SOME ASPECTS REGARDING THE FLASH FLOOD ANALYSIS AND THE NATURAL FLOOD RISK MAP OF SOMEŞ PLAIN

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Abstract. – Some aspects regarding the flash flood analysis and the natural flood risk map of Someş Plain. The knowledge of the characteristic elements of flash flood is of particular importance in designing reservoirs with multiple functions, in designing and placing structures, but, especially in preventing and warning the population in case of flooding, taking into consideration the fact that the area is subjected to river flows, hence to the greatest disasters and also damage caused by this phenomenon. To achieve the calculation of flood parameters, data referring to periods of floods were collected from nine gauging stations from across the Someş Plain, related to four main watersheds, Tur, Someş, Crasna, and Ier, with good presentation in the territory. To have a common calculation period, in order to compare results, a single range was chosen for all stations for 26 years (1979-2004). The natural flood risk map represents the documentation that includes(in writing and graphics) the flooded areas at different probabilities at producing floods, indicating damage to property and humans for the administrative units affected by floods. The natural flood risk map is part of the county planning documents and it is detailed in the general, regional and community urban plans.

Keywords: *flood wave, frequency, hazard, flood risk map*

Introduction

Floods are the most common hazards on Earth, with many casualties and large-scale damage, disturbing the smooth conduct of socio-economic activities in the affected area.

Periods of high flow are an important phase in the flow regime of rivers, both by their extreme character and by the effects they can produce on the environmental components. The phenomena during these periods of high flow usually occur in the form of pulses with intensities, durations and dimensions which differ, and which in the hydric regime of rivers come as **floods and flash floods**. The knowledge of the genesis and production mechanisms of these

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phenomena offers the possibility of preventing and combating the economic, social and ecological effects they can produce (Sorocovschi, V., 2005).

The flash flood is different form the *high water phase* through, a time leak concentration, that is, through brief and sudden increase in levels and flows, and then through a relatively rapid loss of water, which is, however, generally slower than the growth. Flash floods and floods represent those phenomena with a widespread risk on Earth, over layered to major and minor river beds, locations quite often exposed to increased anthropic stress. In such conditions, it is expected that such natural events affect more people and generate more economic loss than any other natural phenomenon of risk.

Frequency of floods

Monthly and seasonal frequency of floods, especially those of high intensity, is particularly important in effective management of water resources.

Regarding the seasonal flood frequency, most often cases occur in Spring as it is shown in table 1, in Someş and Crasna catchment basins, at Satu Mare, Domăneşti and Supuru de Jos stations. Also a maximum frequency is recorded in Winter in Tur basin (40-52 %) at the Păşunea Mare, Gherţa Mare and Turulung stations (figure 1-2). This is the result of basin's position to the advection of warm and wet air masses from west, defined by liquid and mixed precipitation in significant quantities, and with temperatures slightly above zero. The second climatic feature is leading to melting of the snow layer on the hilly areas of Oaş, so that floods in Winter exceed those happening in Spring.

Table 1. The flash floods seasonal frequency on the rivers from Someş Plain (1979 - 2004)

River	***Station***	***H med (m)***	***F (km²)***	***Season***			
				Winter	*Spring*	*Summer*	*Autumn*
Talna	Păşunea Mare	402	170	42.2	30.7	19.3	7.8
Turţ	Gherţa Mare	315	36,6	42.4	19.1	24.9	13.4
Tur	Turulung	366	733	51.9	26.9	11.5	9.6
Someş	Satu Mare	534	15600	28.9	46.2	15.4	9.6
Valea Vinului	Valea Vinului	251	66,8	38.4	38.5	19.2	3.8
Crasna	Supuru de Jos	310	1170	32.6	36.6	19.3	11.5
Crasna	Domăneşti	261	1705	32.7	38.5	21.1	7.6
Ier	Săcuieni	287	1346	46	40	10	*4*
Santău/Cehal	Valea Morii	294	91	44.3	32.7	19.2	3.8

A similar case is registered in Valea Vinului (figure 3), between the frequency of spring floods and the winter ones (38.4-38.5 %) and also in Ier basin (figure 4), where the maximum frequency of floods is achieved in Winter (44-46 %) followed by the those from Spring (32-40 %).

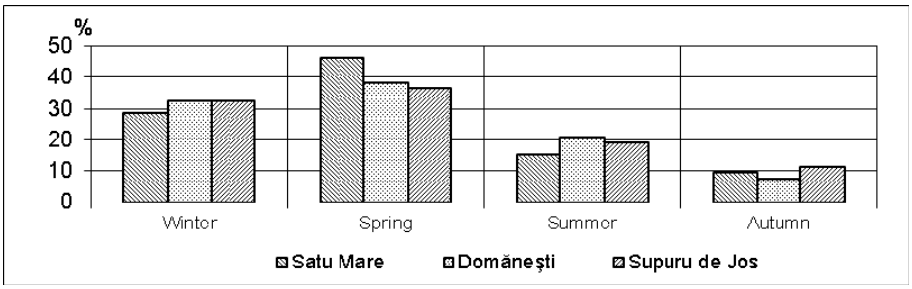

Figure 1. Seasonal flood frequency in Someş and Crasna basins

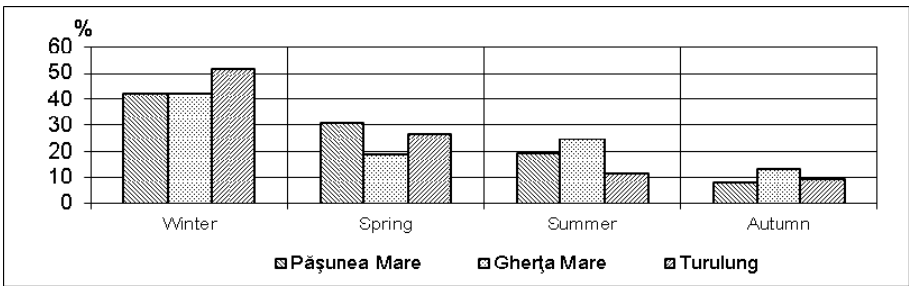

Figure 2. Seasonal flood frequency in Tur basin

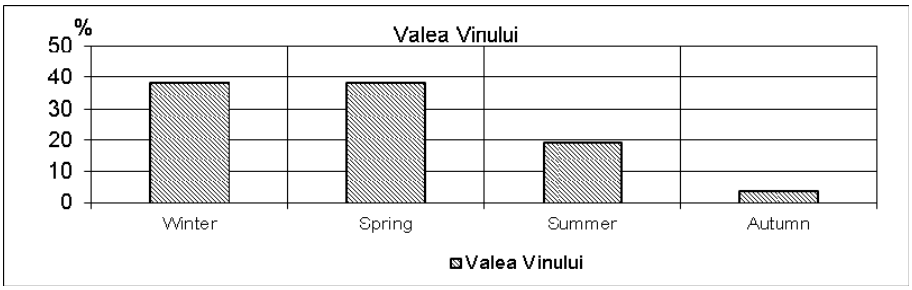

Figure 3. Seasonal flood frequency at Valea Vinului hydrometric station

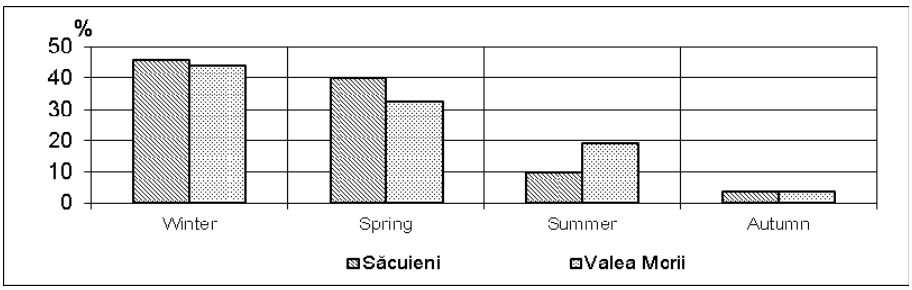

Figure 4. Seasonal flood frequency in Ier basin

Similar situations are recorded for other stations in Someş Plain which, such is the case from Tur basin, where the percentage difference in the two seasons is much higher (Tur River at Turulung, where the maximum frequency of floods is recorded in Winter 51.9 %, and Spring 26.9%, while on Ier River, at Săcuieni, the maximum frequency is registered in Winter, 46% and Spring 40 % out of all cases). The monthly frequency rate of floods presents a maximum in June on Crasna at Domăneşti (17.3% of the total number of floods selected), in April, on Someş at Satu Mare (22.1%) following at the other seven stations the maximum frequency of floods to produce in January and February (table 2)

Table 2. The monthly flood frequency in the period 1979 – 2004 (%, of all cases)

River	Station	Month											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Talna	Păşunea Mare	11.5	**19.2**	11.5	9.6	9.6	9.6	7.8	1.9		5.9	1.9	11.5
Turţ	Gherţa Mare	13.5	**15.4**	11.5	3.8	3.8	11.5	11.5	1.9	1.9	11.5		13.5
Tur	Turulung	**21.1**	17.3	11.5	9.6	5.8	3.8	7.7			5.8	3.8	13.5
Someş	Satu Mare	13.5	7.7	15.4	**23.1**	7.7	7.7	5.8	1.9		5.8	3.8	7.7
Valea Vinului	Valea Vinului	**21.1**	9.6	17.3	13.5	7.7	9.6	9.6			3.8		7.7
Crasna	Supuru de Jos	11.5	**17.3**	15.4	13.5	7.7	13.5	5.8		1.9	3.8	5.8	3.8
Crasna	Domăneşti	15.4	13.5	11.5	13.5	13.5	**17.3**	3.8		1.9	3.8	1.9	3.8
Ier	Săcuieni	**20.0**	**20.0**	18.0	10.0	12.0	6.0	4.0		2.0	2.0		6.0
Santău/Cehal	Valea Morii	**27**	11.5	9.6	13.5	9.6	17.3	1.9				3.8	3.8

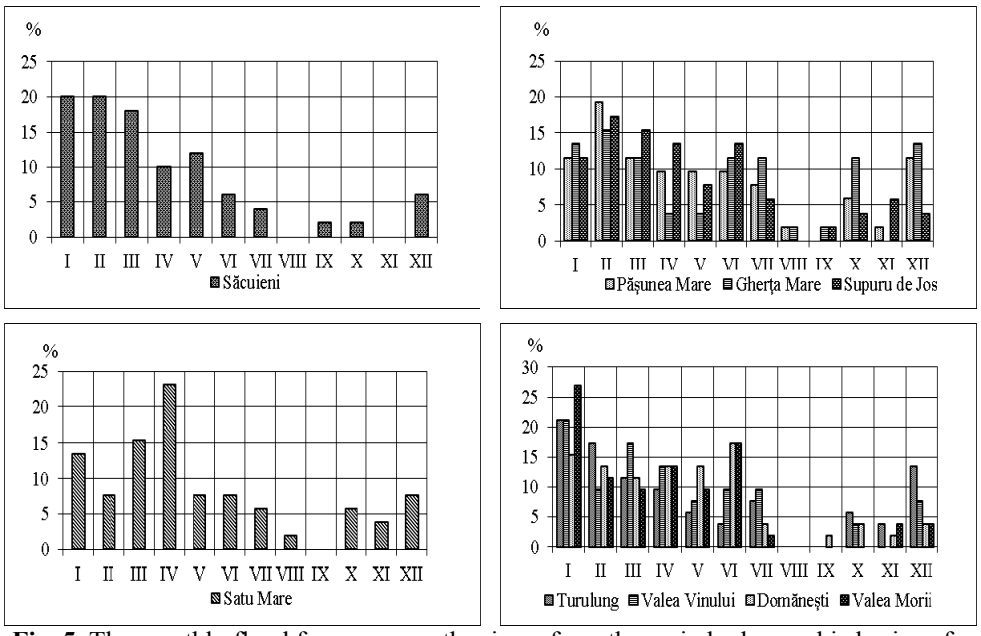

Fig. 5. The monthly flood frequency on the rivers from the main hydrographic basins of Someş Plain

During this period 1979-2004 you can notice differences in the frequency of floods on the gauging stations which led to its division into four groups, namely a first group including Păşunea Mare, Gherţa Mare and Supuru de Jos stations (figure 5) with

approximately equal frequency in the Winter months and March, plus June, July and October to Gherța Mare, with the same frequency and an overall maximum in January.

A second group of stations including Turulung, Valea Vinului, Domănești and Valea Morii with relatively equal frequencies in February, March and June and the overall maximum recorded in January; a third group employing Săcuieni station, with maximum frequencies of floods equal in January and February and almost equal as value as those in March and a final group, including Satu Mare hydrometric station with maximum values of frequency in March and April, followed by the ones in January. The minimum frequency of producing floods or even their lack occurs in August (5 cases in Turulung, Valea Vinului, Domănești, Valea Morii and Săcuieni) and in September (one case in Satu Mare).

Hydrographs characteristic parameters of the largest floods

Considering the data from stations with continuous data series for the entire period taken into account, the following values of the mentioned parameters were obtained (tabel 3).

Tabel 3. Data regarding the parameters of the first flash flood* from the analysed hydrometric stations

Station	River	Year	Month	Volume (mil. mc.)			Duration – Time (hours)			Basic flow (mc/s)	Max. specific flow (l/s*km^2)	Over-run stratum (mm)	Y
				total	basis	flown	total	Increas.	Decreas				
Turulung	Tur	1970	may	87,82	21,79	66,02	144	20	124	42,05	708	90,1	0,33
Păşunea Mare	Talna	1998	oct.-nov.	10,16	1,683	8,484	82	25	57	5,7	1150	49,9	0,18
Gherța Mare	Turț	1997	july	1,523	0,101	1,423	38	5	33	0,735	1631,1	38,9	0,19
Satu Mare	Someş	1970	may	1107,	405,7	701,3	173	52	121	651,5	214,2	45	0,53
Domăneşti	Crasna	1970	may	109,0	25,17	83,83	428	66	362	16,34	161,9	49,2	0,26
Valea Vinului	Valea Vinului	1980	jul.-aug.	4,018	0,297	3,721	66	24	42	1,26	1886,2	55,7	0,14
Săcuieni	Ier	1980	jul.-aug.	74,33	7,802	66,52	672	138	534	3,225	40	49,4	0,57

* largest first flood from the entire analysed period (1979 – 2004).

Natural flood risk map

The natural flood risk map of the county is done usually at 1:25,000 scale, as part of the landscaping plan of the county are and/or of the entire area. The town-planning documentation- general plans and specific local regulations- detail the natural hazards map for floods through risk plans at appropriate scales.

The topographic and cartographic base for natural flood risk map uses the Stereo '70 projection system, with equidistant contours of 2 meters and has as the

Black Sea as a reference level. The flood risk map of the city shall be made in stages, starting with areas highly exposed to hazards, on rivers and torrents, as well as/ or in areas in which flooding phenomena have been identified.

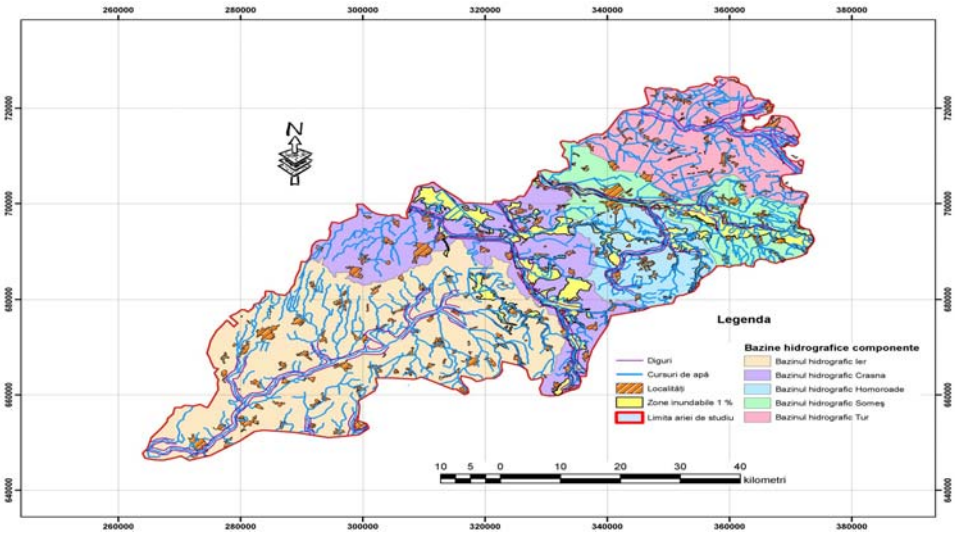

Fig. 6. The map of the areas exposed to natural risks of flood associated with 1% exceeding flow probability

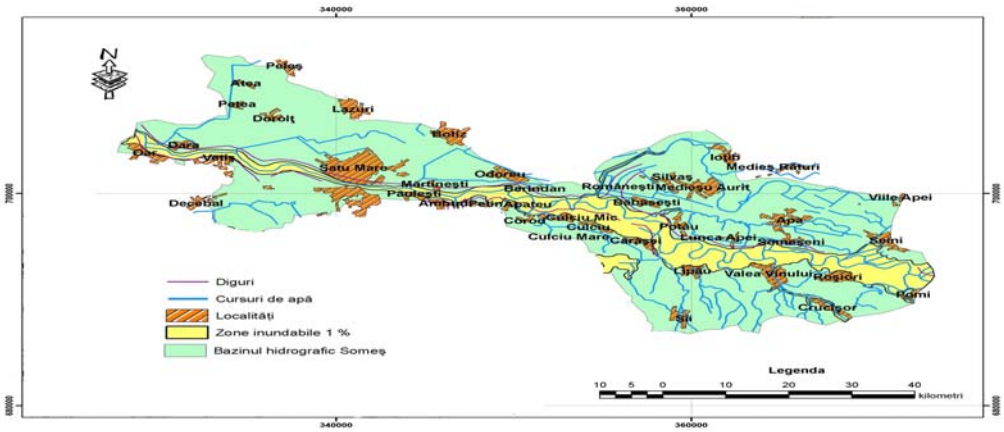

Fig. 7. The map of the flood natural risk areas associated with 1% exceeding flow probability in Someş Basin.

Based on the determined values during floods over the studied period a flood risk map can be done, with different possibilities of exceeding. The most common in this sense refers to the value of 1%- the debit value whose probability of occurrence is once every 100 years. Thus, we conducted a thematic cartographic

representation, which includes exposed areas completed as well with linear protection structures, that is longitudinal dykes. (figure 6).

It should be noted that upstream from Satu Mare, the extension flooding area is much larger, its width varying from 1-5 km, downstream the county capital, the band is reduced to the level resulting from the building longitudinal protection dams. (figure 7).

Particular case study - the floods of May 1970

The greatest damage caused in Satu Mare county were those in May-June 1970. The floods have been developed on the following rivers: Someş, Tur and Crasna as well as on a number of their tributaries (figure 8). These events led to the flooding of large areas of farm land, settlements, communication routes, causing losses in the economy of the county.

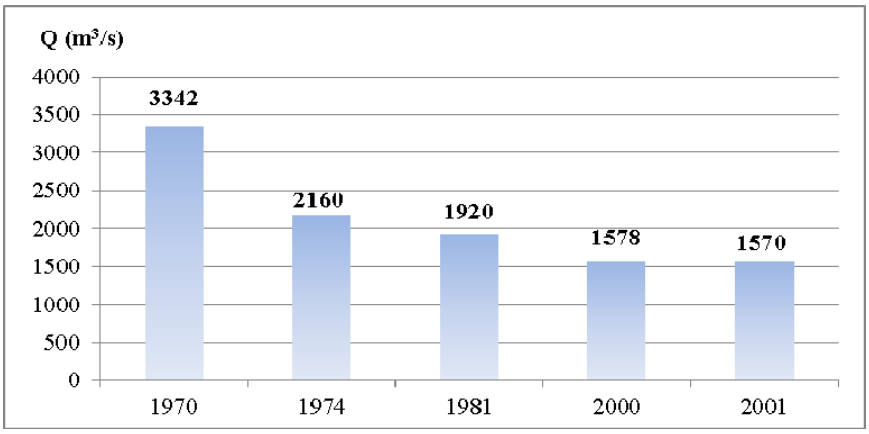

Fig. 8. The highest flows recorded at the hydrometric station from Satu Mare (1970 - 2004)

The phenomenon was caused by unprecedented amounts of precipitation from 10th to the 13th of May 1970, which reached intensities up to 100 l/m2 in 24 hours, ie 2-3 times the total volume of rainfall in a month. In addition, from the 1st to the 10th of may 1970 snow fell in the mountainous area, reaching 3 meters in some places. The heat wave that followed immediately led to the melting of the snow which added to the rainfall, and which overlapped with the humid soil, due to the fact that 2-3 month prior to the rain causing the flash flood, the rate of precipitation was exceeded by 2-3 times in this area.

Because of this soil humidity, 60-80% of the rainfall volume flowed from the Someş and Tur basins gathering in riverbeds billions m³ of water filling cities and villages and bringing many casualties.

The intensity of high rainfall, the simultaneity of their fall on an area spread over 15,000 km² only in Someş basin, and the drainage conditions

determined catastrophic levels on Someş which exceeded by far the levels on this river up at that time.

The catastrophe could not be prevented regardless the human and material effort made to prevent spillage and braking of the levees. The main reason was that the existing dams on Tur, Crasna and Someş rivers in 1970 were designed and built to resist flood flows that can occur once in 100 years, which would have corresponded on Someş river to a flow of 2000 m^3/s, whereas the flood in May exceeded 3400 m^3/s. For this flow to go through only between the dams, these should have been raised throughout their length with 1-1.5m in a time of only 6-8 hours, as was available after the weather forecast of 900 cm, impossible to have been done.

From the overflow that occurred starting with May 13th 1970 on its tributaries in the hill area of the water flows in the county, a series of damaged was produced to the buildings in the unplanned areas and through the increase of flow on Tur and Someş rivers on the 13th and 14th of May 1970, downstream, the overflow produced breaches in the levees, slope and bank erosion and seepage in the structure of dams.

After the withdrawal of water flows, it was found that on Tur river there were eight breaches, all of them between km 0+000-6+000 from the border, and on Someş river, a number of ten breaches on the right bank near Berindan, Cucu, Marinesti, Satu Mare and Dara, and two other breaches on the left bank near Apateu.

Less than a month from the catastrophe, when not all breaches had been closed, a new flood, of a lower magnitude on Somes, but higher on Crasna hit Satu Mare county, in the plain section.

Since this second flood on Someş was smaller, although on Crasna there were extraordinary levels, the fact that the flood wave propagation was done in less time than on the other courses, it was possible to take the necessary intervention measures.

Despite the measures taken, due to extraordinary levels recorded on Crasna river, discharges occurred over the crest of the dam in Craidorolt village on 350m, and due to the raising of the dam, it was avoided the water discharge on approx 11 km from the dam.

The breaks in the levee occurred near Craidorlt village on a length of 100 meters and near Lucaceni on the Agerdo dike on a length of 12 m. there was also some other seepage through the dam which added up to 5500 m, most of which being reported near Berveni.

Following the floods in May and June 1970 the main objectives and areas affected in Satu Mare County were:

- 19 communities totally flooded
- 34 communities partially flooded
- 23.066 homes flooded
- 3.557 homes destroyed
- 1.823 homes damaged

- 84 bridges and culverts destroyed or damaged
- 380 km of paved roads destroyed or damages
- 50 km railroad damaged
- 84 km of telephone and electricity lines affected
- 177.233 ha of land flooded

Conclusions

Floods are the most common hazard on Earth with numerous casualties and large-scale damage, disturbing the smooth conduct of socio-economic activities in the affected area.

Floods are included in the high risk hydric phenomena, being rare and unusual, also part of a continuous series. The forms they take are different from normal and may occur with some regularity or by chance.

Thus, the determination of the frequency of floods and especially of their parameters leads to effective management of water resources. Knowledge of the genesis and of the production mechanisms of these phenomena offers the possibility of preventing and combating the economic, social and ecologic effects they can produce at the level of an area, region or on a larger scale.

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