TORRENTIAL FLOODS IN SERBIA-MAN MADE AND NATURAL HAZARD

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INTRODUCTION
Torrential floods are the most frequent phenomenon in the arsenal of “natural hazards” in Serbia, being the first when it comes to losses, causing huge damage and the loss of human lives. Frequency of event, intensity and diffusion, in the whole territory, make them as permanent threat with consequences in ecology, economic and social sphere. Climate, specific characteristics of relief, distinctions of soil and vegetation cover, social-economic conditions have done that the occurrence of torrential floods is one of the resulting forms of existing erosion processes. Torrential events are characteristic both in urban and rural landscapes. Attribute “torrential” belongs to any watershed with sudden appearance of maximal discharge with high concentration of hard phase, regardless of magnitude and category of stream. They are characterized by a rapid increase in discharge and the extensive transport of material. Serbia had numerous torrential events, in the last 15 years, on the watersheds of main tributaries of: Kolubara, June 1996; Velika Morava, July 1999; Kolubara and Drina, June 2001; Južna Morava, November 2007; Zapadna Morava, Drina and Lim, November 2009; Timok, February 2010; Pećinja, May 2010; Drina, December, 2010.

Erosion processes of different categories of destruction are present on 76355 km² (86.4% territory of Serbia); 70.61% of surfaces are on the slopes steeper than 5%. Average annual production of erosive material amounts to 37.25 × 10⁶ m³, in other words, 487.85 m³/km², which is 4.88 times more than normal (geological) erosion. Strong and excessive erosion processes cover 35% of territory of Serbia. Over exploitation or mismanagement of forest and agricultural land and urbanization provoke severe erosion and torrential floods. Soil erosion becomes more frequent and severe along with local economical development. As the watershed becomes more developed, it changes its hydrological regime, increasing the torrential flood volume. Torrential floods that ones occurred rarely during pre-development period have now become more frequent and destructive due to the transformation of the watershed from rural to urban land uses. Decreasing the surfaces under forest vegetation, urbanization and inadequate agricultural measures are some negative aspects of human work which cause torrential floods, so that former discharges with recurrence interval of 100 years, become events with recurrence interval of 20 years.

Appearance of torrential floods is mostly out of man control. Man made hazard could be increased by irresponsible activities concerning land use or decreased with preventive activities: spatial planning in endangered watersheds; afforestation of bare lands, amelioration of degraded forests, meadows and pastures; appropriate agricultural techniques; application of agroforestry; erosion control measures and torrent training works. Soil bioengineering works in the headwaters lead to improvement of interception effects and infiltration-retention capacity of soil. Watersheds with huge surfaces without forests are very sensitive to fast surface runoff forming, even in the case of small depth of precipitation, because of reduced infiltration-retention (water storage) capacity of soil. Application of

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biotechnical works in the headwater could be the way for decreasing of natural hazard partly and seriously control of man made hazard.

RESULTS

The results of investigations of some interesting cases of historic, very destructive torrential floods are related both to the impact of natural characteristics of the watersheds and human activities, on appearance of historical torrential floods. Also, restoration works were planned as a mean for improvement of hydrological conditions. The effect of hydrological changes was estimated by the computations of maximal discharges after the planned restoration of endangered surfaces in the watersheds. Computations of maximal discharges was done using a synthetic unit hydrograph theory and SCS methodology (SCS, 1979). In Serbia, this is the most frequently used procedure for computations of maximal discharges at small, unstudied watersheds, enriched by regional analysis of lag time (Ristić, 2003), internal daily distribution of precipitation (Janković, 1994) and classification of soil hydrologic classes (Djorović, 1984). The computation was carried out for AMC III (Antecedent Moisture Conditions III-high content of water in soil, and significantly reduced infiltration capacity). Area sediment yields and intensity of erosion processes were estimated on the basis of the “Erosion Potential Method“ (EPM). This method was created, developed and calibrated in Serbia (Gavrilović, 1972). It is still in use in all the countries which originated from former Yugoslavia. The EPM is marked by a high degree of reliability of calculation of sediment yields, transport and reservoir sedimentation. Land use changes were analyzed on the basis of field investigations, usage of aerial and satellite photo images, topographic, geological and soil maps. Land use classification was made on the basis of CORINE methodology.

OUTLOOK

The aim of this investigation is to show how planned land use changes, on the basis of analysis of historical events, can help to improve hydrological conditions on endangered watersheds, provide effective erosion control and torrential flood protection.

REFERENCES


Keywords: torrential floods, hazard, maximal discharge, land use, restoration