THE 05.06.2012 SLOPE FLOOD RUNOFF IN THE LOWER BASIN OF ILIŞUA RIVER – CAUSES, EFFECTS AND FUTURE MEASURES

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ABSTRACT. – The 05.06.2012 slope flood runoff in the lower basin of Ilişua river – causes, effects and future measures. In the context of the Code Yellow for rainfalls and storms, issued by National Administration of Meteorology (NAM), a downpoor occurred on the 5th of June 2012 in the afternoon, between 16.00 and 16.30 hours, with maximum intensity in the area of the Dobric – Dobricel – Spermezeu – Păltineasa – Dumbrăviţa – Căianu Mare – Căianu Mic localities. The extreme meteorological event has caused a severe slope runoff. Fortunately, the effects did not include any victims, although they were very severe, judging by the blocking of tens of kilometres of road, the flooding of almost 200 households and several hundreds of hectares of agricultural land. The risk map showing the occurrence distribution of slope flood runoff and associate meteorological events reveals the need of implementing strict measures consisting in: partial afforestation of the two thirds of the cleared slopes, management and diversion of floods that discharge their liquid and alluvial material over the human settlements located in the closest proximity of the slopes, resizing of the access infrastructure (bridges, footbridges) and flood defence infrastructure (dams, runoff drainage system), scenario-based training of population to react promptly to the development of the extreme hydrometeorological events. On the contrary, the questionnaires applied in the study area reveal a lower preparedness level of the population for an efficient, optimum reaction, in order to significantly reduce the effects of these phenomena.

Key words: downpoor, slope flood runoff, local effects, risk map, structural and non-structural measures.

1. INTRODUCTION

The geographical location represents a conditional and amplifying factor in the occurrence and evolution of the risk generating hydrical phenomena. The Oriental Carpathians, in general, and the Oaş-Gutâi-Ţibleş volcanic mountains chain, as a constitutive unit, in particular, by their transversal location on the movement direction of the air masses coming through the connection areas between the Carpathians, favour the regeneration of the air masses and their stagnation in the Transylvanian basin for a longer time (Hognogi et al., 2012, Şerban et al., 2012). The South-Eastern component

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of the “chain”, respectively the Lăpuş Mountains, together with the Ţibleş Mountains, represents one of the rainfall hotspots of Transylvania, with heavy rainfalls of an extreme intensity and quantity. These rainfalls affect not only the mountainous area, but also its Southern border and the North-Eastern sector of the Transylvanian Depression (Sorocovschi et. al., 2002, Croitoru, 2006).

The lower basin of the Ilişua river is located at the border between the Hills of Ciceu and Suplaiului, subunits of the Someşul Mare Hills (Hognogi et al., 2012). Morphologically speaking, the hydrographical unit is generally organized as a monocline structure, structurally folded in the South-East, in the presence of the diapiric vault located between the localities Beclean-Coldău-Cristeştii Ciceului-Uriu-Ilişua-Căianu Mare-Dumbrăviţa-Săsarm, causing the deviation of the Someşul Mare river course towards the South (Cocean & Danciu, 1994, Pop, 2001) and of the Ilişua valley course towards the North-West and South-West (Şerban et al., 2012) (Fig. 1).

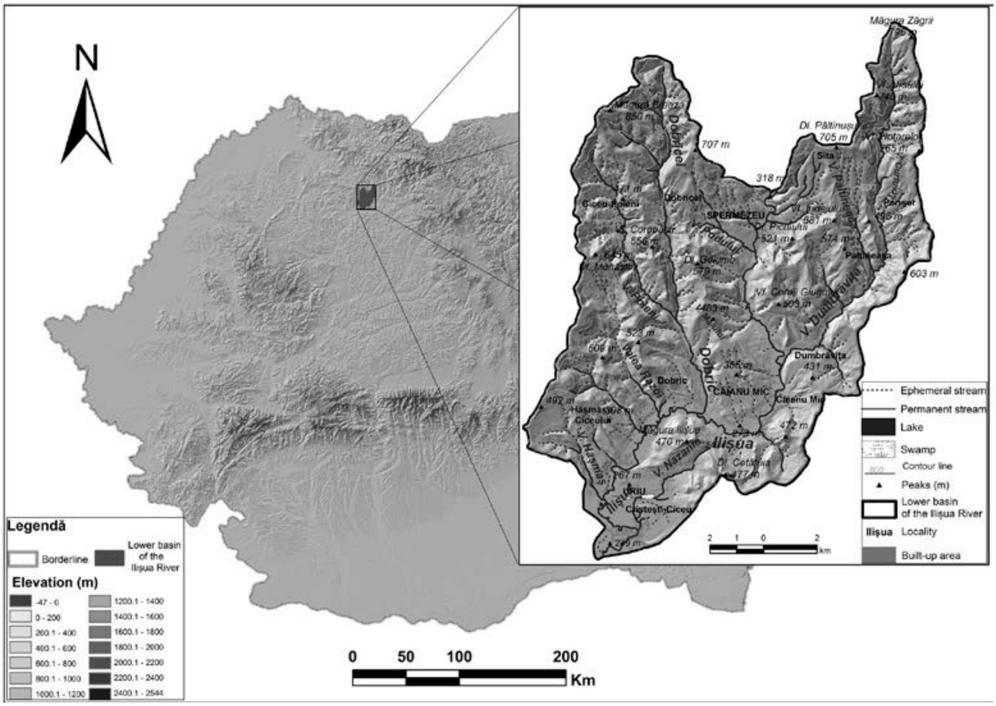

Fig. 1. ***Location of the lower basin of the Ilişua river within the Romanian territory***

The existing terraces represent favourable areas for the location of human settlements, as follows: Căianu Mare, Ciceu-Poieni, Dumbrăviţa are located within the alluvial plain, while Căianu-Mic, Dobric and Spermezeu take advantage of the upper terraces II, III or IV for their partial or complete location (Hognogi et al., 2012).

The effects of heavy and quantitatively significant rainfalls, materialized in rapid flash floods generating risks, were relatively frequent in the basin. In this regard, one needs to mention the flash floods in the summer of 1875, in July 1910 (Dobric Valley - 23 victims) and on the 20th of June 2006 (Hognogi et al., 2011, Şerban et al., 2010). The flash flood occurred in the 12-17 May 1970 interval, although it was not of the flash flood type, is a historical one, relevant for the largest water volume carried away and by the fact that it included the entire basin, without causing any human victims.

Under the circumstances of the Code Yellow - rainfalls and storms, issued by NAM, there was a clowd burst on the 5th of June 2012 in the afternoon, between 16.00 and 16.30 hours. This was confirmed by the synoptic and RADAR images, with maximum intensity inside the area of the Dobric – Dobricel – Spermezeu – Păltineasa – Dumbrăviţa – Căianu Mare – Căianu Mic villages (Fig. 2).

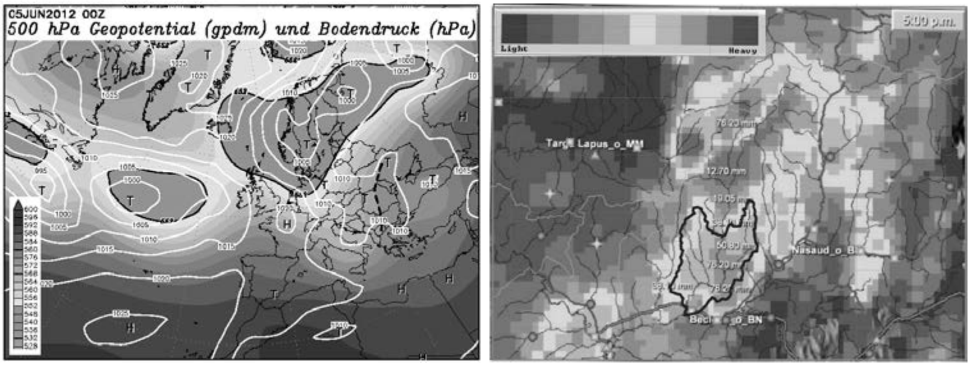

Fig. 2. ***The synoptic state and radar footprint of the rainfalls accumulated in 3 hours on the day of the downpoor (Source: http://www.wetterzentrale.de and the National Institute of Hydrology and Water Management NIHWM Bucharest)***

The extreme meteorological event caused a large slope runoff, under the favourable circumstances described in other studies (quasi-cleared topography, loamy substrata and significant slope declivity - Cocean & Danciu, 1994, Hognogi et al., 2012, Şerban et al., 2012).

2. METHODS

During the research, analysis and data processing, the authors used the chronology of the natural phenomena and processes in general, and the hydric risk in particular, pursuing two phases: field work and laboratory analysis. The basic data were obtained by observation, measurement and interview campaigns developed during the last years, and by studying cartographical sources and high resolution satellite images aiming to collect statistical, attribute and spatial data.

Topometric surveys (GPS, theodolite and benchmarks) and questionnaires applied to the local population were used for the achievement of data on the runoff land forms which generate large liquid and solid flows, as well as on the affected areas. High resolution ortophotoplans were used when the potentially hazardous runoff land forms were vectorised, along with the routes measured by means of GPS, georeferenced, projected and overlaid to the digital elevation model.

The images illustrating the baric situations and rainfall accumulation (RADAR productions) were obtained from specialized websites and competent institutions in the field (http://www.wetterzentrale.de, National Forecast Centre - NIHWM Bucharest, "Someş-Tisza" River Basin Administration).

The processing of data was performed by the use of licensed and free/open source statistical and GIS software (MS Excel, SPSS Statistic, GPS Utility, ArcView, ArcGIS-ArcInfo package), dedicated to spatial analysis and modelling.

Last but not least, of particular significance were the statistical and hydraulic data provided by relevant institutions ("Someş-Tisza" River Basin Administration), enabling the authors to compare their results with those obtained by monitoring the hydraulic parameters at the hydrometric station located immediately upstream of the junction with the collecting water body, in the river basin subjected to study.

3. RESULTS

Once the data obtained during the field campaigns and auxiliary sources have been centralised, processed and mapped, a comprehensive map was achieved with all the elements referring to this topic (Fig. 3).

In this regard, all *runoff land forms* with a liquid and solid runoff potential were represented, as well as those that might involve other existing materials from the slopes. The most important criteria considered when identifying these land forms, were: the shape of the collecting basin, the vegetal layer coverage, land use, vertical and surface erosion level of these runoff land forms, and the quantities of alluvial material stored when going into the major riverbeds.

The most important and visible element related to the slope flood runoff is represented by the *areas vulnerable to the risk* induced by this runoff category. Their spatial distribution is not uniform, according to the identification criteria previously mentioned (the local use of land – village pastures is the first in rank, then the forest exploitation). Therefore, four risk classes were identified, from *low risk*, to *very high risk*. The areas belonging to the last category mentioned are represented by *lands affected by excessive grazing*, chosen without scientific substantiation or concise decision of the local communities. Examples in this regard might be: the slope located North-West of the Căianu Mic locality, the slope located West and North-West of the Spermezeu locality, the slope located North of the Păltineasa locality and the collecting basins of some tributaries of the Curtuiuş Valley, as well as that of the Peşterii rivulet, West of the Dobric locality. The lack of forest vegetation and spatial planning works to fight erosion are characteristics that enabled the identification of the areas belonging to the *other risk classes*.

The floodable areas represent a final spatial resultant of the slope flood runoff, as these are lands subjected to massif transit and accumulation of liquid and solid carried matter.

Hence, one can mention the base of the slope hosting the Căianu Mic village area, as well as that of the slope located in the West and North-West of the Spermezeu village, the major riverbed in the lower course of the Păltineasa Valley, which hosts the Păltineasa village and the area related to the junction between the Peşterii rivulet and the 171 Uriu - Târgu-Lăpuş county road.

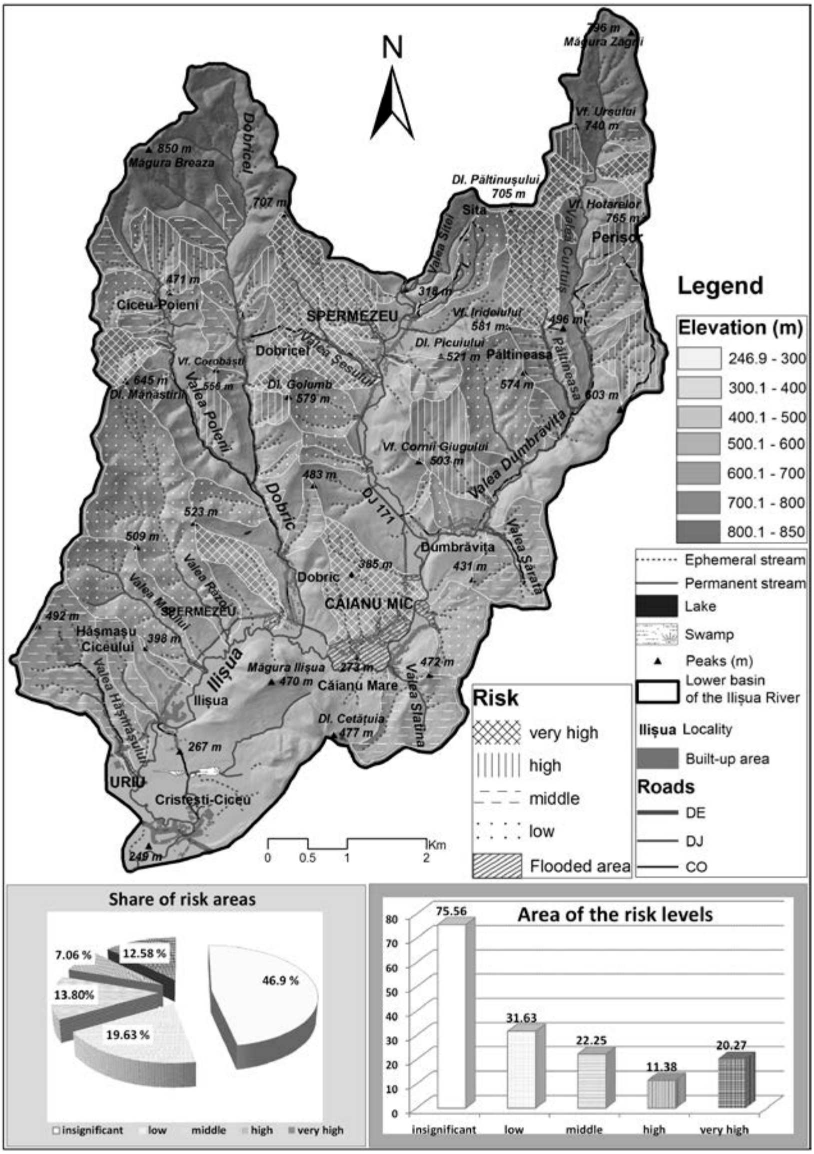

Fig. 3. ***Areas which induce risks by slope runoff (% and absolute values from the total area subjected to study)***

Referring to the percentage of the areas with certain risk potential, half of the basin total is included in one of the four classes presented above (Fig. 3).

After the statistical and GIS modelling of the rainfall and earth quantities in the basin area of the Ilişua river, it was concluded that the contribution of the lower basin analysed within this paper, at maximum debit, represents 22.9 m^3/s (Fig. 4).

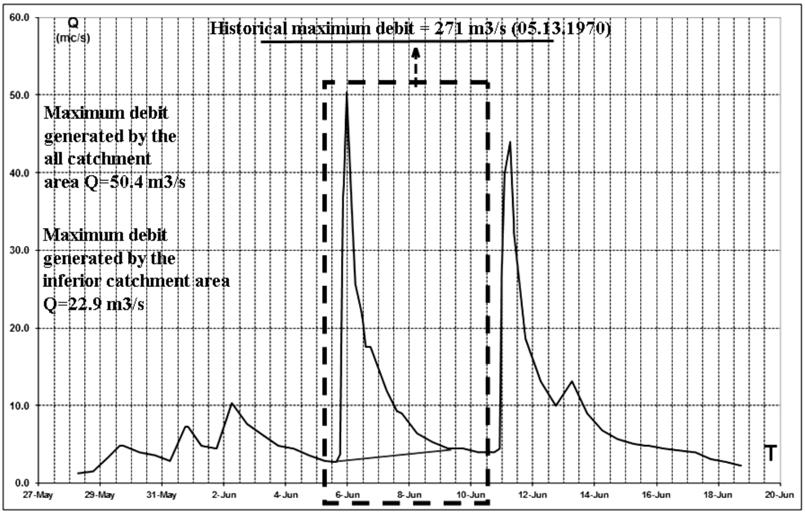

Fig. 4. ***The flood hydrograph downstream in the basin (Cristeştii Ciceului hydrometric station) (Source: "Someş-Tisza" River Basin Administration)***

4. DISCUSSIONS AND CONCLUSIONS

The 22.9 m^3/s debit represents approximately 45 %, of the maximum debit generated by the entire basin during this flash flood (50.4 m^3/s) and approximately 8 % of the historical maximum debit in the basin. Even if these percentages are not particularly significant in the runoff of the collecting body, the local impact of the surface runoff in the lower basin was considerable, considering the effects of this phenomenon. According to the Bistriţa-Năsăud county Inspectorate for Emergency Situations, its effects are considerable (Table 1):

Table 1. ***Damages generated by the slope runoff in the lower basin of the Ilişua river***

LOCALITY	Households	Transport infrastructure			Land (ha)		Wells	Poultry
		DJ	DC	Streets	Arable	Pasture		
Căianu Mic	94	3	-	3.6	170	30	90%	500
Căianu Mare	5	-	-	4	80	20	35	100
Dobric	30	-	0.1	0.5	150	30	-	-
Spermezeu	5	5	-	4	70	25	5	-
Păltineasa	1	4.5	-	1	50	10	3	-
Dumbrăviţa	22	1	-	3	80	20	-	100
Dobricel	-	-	4	0.5	20	10	-	-

Regarding the perspective of new such events, similar in terms of amplitude, the authors consider that effects mitigation measures are extremely important (Fig. 5).

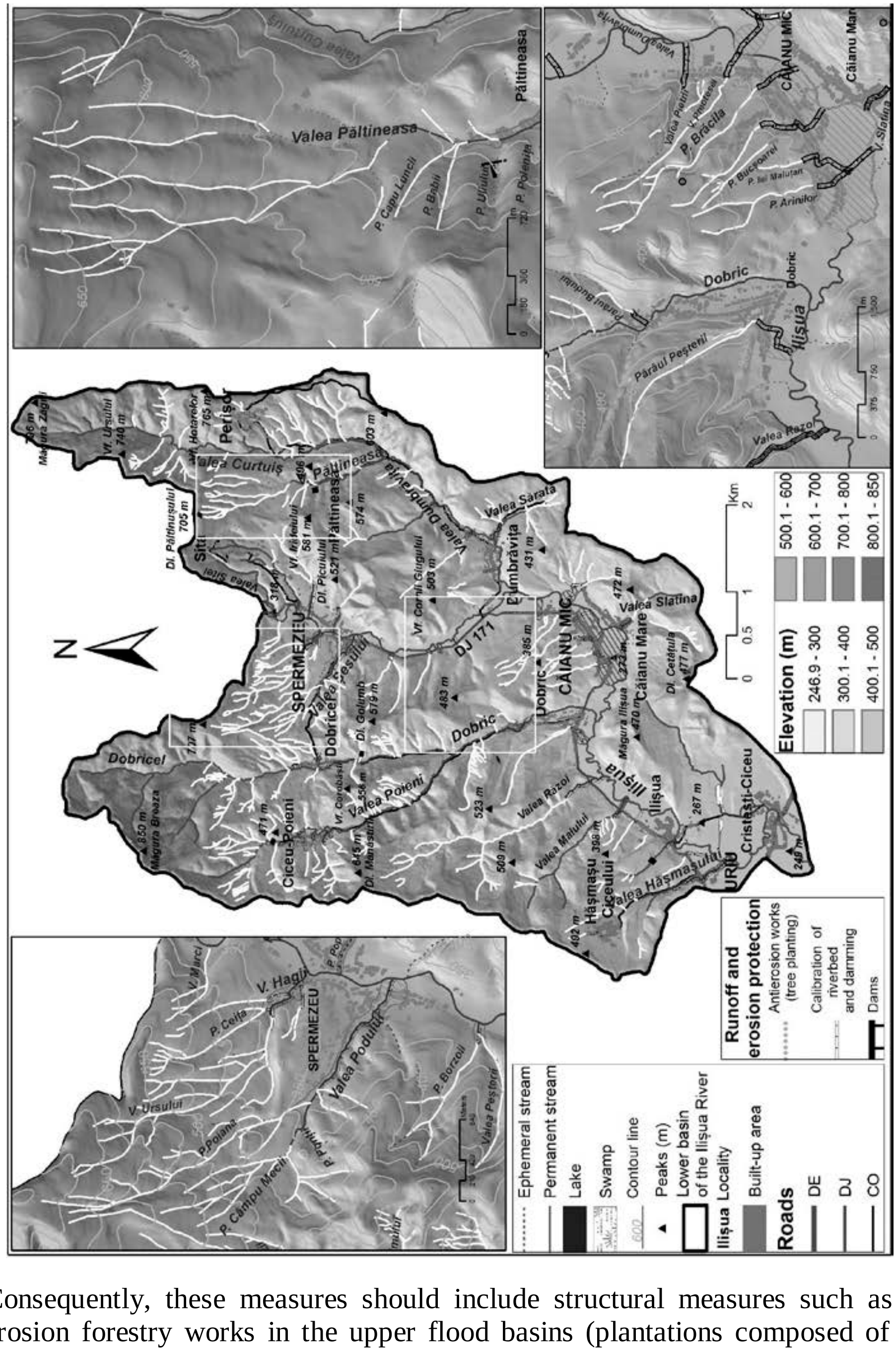

Fig. 5. Structural intervention measures in order to reduce the effects of the slope flood runoff

Consequently, these measures should include structural measures such as anti-erosion forestry works in the upper flood basins (plantations composed of three shrubs and trees), while in the mentioned lower basins hydrotechnical works should be performed, such as: recalibration of the flood riverbeds, dams, resizing of the bridges when crossing the infrastructure objectives, correction of flood riverbed courses, dams construction etc. (Stănescu & Drobot, 2002, Sorocovschi, 2004, Arghiuş, 2007) (Fig. 5).

The questionnaires applied in the basin area subjected to study reveal the availability of the citizens to take active part in structural actions meant to reduce the effects of slope runoff, especially considering the experience of recent events, which set the objective of this research (Sorocovschi, 2004).

The basic conclusion regarding this area and the analysed problems relates to the necessity of small river basins management, especially in the hills, much better populated and more active than those in the mountains. It is absolutely necessary that authorities and local population engage in application of structural measures at basin, but also at local level, as well as implementation of non-structural measures, which will significantly contribute to the shift in the mentality and attitude of the social factor regarding to the extreme natural events.

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