FLOODS, OVERFLOWS AND THEIR MANAGEMENT. CASE STUDIES ON THE LOWER COURSE OF THE CIOROGÂRLA RIVER

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ABSTRACT: - Floods, overflows and their management. Case studies on the lower course of the Ciorogârla River. The paper is made up of 3 parts, divided in 5 chapters. Chapter 1 defines basic notions (hazard, vulnerability, risk) and describes the main phenomena regarding the hydrological risk addressed in the paper, namely floods and overflows. In chapter 2, there is a brief history of the study area from a geographic point of view. Chapter 3 addresses the geographic frame of the study area, insisting on the responsible factors (trigger and favoring) of floods and overflows. Chapter 4 analyzes the hydrological variability of the Ciorogârla River in general and its overflows and floods in particular. In chapter 5, the management of floods and in the lower course of the Ciorogârla River is considered, with a special attention given to the structural and nonstructural measures.

Key words: floods, overflows, management, hazard, risk, hydrological variability, Ciorogârla.

1. INTRODUCTION

The risk represents the expected loss level in the event of a potentially catastrophic event. The term of risk has two dimensions - objective and subjective. The first dimension is the assessment of probable damages, while the subjective dimension is the result of a perception process. The risk is indissolubly linked to the presence of man in the area, capable of realizing the causes and effects of the phenomenon. Due to the lack of man in the territory, one can't talk about risk, but only about hazard, the risk acting only when man is involved. The risk is based on the hazard and vulnerability of the exposed society. The elements of risk are represented by people, buildings, infrastructure, services etc. The fact that risk involves human society also assumes taking measures to reduce the danger.

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Accordingly, the anthropic factor has a double role in relation to risk – as triggering factor, but also as reduction factor of the risk involved. The risk factor is a function of hazard, vulnerability, exposure and resilience, which has the following formula (equation 1):

$$R = H \cdot V \text{ (1).}$$

In short, risk is the product of hazard and vulnerability. The water risk has been a major problem due to its repercussions since ancient times. The concern for studying the hydrological risk phenomenon is relatively new in geographic literature, which is known as the total threats to humans, their goods and the environment generated by water and hydrological processes, mostly in correlation with temperatures and precipitation. The water risk has been, and still is, a serious problem due to its consequences, such as floods and overflows, with serious human and material consequences. Among the water risk phenomena, floods are considered to be the most representative. Overflows are defined as the peak moments in the evolution of river water flow, in other words, the significant increase and decrease of water leakage into the river bed. Floods are characterized by large and rapid increases (in the order of hours) of the water level and flow to reach the maximum point, followed by a decrease and a return to normal drainage parameters, this also manifesting rapidly. The overflow itself is not a disaster, it is a natural phenomenon and is part of the natural and normal course of water leakage. River flood is the overflowing of the natural or artificial banks of a river by the water, or the accumulation of water that is leaked into areas that normally emerge.

2. BRIEF HISTORY OF RESEARCH

The science of risk was proposed by the american geographer Gilbert White in 1958. He said that territories with a high degree of instability may lead in time to the increase of potential in human and material losses. In Romania, Professor Victor Sorocovschi (2002), Florina Grecu (2006, 2009) and Iuliana Armaş (2008). The river basin of the Ciorogârla River has benefited in time of several types of scientific studies. Within this territory, general studies have been carried out, at national, regional level, of the Arges basin or some of the areas within it. General Water Studies, such as the "Romanian Rivers" (Diaconu and Stănculescu, 1971), "The Waters of Romania" (Ujvari, 1972) and "Water Cadastre Atlases of Romania" (AquaProiect, 1992) refer also to the Argeş River basin and Ciorogârla .

3. GEOGRAPHICAL SCOPE OF THE STUDY

3.1. Geographic position:

The Ciorogârla River is one of the main left tributaries of the river Sabar and the secondary order tributary of the Argeş River. The Ciorogârla spring is considered to be situated near the village of Brezoaele. The shed is located downstream of the town of Magurele. The Ciorogârla river basin, like the homonymous river, has a north-west-south-east orientation. The hydrographic basin of Ciorogârla is situated on the territory of Romania in the S-V part of Ilfov County.

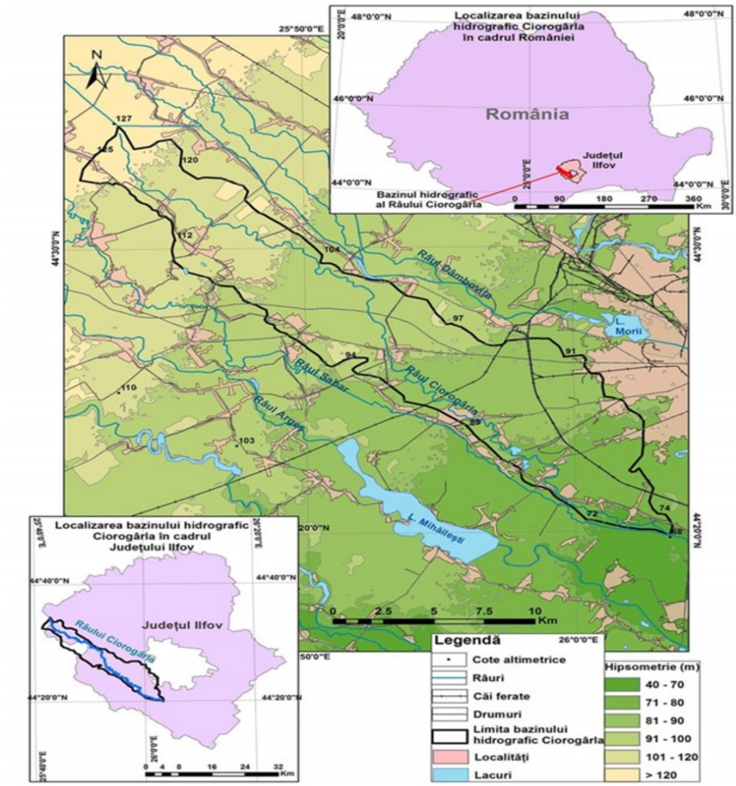

Fig. 1. The geographic position in Romania and in the county of the Ciorogârla river basin; processed from altitude values by topographic map 1: 25000 (DTM, 1984)

The Ciorogârla River has mainly the following morphometric features: a surface area of 149 km^2, a length of 57 km, a slope of 1 m/km, a sinuosity coefficient of 1.51, a forested surface of the 421 ha hydrographic basin, and the average altitude of the 98 m river basin. From an administrative point of view, the river basin of the Ciorogârla River is administered by ABAAV within the Arges-Vedea hydrographic area.

3.2. Factors that influence the flow of river water

3.2.1. Geology

The territory of the study area overlaps part of the northern sector of the Moesian Platform, also known as the Wallachian Platform.

The Wallachian platform consists of two floors, namely the foundation and the sedimentary cover. The foundation is located over 1600 m deep, consisting of crystalline shale penetrated by granite rocks. The second structural layer is the sedimentary cover, this being a succession of formations starting with the Lower Carboniferous and ending with the Quaternary. The constellation is made up of the formations deposited over the peneplenized foundation when, after the subduction movements, the waters invaded the territory.

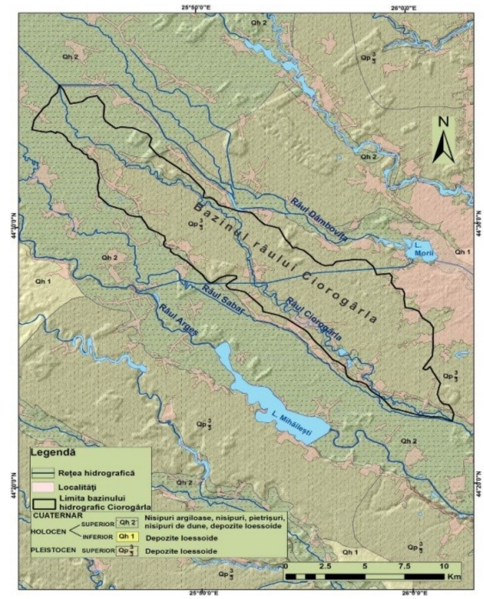

Fig. 2. The geological map of the Ciorogârla river basin; processed from geological map 1: 200000 (IGR, 1965)

3.2.2. The landforms

The lower section of the Ciorogârla River is located in the south-western part of the Vlăsia Plain. The landforms energy records variations of 5-20 m, and the fragmentation density of the landforms is between 1 and 1.5 km/km^2. As part of the Vlăsia Plain, the hydrographic basin of Ciorogârla altitudes between 127 m in the upstream and 68 m near the mouth of the river. Among the morphological indicators, an important role in the formation of the water drainage is played by the density of the landforms and slope. It is also useful to expose the slopes, especially as a determining factor for water-generating meteorological phenomena.

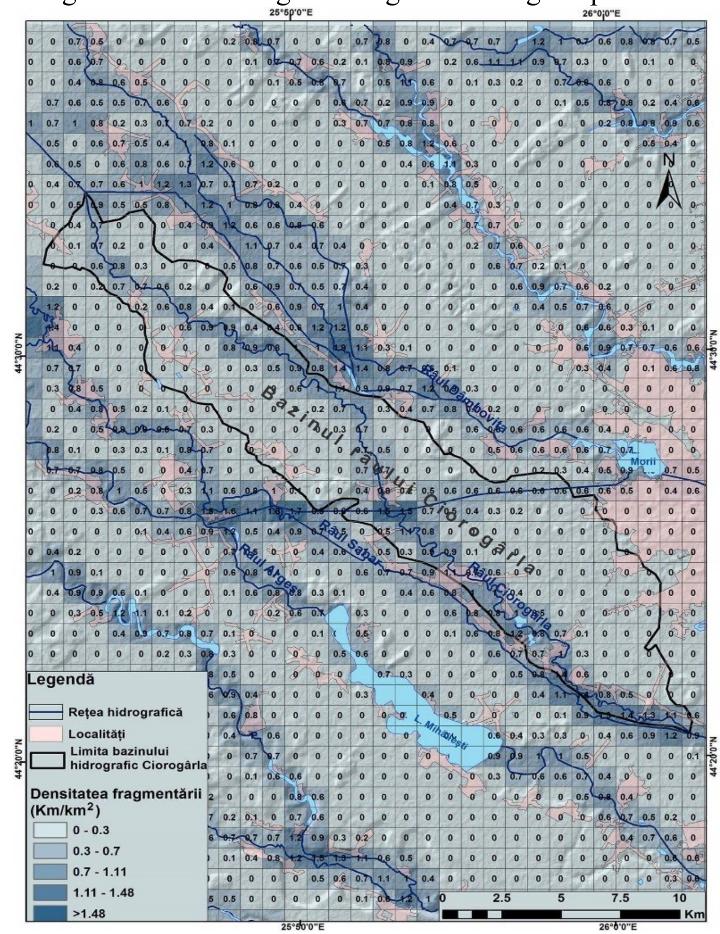

Fig. 3. Map of the fragmentation density of the relief in the Ciorogârla river basin; processed from topographical map 1: 25000 (DTM, 1984)

Density fragmentation of the landforms is a morphometric indicator that reports the length of the erosion network to the surface unit. In the basin of the Ciorogârla River, the density of the fragmentation of thelandforms is between 0 and 1.4 km / km2. Its values are unevenly distributed. The highest values are situated at the confluence areas of natural or artificial origin. The slope indicates the degree of inclination. In the hydrographic basin Ciorogârla the slope has values up to 11 °, although lower values (0.5-1 °) seem to be dominant.

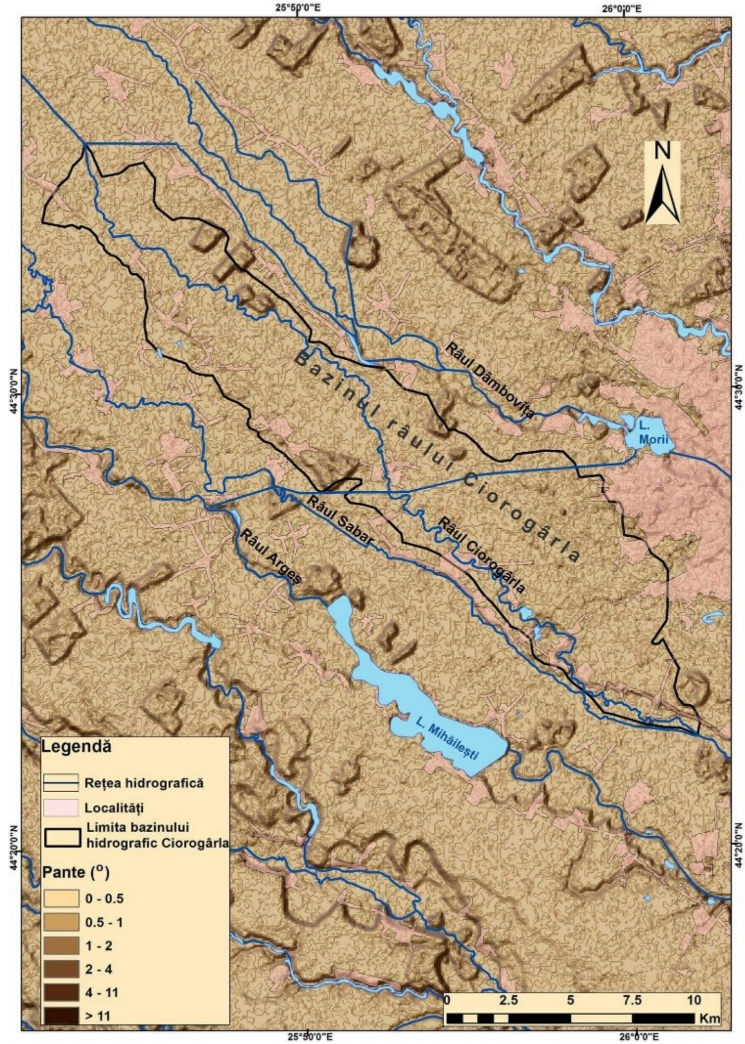

Fig. 4. The slopes map in the Ciorogârla river basin; processed from topographical map 1: 25000 (DTM, 1984)

The small degree of tilt is reflected in a low drainage rate of water, assuming a slow concentration of it in the main river. Due to the low degree of inclination, the flat relief dominates the Ciorogârla river basin. Otherwise, there seem to be several slopes with south and south-west exposure.

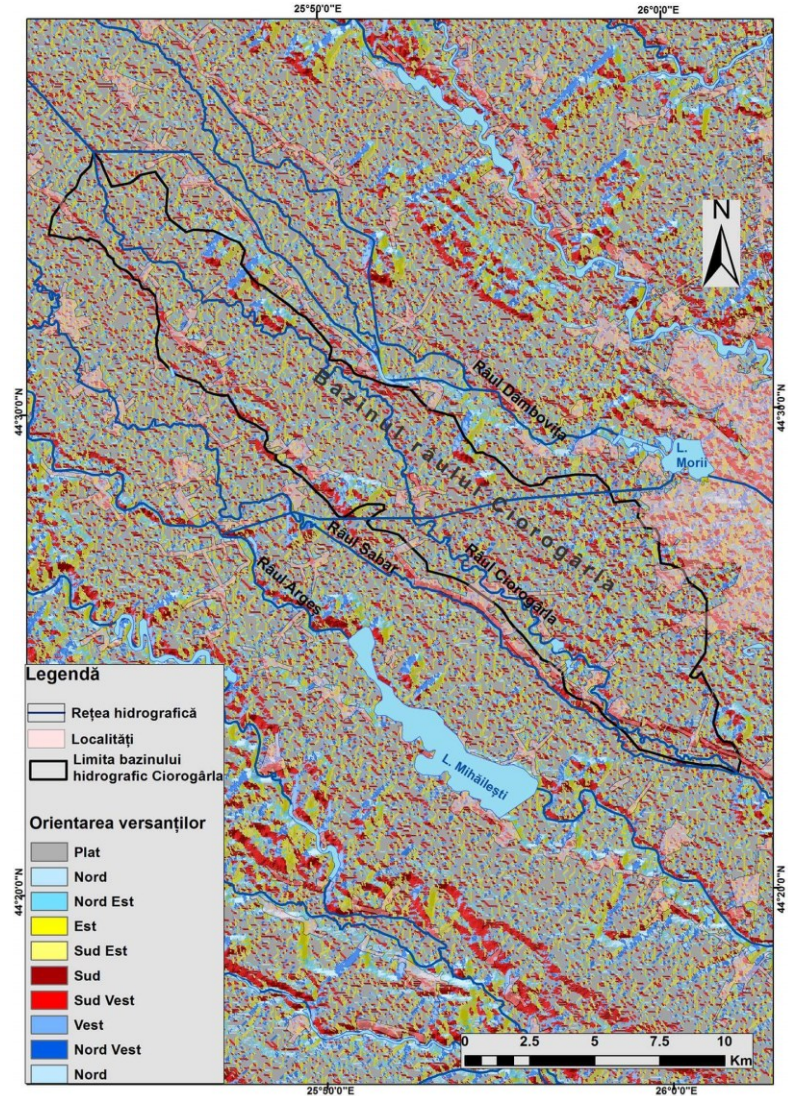

Fig. 5. Map of the slopes orientation in the Ciorogârla river basin; processed from topographical map 1: 25000 (DTM, 1984)

3.2.3. The climate

The lower section of the Ciorogârla River is located at the temperate continental climate. Atmospheric precipitation is the main source of water in the Ciorogârla River basin. Rainfalls during the year are not uniform, and from one year to another there may be significant variations.

4. HYDROLOGICAL VARIABILITY

4.1.1. Average leakage

4.1.1.1. Annual average flow variations

Over the analyzed periods, the average drainage of the fluvial system in the studied area has experienced higher or lower oscillations from one year to the next as a direct reflection of the variability of climatic conditions. From the hydrographic analysis, it is easy to identify the years with the highest and the lowest average annual liquid flows.

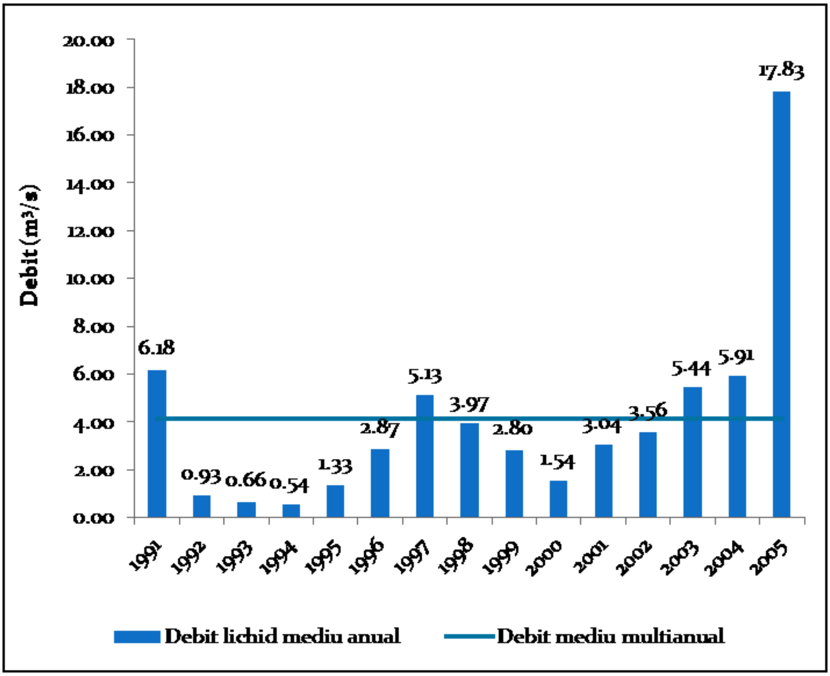

Fig. 6. Annual variations in average flow at the Bragadiru hydrometric station on the Ciorogârla River (1991-2005); source of data: ANAR

4.1.1.2. Monthly variations in average flow

At the Bragadiru hydrometric station, the monthly average drain is characterized by variations from one month to the next. Differential distribution of average monthly flows is conditioned by the annual variability of meteorological and climatic factors.

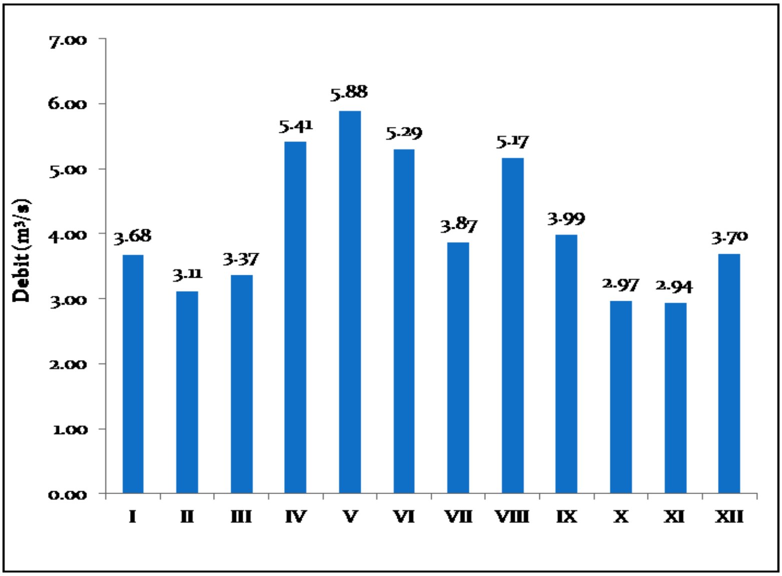

Fig. 7. Monthly variations in average flow at the Bragadiru hydrometric station on the Ciorogârla River (1991-2005); source of data: ANAR

4.2.1. Floods

In 1995 and 2005, some of the largest floods occurred on the Ciorogârla River, at the Bragadiru hydrometric station. The first flood analyzed occurred between May 23 and June 29, 1995. During this time, the main peak of the flood was analysed. It was characterized by a maximum flow rate of 53.4 m^3/s, a basic flow rate of 4.33 m^3/s. It lasted 60 hours, during which a volume of 5.01 million m^3 of water was drained.

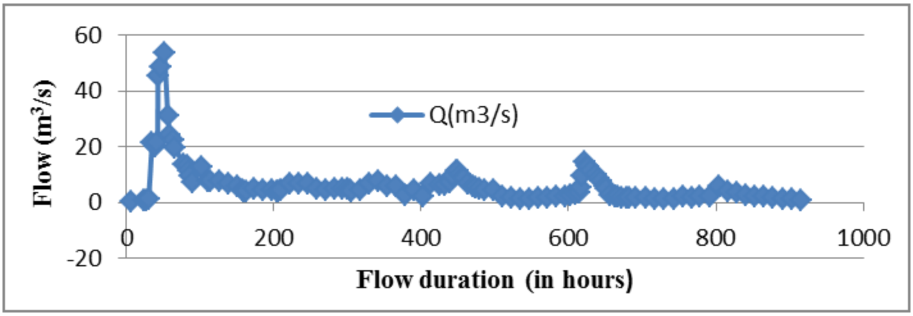

Fig. 8. The flow of Ciorogârla River at the Bragadiru hydrometric station, between 23.05.1995-29.06.1995; source of data**: ANAR**

The second flood occurred from 27 December 1995 to 25 January 1996. It was characterized by a maximum flow rate of 73.8 m^3/s and a basic flow rate of 7.35 m^3/s. The main peak of the flood lasted 254 hours, during which 16.8 million m^3 of water drained.

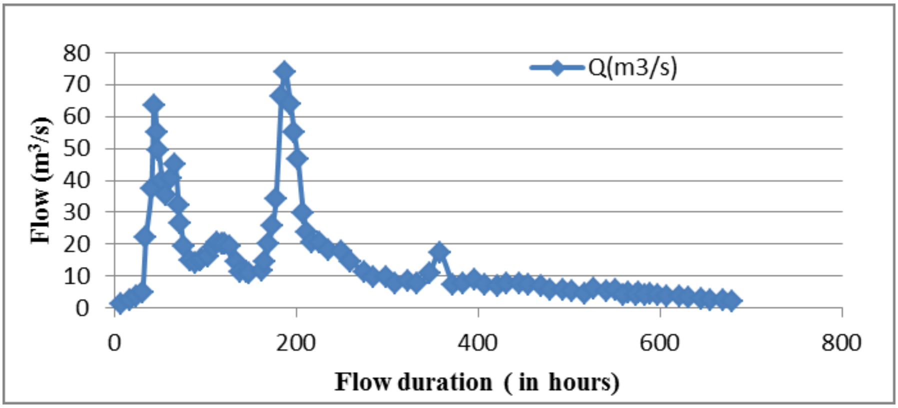

Fig. 9. The flow of Ciorogârla River at the hydrometric station Bragadiru, between 27.12.1995-25.01.1996; source of data: ANAR

The third flood analysis took place between September 13 and October 24, 2005, during which floods and overflows occurred also in other areas of southern Romania. During this period, the maximum flow rate was 111 m^3/s, and the flow rate basis of 20.6 m^3/s. The main peak of the flood lasted 288 hours, during which 36 million m^3 of water drained.

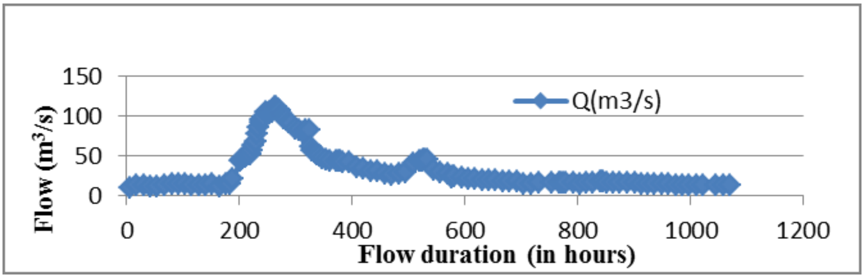

Fig. 10. The flow of Ciorogârla River at the hydrometric station Bragadiru, between 13.09.2005-24.10.2005; source of data: ANAR.

4.2.2. Overflows

In the Ciorogârla basin, overflows occurred in the years 1975, 1979, 1995 and 2005; the overflow of 1975, which occurred following a uniform rainfall on the basin, is the most significant flow. The damages due to the overflow of water affected about 200 ha of agricultural land and five localities had a large number of flooded households: Drăgăneasa - 38 households, Darvani - 37 households, Domneşti - 185 households, Olteni - 145 households and Bragadiru - 93 of households. Other damages include the Arcuda water treatment channel, which prevents sewage from the treatment plant from being drained into the canal. Other damages were: damage to the school in Bragadiru commune, communal and county roads and four bridges along the Ciorogârla River.

5. FLOOD AND OVERFLOW REDUCTION MEASURES

Risk management is a complex process that uses information to identify and assess these water risks as well as to their reduction. Risk prevention and control measures related to hydrological phenomena can be structural and non-structural.

5.1. Structural measures

Structural measures are the most effective solutions to flood risk issues. Structural measures are technical measures to protect the population and material assets against floods in order to reduce the hazard or to influence the way or probability of occurrence of the event, ie the flow conditions and the hydrological regime of the floods. Examples of structural measures are permanent and non-permanent dams and lakes, dams, regularizations, water recalibration, bank consolidation, parapets and ditches**.**

Fig.11. The hydrotechnical node of the Ciorogârla River at Brezoaele

A major hydrotechnical work has been developed on the Ciorogârla River, which influences irreversible effects on the environment. This work includes

a. The Ilfov - Dâmboviţa - Ciorogârla (Arcuda) Derivate, having the role of diverting in the Ciorogârla River the high water generated by the downstream rains from the Brezoaele hydrotechnical node, as well as the waste water discharge from the Arcuda treatment plant.

b. The Brezolae Hydrotechnical Node, located on the Dâmboviţa River upstream of the Bucharest catchment, is provided with three openings, the edges, and the one on the left bank is provided with a clape

c. The Brezoale - Arcuda Channel (Dâmboviţa River) drives downstream boreholes to the Arcuda treatment plant, which is a regularized bed section

d. The dam on the Ciorogârla River, downstream of the Brezoaele hydrotechnical node, has a length of 32m and a height of 0,70 m.

5.2. Non-structural measures

Non-structural measures represent a series of ways to prevent and protect floods with minimal environmental impact. They are very effective for long-term risk reduction in floods. Examples of non-structural measures include: developing the flood warning and forecasting information system and operational decision-making systems before, during and after the floods, establishing rules for the coordinated exploitation of all hydro-technical works at the basin, based on predicted information on the characteristics, duration and timing of flood events, flood risk planning and management, based on flood hazard and flood risk analysis, the introduction of restrictions on the construction of new buildings in floodplains and information and awareness-raising activities risk of flooding. Other measures relate to the flood forecast. The objective of this set of measures is to warn and forecast the floods by continually monitoring hydro-meteorological information and by using an operational modeling and hydrological forecasting system tailored to the types of dangerous hydrological phenomena. Another measure relates to the system of defense shares: CA (share of attention), CI (flood rate) and CP (hazard ratio). The attention spot is corresponding to a water level and therefore it is passed to observation of the phenomenon and defense measures. The flood rate corresponds to flooding the first socio-economic objective, but without the need for evacuation. The share of danger predisposes the evacuation of people and their property, and the dam can be overcome by rising waters at any time.

CONCLUSIONS

This paper analyzed the floods, overflows and their management through structural and non-structural measures, starting from the case study of the lower course of the Ciorogârla River. The Ciorogârla River flows downstream from the Brezoaele Hydrotechnical Node and flows into Sabar, downstream of Magurele. It is a tributary of the Argeş II order. The drainage regime of the Ciorogârla River is anthropic. In conclusion, although the Ciorogârla River is heavily arranged, there is still a flood risk. Therefore, non-structural measures focused on event prognosis and population awareness seem to be a solution for the future to reduce the effects of water risks. Consequently, future studies should focus on a thorough analysis of these non-structural flood prevention measures along the Ciorogârla River**.**

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