

Reservoir Sedimentation as a Consequence of Land Use in the Catchment

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Reservoir sedimentation is a very complex problem. Natural conditions and anthropogenic activities have strong influence on sedimentation intensity and hydrological processes, which is represented at the experimental watershed of the Dicina River, in Western Serbia. Reservoir of 340000 m³ was formed after construction of a 17 m high dam, in 1966. Sedimentation of the Velika Dicina reservoir was determined on the basis of a survey from October 1966 to October 2011, along longitudinal profile, 750 m upstream from the dam, with 15 cross section profiles (at a spacing of 50 m). Land use changes were analyzed on the basis of a comparison of watershed conditions in 1966 and 2012, using the CORINE methodology and the MapInfo software. Sediment yield of the area and intensity of erosion processes were estimated on the basis of the Erosion Potential Method (EPM). The hydrological conditions in 1966 and 2012 (after the performed Erosion and Torrent Control Works-ETCWs) were assessed on the basis of a historical overview of land use changes and their impact on computed maximal discharges. Total quantity of deposited sediment in the reservoir amounts to 18750 m³. Intensity of sedimentation has continuously been decreasing since 2002 as the consequence of land use changes, performed ETCWs and depopulation. The realization of restoration works contributed to a decrease in the annual yield of erosive material from $W_a=16007 \text{ m}^3$ to $W_a=1930 \text{ m}^3$. Presented are the comparative results of sediment transport for rivers in Serbia, with catchment area smaller than 1000 km².

Keywords: catchment area, sedimentation, erosion processes, depopulation, land use, sediment yield

Dams and accumulations have been successfully used for collecting, storage and managing of water resources throughout history. Today, there are a large number of constructed dams with multiple functions, including the production of electric power, flood protection, water supply, irrigation, recreation, fishery and many others. Reservoir siltation is a very complex problem in Serbia, both in big and small reservoirs. The huge Djerdap reservoir in the Danube River, on the border between Serbia and Romania, has a volume of $2 \cdot 10^9 \text{ m}^3$, and traps $15 \cdot 10^6 \text{ m}^3$ of sediment every year. However it has not been significantly endangered due to sedimentation yet [8]. In contrast to that, the small Gvozdac reservoir at Goè mountain in Central Serbia, has a volume of $60 \cdot 10^3 \text{ m}^3$ that is completely filled with sediment and out of function for water storage [13]. Sediment yield due to soil erosion depends on the complex interaction among a number of factors, including the natural characteristics of the area, population growth and fall rates, educational and cultural issues, the institutional conditions, as well as environmental and agricultural policy [1, 2]. The intensity of erosion processes varies depending on storm conditions, hillslope aspect, lithological properties and human impact [12].

In the 60s of the 20th century over one hundred small reservoirs were formed in the hilly-mountainous regions of Serbia. These reservoirs were faced with a serious risk of sedimentation due to intensive anthropogenic activity in the watershed areas [5]. However, already in the 80s of the last century the process of depopulation of rural areas was initiated as a result of the migration of people to cities, which reduced the pressure on the forest and agricultural

areas. In the same period, Water Resources Management of Serbia performed large scale erosion and torrent control works (ETCWs), including technical works (check dams, bank protective structures, torrent training) and biotechnical works (afforestation, forest protective belts, silt-filtering strips, grassing, terracing and contour farming). In addition, spontaneous restoration of forests in large areas of abandoned arable land was observed in the hilly-mountainous areas characterized by intensive depopulation [10]. The large-scale land use changes have produced some favorable effects, including decrease of sediment yield, less intensive reservoir sedimentation and reduced watershed potential for the formation of fast surface runoff. These phenomena were measured and analyzed at the experimental watershed of the Dicina River in Western Serbia.

Experimental part

Materials and methods

Study site description

Reservoir sedimentation and the hydrological effects of land use changes should be assessed at watershed scale, on the basis of complex investigations, including a historical overview of the process of erosion and land use changes, intensity of sedimentation, computations of sediment yield and hydrographic characteristics of the watershed. This paper presents an investigation carried out at the experimental watershed of the Dicina River, profile P at the Velika Dicina dam, (fig. 1).

The dam *Velika Dicina* (made of stone with clay core) was built in the 1965-66 period, above the village of Gornji Banjani, as a water retention area for flood protection with

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