment engine" Š2Ć to change attitudes, ease decision-making and instigate concrete actions. The social component of the Karas river project includes considerable efforts in order to:

- convince local authorities that the proposed technical solution is the optimal one;
- resolve conflict of interests (local construction operative would prefer to build levees);
- make amends with farmers whose land will not be protected as will be used for retention purposes (polder).

The second social implication of the proposed flood management scheme is the public awareness of the benefits that can be gained if this project is carried out. Among many benefits, not least important are those connected to the recreation and tourism. This project opens many possibilities in this respect, as can be deduced from Fig. 6. It would be regrettable if this chance is not taken.

Conclusion

The river Karas project is a good example of an integrated approach of flood management, which, considering many technical and non-technical assets of this problem, promotes solutions of highest environmental and social value.

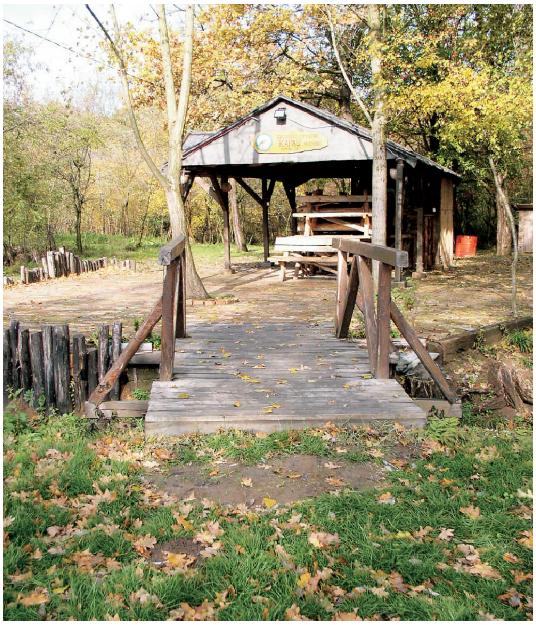

Fig. 6. The recreational park near village Jasenovo

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