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THE RENATURATION OR ECOLOGICAL REHABILITATION MEASURES FOR BEGA RIVER BASIN

Codruța BĂDĂLUȚĂ-MINDA*

Abstract: The renaturation or the ecological rehabilitation is considered by many specialists the ultimate test of the day by day implementation of the ecological science as an autonomous system based on natural reproduction and succession but also as a reconstruction of the functional and structural services of the ecosystem.

The stream rehabilitation implies both the restoration and the development of the affected areas. The rehabilitation program should thus include technical, economic and juridical measures and therefore bring changes to the physical, social and economic conditions of the surroundings.

Keywords: river basin, buffer zone, ecological reconstruction, renaturation

1. INTRODUCTION

The mainstreams in this catchment area, whose surface is bigger than 10 km², are 80, with a total length of the hydrographic system of 1418km, important being the river Bega and Bega Veche. The Bega catchment area represents an area composed by mountain, hills and field.

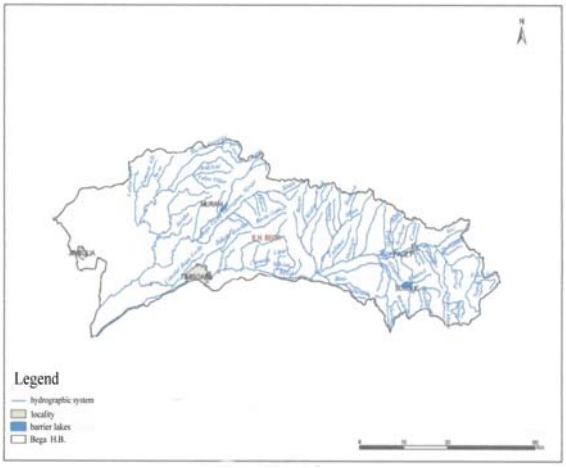

Figure 1.The hydrographic basin Bega

The river Bega springs from the Poiana Rusca Mountains at an altitude of 890m under the Pades peak, and the surface of the catchment area (4470km²) has an east-west general orientation, and it falls into the Tisa River on the Serbian territory. Over the length of 170 km to the border, the Bega River receives many affluents. In the mountainous area it has a narrow valley in which it receives important affluents like: Paraul Mare, Bega Poenilor, Icui and Vadana. The mainstream of Bega goes then towards west to the Lipova foothills, presenting a large valley where it falls into other rivers: Gladna, Fedimac, Minis and Chizatau. The last part of the mainstream goes on the Bega field, where the valley gets even larger and it receives less affluents which have also reduced water flows (important to mention being only Iosifalau and Gherteamos affluents), and the last 44 km on the Romanian territory are transformed into a navigable channel - the Bega Channel.

The track followed by the Bega River laps over silicon formations, with a river bed substratum made of rocks, rubble and mud, with a sinuously quotient of 1, 34 and a medium slope of 5‰.

The Bega Veche River is presented as a special mainstream due to its hydro technique developments which were finished at the end of the last century, even though it is in fact the old layout of the Bega River. This is a continuation of the Beregsau stream, which on a length of 107 km sews a surface of 2108km², and presents a sinuosity quotient of 1, 41 and a medium slope of 2‰. It is a mainstream that has few tributaries.

Ecological rehabilitation is considered to be an anthropogenic exercise of fighting against anthropogenic effects. The rehabilitation aims to provide sustainable benefits to the society and ecosystem.

Streams ecological rehabilitation implies bringing the anthropologic altered water bodies as close as possible to a natural status. After identifying the pressures and their impact on the specific water body, a complex set of structural and non-structural measures should be implemented in order to improve the ecological status of a stream

In the daily water management numerous terms are used for nominating the process described in the present paper. The most used ones are:

*[1]Politehnica University of Timisoara, Hydrotechnical Department, George Enescu Street, no. 1A, 300022, Timişoara, Romania, badaluta_minda@yahoo.com

renaturation/restoration, ecological rehabilitation, and ecological reconstruction.

Renaturation is a term that defines the restoration of the structure and functions of an ecosystem. Renaturation is the process through which s specific ecosystem reach as close as possible to the natural status, the one before the anthropologic altering.

2. THE REHABILITATION MEASURES

Ecological rehabilitation means the process through which natural or as close to natural ecological condition are set or reset, dependent or independent of the initial status, so that the stream should attain a dynamic equilibrium and the reached status should be sustainable without further human interventions.

The ecological reconstruction implies activities that can change physical, chemical or biological capacities of an ecosystem with the aim of creating or recreating habitats for specific species.

Figure 2. The ecological reconstruction

While in the case of renaturation or ecological rehabilitation one can understand a very complex process aiming the sustainable restoration of both the stream and the habitats, in the case of ecological reconstruction, the focus is on the implementation of a more limited set of measures aiming better conditions for the existing species, but in most cases the hydro morphological conditions do not suffer major changes or, if they do, the changes are minor, therefore not sustainable.

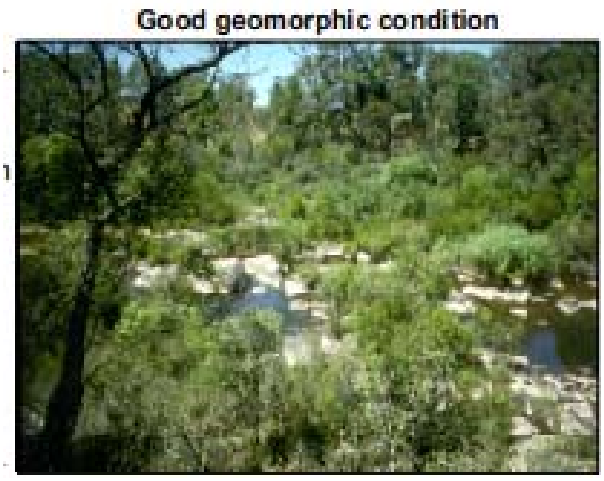

Figure 3. The occasional floodplain pockets in Bega catchment (moderate and good conditions)

During the last years the rehabilitation concept got different connotations and was associated to different rehabilitation techniques.

The rehabilitation measures may vary from passive measures that imply the removal or the mitigation of the anthropologic activities with chronic negative impact, to active measures that imply quantifiable interventions for the fixing the damages produced to an ecosystem. Thus we can talk about natural restoration, in the cases when the water bodies recover themselves in a short period of time, partial intervention measures, when a water body can recover itself, but the period of time is too long and the uncertainty is too high, and substantial intervention measures, when the water body is too degraded in order to restore by itself the altered functions.

In case of continuous and narrow embankments one can propose dike relocation techniques in order to restore the old characteristics of the longitudinal course of the water stream.

The advantages of the dike relocation are:

- the creation of a vital area in which the river could manifest its dynamics inside the enlarged flood plain;
- the development of biodiversity of the aquatic ecosystems;
- the reconnection of the groundwater resources with the surface water resources in the areas inside the relocated dikes;
- the mitigation of the de-attenuation effects (de-attenuation is a direct effect of the close embankments)
- the mitigation of the erosion processes in the flood plain.

The disadvantages of this rehabilitation measures are: the high costs of the water works and the possible difficulties in the acquisition of the necessary land along the dikes.

The aim of remaindering is the restoration of the former river bed, reconnection of the aquifers in the flood plain and the mitigation of the flood velocity in the river bed. The main advantages are:

- the creation of a supplementary vital area in the flood plain;

- the development of a wet land between the river branches, implying the development of new habitats;
- the development of biodiversity of the aquatic and terrestrial ecosystems;
- the increase of the river bed transport capacity during high waters;

The main disadvantages could be: the possible occurrence of the banks erosion and the possible difficulties in the acquisition of the necessary land.

The changes of the longitudinal and transversal profile of a river done for navigation, bank protection, water intakes and so on, influence a lot on the solid and liquid regime of that river, increasing the flow velocity in the river bed.

The advantages of the restoration of a rectified/recalibrated stream are:

- the recovering of the litologic texture diversity in the river bed and flood plain and implicitly the diversification of the stream benthic habitats;
- the development of some floodable areas along the river bed with direct effect on biodiversity;
- the development of the nutrient buffer ecosystems in this floodable areas;
- the significant increase of the chemical self-restoration of the water stream.

The transversal obstruction of a stream will bring hydro morphological, physical-chemical and biological changes. In order to eliminate the effects on the liquid and solid flow both upstream and downstream the dam, a possible solution is the removal of the dam. This is a drastic and costly measure, therefore it implies the development of a long-term cost-effectiveness analysis before considering it an efficient measure.

When dam removal supposes high economic losses, the short-term controlled flow techniques may be applied as alternative measures in order to wash out the silted sediments and to restore the downstream habitats. This non-structural measure requires a detailed analysis of the discharge program through the dam structures, but has as an important advantage the opportunity of saving from extinction numerous species of aquatic species downstream the dam.

In order to improve water quality other non-structural measures are used beside these measures: water oxygenation and bio-manipulation techniques.

In case fish migration is at risk due to a dam, fish ladders (in case of low elevation of a dam) or fish elevators (in case of high dams) can be built.

The advantages of building a fish ladder are the following: the fish ladder offers the possibility of aquatic macrofauna migration to and from the spawning areas.

Due to the fish traffic on the ladder, the fish enclaves are avoided both upstream and downstream the dam.

The main disadvantage, but hard to combat, is the high implementing costs, especially when the fish ladder is proposed to be built after the dam construction.

Figure 4. Fish ladder Gura-Golumbului Dam

A buffer zone is an area with vegetation, usually trees and shrubs, but other species too, created along the water stream with the purpose of maintaining the river functions, the pollution mitigation, the provision of food, habitats and thermal protection to fish and other species.

Buffer zones filter sediments, nutrients and also have a positive role on slope stabilization; therefore they are set especially in areas with intensive agriculture for a width between 6 and 60 meters, considering the needs. The advantages are:

- apparition of habitats where ecosystems which are huge consumers / fixatives of nutrients, pesticides or heavy metals;
- significant natural reduction of the diffuse pollution with the above mentioned substances;
- increasing aquatic and terrestrial biodiversity;
- thermal control of the area by providing shadow to the river;
- increasing the self-purification of the river;
- prevention of the erosion along the river.

Figure 5.The buffet zone

Wet lands represent natural reservoirs where water can be stored during a flood but also represent a specific habitat for the aquatic population and maintain a good water quality.

In order to restore these areas some techniques of ecosystem restoration and removal of silts are applied. This water works aim increasing water depth and volume of the reservoir, removal of the sediments rich in nutrients or toxic substances and fighting against

excessive aquatic plants abundance. The advantages of this rehabilitation measures are:

- maintaining of the hydrologic equilibrium and improving of the aquatic and terrestrial biodiversity;
- changing of the local microclimate;
- apparition of new economic activities in the area: fishing, aquaculture, tourism etc;
- radical changing of the zone landscape;
- qualitative water control through water chemical self-purification (decreasing of the organic matters and nutrients);
- flood mitigation and soil erosion control;
- solid discharge control.

The disadvantage of the measure is the high investment cost, but the depreciation period is short. The biological methods for bank protection ensure a strong organic bond between water and the flood plain, without the existence of the breakage consisting in structural works. The same benefit exists in case of river bed biological consolidation.

This is a method that stands at the limit between structural and non-structural methods.

The advantages of the biological consolidations are:

- ensuring bank/river bed stability;
- reducing flow velocity and erosion through increased roughness;
- water oxygenation through local turbionar flow due to roots and through chlorophyll assimilation processes due to aquatic plants;
- sediments filtering and nutrients absorption;
- influencing thermal balance through providing shadow to the banks;
- development of habitats for specific aquatic species;
- increasing landscape value;
- low investments costs.

The disadvantage of the biological consolidation works comes from the fact those they:

- do not ensure immediate protection;
- cannot be implemented in all seasons;
- can be applied only above the average water levels;
- increase river bed roughness that brings to level increases.

3. CONCLUSIONS

All the rehabilitation measure should focus on the water resource and habitat conservation and also on the water and water regime sustainable improvement. Most of the rehabilitation objectives aim the recovering of the initial status prior to the anthropologic alteration, but the ecological theory also recognize the existence of the irreversible transitions induced by random perturbations and components of the ecological succession processes.

Therefore, a rehabilitated ecosystem doesn't need to be identical with the unaltered ecosystem and doesn't have to include the same predominant species, the same species diversity, the same productivity or the same rhythms for nutrient recycling.

Still, in order to have a viable and autonomous system, the system's functional capacities have to be restored in a sustainable manner.

Identifying bio-engineering rehabilitation techniques represents an important step in reaching the objectives set by the Water Framework Directive 60/2000/EEC.

The method can be implemented combined with other habitat restoration measures as wet lands and buffer zones development.

Once with the development of the socio-economic activities the water consumption has increased. Therefore the ecological discharge has to be assessed considering the local conditions and the trend assessment.

Ecological discharge management has to be correlated with the management of the water resources. The integrated management brings to increasing consumption efficiency and sustainable water use without affecting the social-economic and ecologic functions for a long period of time.

The reassessment of the ecological discharge is a basic condition prior to river basin management planning. The measure has as advantage the sustainable management without any disadvantages in all cases when water use is correctly assessed and water allocation is prioritized efficiently.

The management of the reservoir discharge can be implemented together with this measure. The objectives of such a measure may be the provision of the minimal salubrious discharge or the ecological discharge, but may have higher objectives too, as the wash out of the downstream areas at least in some seasons of the year in order to revitalize the downstream water related ecosystems.

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