Flood Modelling in the Barzava River Sector

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Abstract. In recent years, the climatic change had led to an increasing number of floods in many areas. It is required to develop tools for flood prediction and prevention. This paper presents the modelling of the flood wave propagation on Barzava River, Gataia - Bocsa sector. Banat catchment area is situated in the western part and south-western part of Romania, and this catchment is situated in the western part and south-western part of Romania, limited to the north of Mureș River, to the south of Danube River, to the west of the border between Romania and Serbia and to the east bordering Mureș hydrographical basin. This hydrographical area covers a surface of 18.320 km² and includes several river hydrographical basins, including the Bârzava River basin. Preventing and combating floods, the forecast operations have a very important role: based on such prognosis, the anticipation time can be determined. The efficiency of measures depends on the preparation level and on modalities for the realization of proposed measures.

1. Introduction
The Banat hydrographic area comprises the hydrographic basins of the rivers Aranca, Bega, Timiș, Caraș, Nera, Cerna situated in the South-West extremity of Romania, as well the Danube sector situated downstream of Nera confluence – upstream of Cerna river confluence, having a total surface of 18,393.15 km².

From a climate perspective, the Banat hydrographic area fits in the area of continental temperate climate, having the multiannual average rainfall between 600-1400 mm/year, and the multiannual average of temperature between 10-11 Celsius degrees. The annual average of rainfall varies from 500 mm in the plain area, until 1,000-1,200 mm in the mountainous area from the East part of the Banat hydrographic area [1].

Floods are natural phenomena that cannot be prevented and cause environmental damage, even human loss of life, etc. At the European Union level, a set of legislative instruments for protection and sustainable development concerning the quantitative and qualitative water resources and also concerning the decreasing of the vulnerability at the climate changes has been implemented. From these tools, we mention The Frame Directive 2007/60/CE regarding the assessment and management of flood risks and the Frame Directive 200/60/CE [2].
The study of this work focuses on the Gătaia - Bocșa sector located on the Bârzava river, the lower sector of the river downstream from the locality of Bocșa, until downstream of the locality of Gătaia and the inner city of Denta.

2. The natural characteristics of the study area
The Bârzava River springs from the Semenic Mountains at an altitude of 1,190 m and has a length of 154 km, and the surface of the reception basin is 1,202 km². It has an average slope of 7 ‰ and a sinuosity coefficient of 1.50 [1].

The topographic map of River Barzava is produced in a 30 m x 30 m grid resolution, this degree of resolution is sufficient for the hydrological modelling. The elevation of the study area varies from 70 to 1,429 m as mentioned above (figure 1).

Figure 1. Bârzava hydrographic basin

Along the Bârzava river (figure 2) or in its vicinity there are a number of protected natural areas, such as Caraș Gorges, Semenic national park, and upstream of Bocșa locality is the Ezerișel Forest natural reserve (natural reservation of floristic and fauna type), etc.

Figure 2. Representation of the Bârzava river course, Bocșa - Gătaia sector
The reception basin of the Upper Bârzava river has an area of 175 km², and the length of the Upper Bârzava river is 44 km, on which there are a series of hydro-technical and hydro-energetic arrangements (Gozna, Văliug, Secu). The middle river basin of Bârzava has an area of 249 km², the length of the course is 35 km.

The lower river basin of Bârzava has an area of 793 km² and the length of the course is 75 km representing the length from the upstream confluence with the Gârliste stream to the border with Serbia. Gherteniş, which has the role of mitigating the floods and reducing the water flows, is also in this sector.

3. Flood risk assessment on the Boeşta - Gătaia sector

After SEC (2010), risk assessment and survey appear as a product between probability exposure and vulnerability, according to the above mention equation [3]:

\[
\text{Risk} = \text{probability} \times \text{exposure} \times \text{vulnerability}
\]

The risk is characterized by three elements: hazard, vulnerability and exposure [Crichton, 1999]. If one of the three factors increases or decreases, then the risk increases and decreases.

In order for a risk to occur, there must be a hazard formed by an event or a source (for example, long-term rainfall); a receiver (the properties of the flooded area) and a path between the source and the receiver (the route of the flood, including defence works, slope flow or landslides).

Risk assessment is the process of measuring the potential for loss of human life, total or partial destruction of housing, economic objectives, infrastructure, etc.

Analysing the risk of the flood, this is defined as a probability of the flood multiplied / increased by damages, which increases with a developed economy, as the potential for damages increases. Assessing flood risk, for example, determining what the damage is, is important, both for planning the measures to reduce the effects and in order to be able to act in an emergency situation.

The diffluent hydrograph \( q'(t) \) is determined from the tributary hydrograph on the river \( Q(t) \) in the section of the spillway and the rating curve on the river in the same section under unchanged regime \( Q = f(H) \), respectively in modified regime \( (Q + q_d) = f(H) \) (Figure 3)[4].

![Figure 3. Diffluent hydrograph and lateral accumulation volume](image)

The increase of the flood’s frequency, the variability of the operating parameters superposed with the increase of their aging degree, make not only necessary but also opportune the preparation of these
studies. They, although they can be based on a rich literature in the field, do not have a unitary methodology, which reflects the complexity of the phenomenon, which requires a specific research development.

The Gherteniș non-permanent accumulation (figure 4) is located on the left bank of the river Bârzava, downstream from the confluence with the Fizeș stream near the town of Gherteniș. Gherteniș accumulation is expected to enter into operation during periods of high water when tributary flows exceed 120 m$^3$/s. The non-permanent hydrographic arrangement Gherteniș consists of two compartments [4].

![Figure 4. Gherteniș non-permanent lateral accumulation](image)

The attenuation in the lateral accumulation starts from the moment of the incidence of the flood with the probability of 5% and is achieved by means of the control watering and the lateral access spill when the water level reaches the level of 126.50 mdMN.

During the historical floods, it was found that the arrangement did not come into operation at the flow of the project, which entered into operation late, which led to higher evacuated flows downstream of the river.

3. Conclusions
The measures of risk contain structural measures and non-structural measures – structural for the reduction of moment floods and future floods.

The measures for pre-floods are taken before the floods phenomena could happen. The concept can be distinguished: prevent the floods and the derogatory impact of floods; the status of preparing to be the capacity of ensuring an efficient answer of the impact risk, including the favourite emitting and preventing and temporary evacuation of the population from flooded areas.

Post flooded measures contain all the decisions and actions taken after the natural hazard phenomena.

The non-structural measures tend to be the most efficient and durable solutions for solving water problems and have to be more developed for reducing the vulnerability of human life and for goods exposed to flood risk. For diminishing the impact generated by flood, those measures concerns: to make a zonation of flooded land field and adaptation of measures for each specific area, to promote a discouragement policy for socio-economic development, to increase anticipation time for flood forecast, to organize efficiently the operational defence actions.
Locating socio-economic objectives near water courses, ignored ore minimized the potential danger of floods. The idea of reducing damages generated by flood can be applied to the discouragement policy for socio-economic development in the flooded area. According to this policy, the actual instrumentation/equipment situated in front of the flood ore in the flooded area must be moved outside this area and the new constructions will be situated exclusively outside the flooded area, according to some land field systematization plans.

Preventing and combating floods, the forecast operations have a very important role: based on such prognosis can determine the anticipation time. The efficiency of measures depends on the preparation level and on modalities for realization of proposed measures.

References
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