THE EFFETCS INDUCED BY THE FLOODS IN THE UPPER CRASNA BASIN

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ABSTRACT. The effects induced by the floods in the upper Crasna Basin. The effects induced by floods can be classified by several criteria. According to their nature the effects can be classified as: economic, social and ecological. We analized the effects of the floods in the period between 1974-2010. There were no human life losses or severe injuries recorded. The flood in August 2005 had sanitary effects given by the mudding of some local water supplies. The floods affected households, socio-economic units, agricultural land, roads and railways, bridges and footbridges, drainage, electricity and telephone networks as well as hydraulic works done on the water courses. In Zalău Basin the most frequently affected localities were Sărmăşag (16 events), Bocşa (15), Zalău (14), Hereclean (12). On Crasna river more events were recorded in the villges upstream the Vârşolţ reservoir (Crasna – 19 events, Horoatu Crasnei – 14 events). The years with the broadest floods (which affected most settlements in the basin) were 1974 and 1998. The most significant ecological effects are bank erosion and the silting of the Vârşolţ reservoir.

Key-words: Crasna, effects, flood, damages, bank erosion

1. INTRODUCTION

Being situated in the North-Western part of the country and having an area of de 804.04 km^2, the Upper Crasna Basin develops entirely within the Sălaj County. In includes several landforms with distinct geographical features: mountains in the South-Eastern part, hills and depressions in the central and Northern one (Fig.1.)

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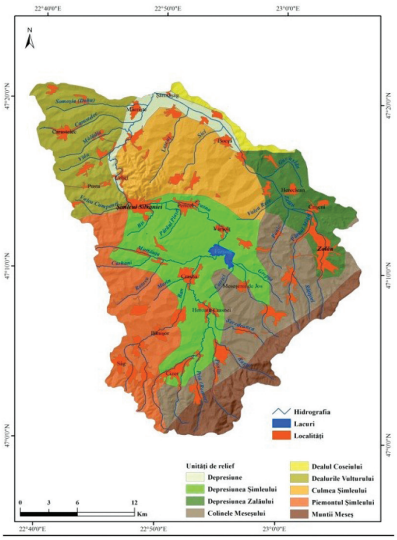

Figure 1. The localization of the Upper Crasna River Basin

The population of the two towns and 14 villages counts 127.421 inhabitants, who exert a quite strong human pressure upon the studied territory. The average population density (158.4 inh/km²) is over the national average and has a quite irregular distribution (Fig. 2).

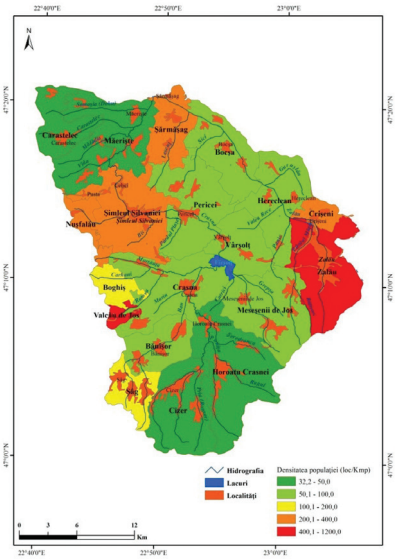

Figure 2. The map of the population density in the Upper Crasna Basin.

The effects of the floods are more often negative than positive. The effects induced by floods can be classified by several criteria. According their importance, the effects can be major or subsidiary. According to their nature the effects can be classified as: economic, social and ecological.

2. DATA BASE AND METHODS

The database referring to the effects induced by the floods in the Upper Crasna Basin was obtain from the Salaj Water Management System and in a little extent from personal field observations and measurements. We have to mention that not all the ecological and social effects were recorded. The time span taken into account for the statiscal calculus of the data was 1974-2010.

3. RESULTS AND DISCUSSION

The effects of the floods are various and complex, affecting many fields of human life and activity as well as the environment.

3.1. Social effects

Regarding the social effects there were no human life losses or severe injuries recorded. The flood in August 2005 had sanitary effects given by the mudding of some local water supplies (wells) which lowered the possibilities of drinking water supply of some villages situated on Crasna an Zalau (20 wells in Crasna village and 35 wells in Crişeni village.

Psychological effects (panic) manifested in the settlements affected by the floods in July 1974 (Şimleu Silvaniei, Sărmaşag, Măerişte) and June 1998 (Carastelec, Şimleu Silvaniei, Bocşa, şi Sărmăşag).

Cultural values were destroyed as a result of the floods in 1974 (Şimleu Silvaniei), 1978 (Hereclean, Bocşa and Sărmăşag) and 1997 (Zalău, Hereclean, Bocşa).

3.2. Economic effects

The economic effects are usually divided in two categories: direct (tangible) and indirect (intangible). The direct effects consist in the destruction, deterioration or affecting of more elements of social and economic importance. The indirect effects refer to losses (dysfunctions of economic institutions and units) and additional costs determined by the occurrence of floods (the measures adopted during floods, returning to the normal state and restarting the economic activities and those related to the restoration of the damaged elements) as well as the payment of the insurances for the material and human goods. Only the direct economic effects were recorded (the

number of households and socio-economical units, agricultural land, communication infrastructure, public utilities networks and hydraulic works).

All the villages within the studied basin were affected by floods in different extents. The degree of the damage depends on the number of events that affected the settlement an on the quantitative and energetic parameters of the flood.

The floods affected households, socio-economic units, agricultural land, roads and railways, bridges and footbridges, drainage, electricity and telephone networks as well as hydraulic works done on the water courses. The most affected settlement (considering the number of cases) was Crasna, where 19 flood events were recorded, while the least affected was Sâg, where only one event was recorded (Fig. 3).

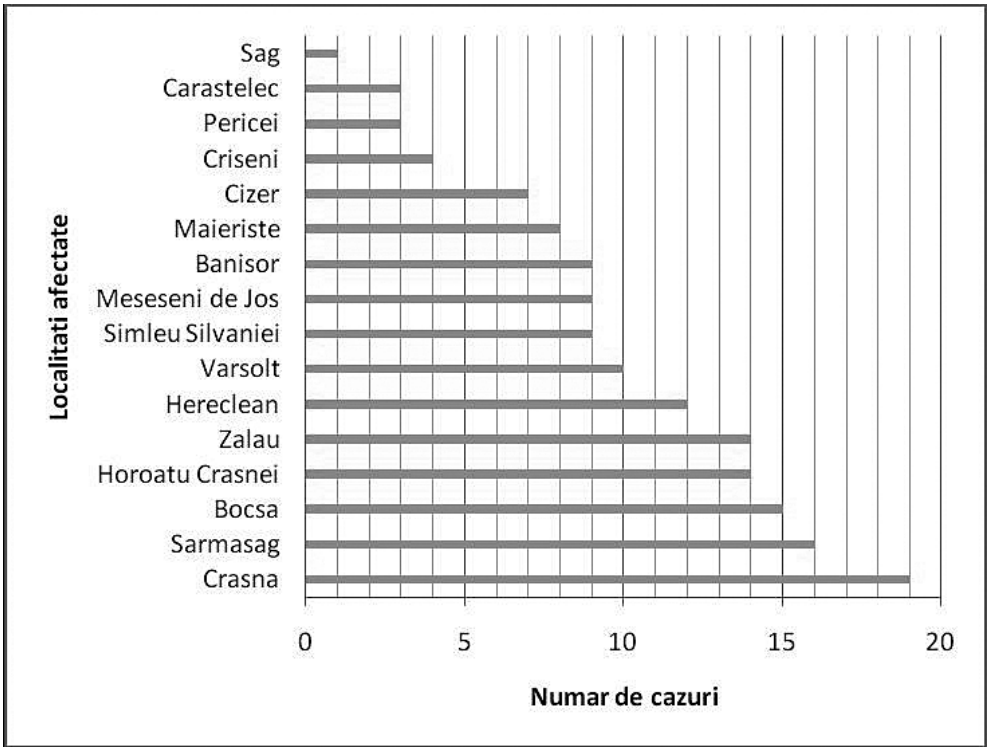

Figure 3. The number of floods recorded in the Upper Crasna Basin (1974 – 2010)

Out of the analysis of the number of cases at the level of river basins we can notice the fact that in Zalău Basin the most frequent were affected the following localities: Sărmăşag (16 events), Bocşa (15), Zalău (14), Hereclean (12). As an exception we can mention Crişeni, with only 4 events. On Crasna river we can notice that more events were recorded in the villges situated upstream the Vârşolț reservoir (Crasna – 19 events, Horoatu Crasnei – 14 events). Quite many events (9) affected

the settlements situated on some of the smaller tributaries of Crasna (Bănişor on Ban) and Zalău (Meseşeni de Jos on Colița). On other tributaries of Crasna and Zalău were recorded fewer events: three on Carastelec (Carastelec), Mortăuța (Crasna); two on Cumpăna (in Şimleu Silvaniei), Vida (Măierişte) and Mița (Zalău).

The years with the broadest floods (which affected most settlements in the basin) were 1974 and 1998, when 15 of the 16 settlements in the studied area were affected. Similar floods also recorded in 1999 (13 affected settlements), 1997 (12 settlements) and 2000 (11 settlements). Floods with a narrower area of occurrence were recorded in 1995 and 2001, when only two settlements were affected each year. (Fig 4).

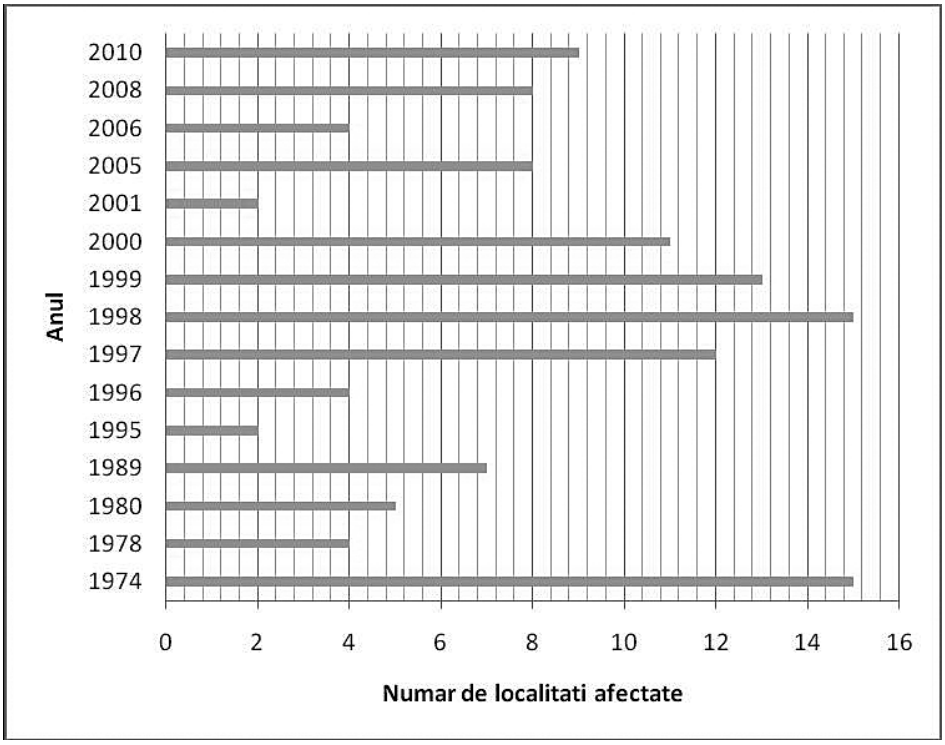

Figure 4. The number of settlements affected by the floods in the Upper Crasna Basin (1974 – 2010)

The effects induced by the floods that occurred between 1974 and 2010 were centralized, and out of the analysis of the obtained data (Table 1) we can draw several conclusions:

– out of the tangible economic effects one can distinguish in the first place the great number of households and household annexes that were affected (1823) and the quite great areas of agricultural land affected by floods (25 362.5 ha);

– the transportation infrastructure was less affected : 0.4 km of railroads, 175,45 km of different types of roads (18,4 km of county roads, 122,85 km of village

roads, 34,2 km of forest roads), 0,4 km of electricity networks;

– the public utilities network was also less affected: 24,987 km of sewerage networks, 0,1 km of telephony lines.

– among the hydraulic works a series of regularization works, bottom thresholds, protection works executed on Crasna River (Şimleu Silvaniei, Pericei, Cizer, Horoatu Crasnei), and Zalău River (Zalău, Bocşa) etc. were affected by floods (Table 1).

Table 1. The objectives damaged by the floods occurred between 1974-2010

Nr Crt	Locality	Water course	Bank	Year	Intensity of degradation	Length of degradation (m)	Width (m)	Height of bank (m)
1	2	3	4	5	6	7	8	9
1	Horoatu Crasnei	Crasna	D	1974	M	130	1	2
2	Vârşolţ	Crasna	S	1975	M	95	1	2
3	Horoatu Crasnei	Crasna	S	1978	M	240	2	3
4	Măierişte	Crasna	D	1978	M	185	1	3
5	Vârşolţ	Crasna	D	1978	M	170	1	2
6	Sărmăşag + Moiad	Crasna	S	1978	M	120	1	3
7	Pericei	Crasna	D	1979	F	240	2	3
8	Horoatu Crasnei	Crasna	D	1985	M	160	2	2
9	Cizer	Crasna	D	1986	D	170	1	2
10	Cizer	Crasna	D	1986	M	270	1	2
11	Cizer+Plesca	Crasna	D	1986	F	270	2	2
12	Horoatu Crasnei	Crasna	D	1986	F	180	2	2
13	Horoatu Crasnei	Crasna	S	1986	D	210	1	2
14	Pericei	Crasna	D	1986	F	180	2	3
15	Pericei	Crasna	D	1986	M	130	1	3
16	Cizer	Crasna	S	1991	F	160	1	2
17	Cizer+Plesca	Crasna	D	1991	M	130	1	2
18	Cizer+Plesca	Crasna	S	1991	M	140	1	2
19	Cizer+Plesca	Crasna	S	1991	M	220	1	2
20	Măierişte	Crasna	D	1991	M	50	1	3
21	Sărmăşag	Zalău	S	1991	D	1350	1	3
22	Sărmăşag	Zalău	D	1992	D	280	1	3
23	Hereclean	Zalău	D	1994	F	210	3	2
24	Cizer+Plesca	Crasna	S	1998	M	170	2	2
25	Bocşa	Zalău	S	1998	M	460	1	2
26	Măierişte+ Uileacul S	Crasna	D	1998	M	200	2	3
27	Simleu Silv.	Crasna	S	1999	D	160	1	2
28	Vârşolţ	Crasna	D	1999	M	340	2	2
29	Simleu+ Uileacul S.	Crasna	D	1999	M	320	2	3
30	Hereclean	Zalău	D	2000	D	560	1	2
31	Sărmăşag	Zalău	D	2000	M	220	2	2
32	Sărmăşag+ Lompirt	Zalău	S	2000	M	450	3	2
33	Bocşa	Zalău	D	2000	M	350	1	2
34	Bocşa+Borla	Zalău	D	2000	M	315	2	2
35	Bocşa+Campia	Zalău	S	2000	M	390	2	2
36	Bocşa+Salajeni	Zalău	D	2000	M	340	2	2
37	Măierişte +Giurtelec	Crasna	D	2001	D	70	1	2
38	Măierişte +Giurtelec	Crasna	S	2001	M	90	1	2
39	Măierişte +Giurtelec	Crasna	D	2001	D	75	1	2
40	Măierişte +Giurtelec	Crasna	S	2001	M	100	1	2
41	Măierişte +Giurtelec	Crasna	S	2001	F	120	1	2
42	Măierişte +Giurtelec	Crasna	D	2001	D	100	1	2
43	Măierişte +Giurtelec	Crasna	D	2001	D	70	1	2
44	Hereclean+ Guruslau	Zalău	D	2001	F	100	4	3
45	Măierişte	Crasna	S	2001	D	50	1	2
46	Măierişte	Crasna	S	2001	D	50	1	2
47	Măierişte	Crasna	S	2001	D	100	1	2
48	Bocşa+Borla	Zalău	S	2001	F	50	3	2
49	Măierişte	Crasna	S	2001	D	120	1	2
50	Bocşa+Borla	Zalău	D	2001	F	100	2	3
51	Uileacul Simleului	Crasna	S	2001	D	120	1	2
52	Uileacul Simleului	Crasna	D	2001	D	60	1	2
53	Pericei	Crasna	S	2002	M	95	1	3
54	Pericei	Crasna	S	2002	F	95	2	3
55	Bocşa+Salajeni	Zalău	D	2002	M	140	1	2

The monetary value of the damages produced by the floods issued between 1974 and 2010 was not assessed because of two reasons. In certain years of the period the damages were not monetary quantified. In the 36 analyzed years the national currency suffered important changes because of inflation and denomination, which made harder bringing the monetary value to a common denominator.

3.3. Ecological effects

The most significant ecological effects are bank erosion and the silting of the reservoirs, which take place because of the erosion, transport and accumulation processes, much more intense during floods. As a consequence these were the only recorded effects, although floods produce other effects too, such as: changes of the physical, chemical and bacteriological properties of the water or the bio-edaphic effects.

Regarding bank erosion, between 1974-2002, 55 such events were identified, out of which almost three quarters (72,7 %) were recorded on Crasna, and over one quarter (27, 2%) on Zalău (Table 2).

Table 2. The localization and features of the bank erosion produced in the Upper Crasna Basin (1974-2002)

Damaged objectives	The damage size
Households (houses + household annexes)	1823
Socio-economic units	31
Agricultural land	25 362.5 ha
County road	18.4 km
Village road	122.85 km
Forest road	34.2 km
railways	0.4 km
Streets	30,8 km
Alleys	30.95 km
Bridges	91
Footbridges	50
Sewerage networks	24.987 km
Gutters	3.83 km
Electricity lines	0.4 km
Electricity poles	8
Telephony lines	0.1 km
Bank protection works	1748 ml
Bottom thresholds	33
Bank erosion	4020 ml
Concrete wall	170 ml
Hydraulic improvements	30 km
Water courses regularizations	4.58 km

Regarding the frequency of the occurrence of this process we can notice an intensification of it at the end of the analyzed period (Fig. 5). So, in 2001, were recorded almost a third of the cases (29,09%), followed by 1986 and 2000, with equal shares (12,73%) and 1991 (10,91%).

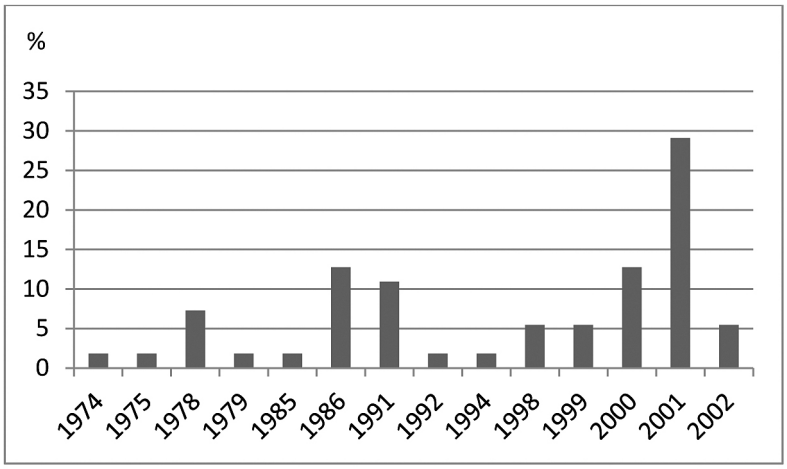

Figure 5. The frequency of the occurrence of banks errosion of the rivers in Upper Crasna Basin.

Of all the events recorded over a half had high intensity, a third medium intensity and over one tenth had very high intensity. (fig.6)

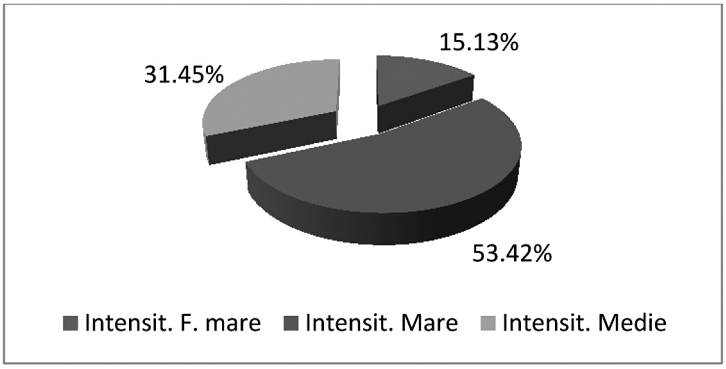

Figure 6. The classes of intensity of river bank errosion in the Upper Crasna Basin

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The total length of the banks affected by errosion was assesed to 11 270 m, out of which 6115 m on the right bank and 5155 m on the left one. Over half ot the right bank (56,4%), is affected by high-intensity errosion, while the classes with medium and very high intensity have almost equal shares (22,6%, respectively

20,9%). For the left bank the classes with high and medium intensity have almost equal shares (49,8%, respectively 41,9%) while the class with very high intensity is weakly represented (only 8,24%).

Within the studied region there is only one reservoir on Crasna River (Vârşolţ), with complex functions (drinking water supply, attenuation of high floods). The silting process of Vârşolţ reservoir has been monitored beginning with the year 1983 by Someş-Tisa Water Branch and Sălaj Water Management System. The successive hydro-topometric surveys done in 1983, 1985, 1989, 1991, 1995, 1997, 2002, 2009 and the resulting data were reported to the initial morphometric characteristics of the lake, for the period 1979 – 2009 and to the one obtained out of the following topographic surveys.

The main factor that influences directly the silting phenomenon is the suspension load discharge brought by the lake's tributaries. Analising the monthly variation of the average solid discharge (Fig. 5) one can notice that the highest values are recorded in spring in May and at the beginning of the summer, when the high frequency of floods favourize the carring out of a great quantity of sediment load (over a quarter of the global sediment load).

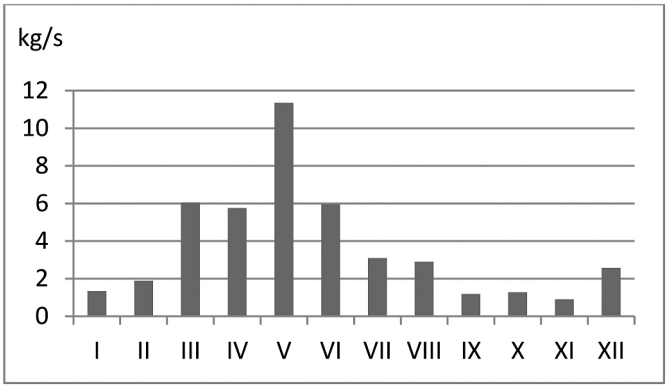

Figure 7. The monthly variation of the solid discharge at Crasna hydrometric station (1981–2009)

The evolution of the silting of Vârşolţ reservoir was assessed for the characteristic volumes: dead volume, available volume, flash-flood protection volume, above overflow volume, flash flood attenuation volume and global volume (Table 3).

Table 3. The evolution of the characteristic volumes of Vârşolţ reservoir (1979-2009) (source Someş – Tisa water Branch)

Year / Volume	1979	1983	1985	1989	1991	1995	1997	2002	2009
Dead	0.592	0.279	0.183	0.117	0.084	0.081	0.048	0.0005	0.000
Available	20.908	18.371	17.877	16.783	16.687	16.449	16.358	16.0695	15.7886
Flash flood protection	11.900	11.224	11.220	10.840	11.138	10.460	10.367	10.460	8.6233
Above overflow	14.400	14.626	14.400	12.955	13.041	12.870	12.874	12.858	15.5364
Flash flood attenuation	26.300	25.850	25.620	23.795	23.879	23.330	23.241	23.318	24.1597
Total	**47.800**	**44.500**	**43.680**	**40.695**	**39.650**	**39.860**	**39.647**	**39.388**	**39.9483**

Analyzing the silting of the characteristic volumes between 1979 – 2009 one can notice that in the first 12 years (1979 – 1991) the process was very accelerated and considerably diminished in the last 18 years (1991 – 2009).

The dead volume has been silted between 1979 – 1991 in an extent of 85,8%, and it was completely silted by 2009. The available volume has been silted between 1979-1991 in an extent of 20,2 % and of 24,5% on the entire period.

Regarding the flash flood protection volume it has been silted less during the first period (1979-1991) – 8,9% and more during the last years, reaching at a rate of 26,8% for the entire period. The global volume has been silted in an extent of 15% between 1979-1991 and of 16,4 % on the entire period. (Moigrădean, 2013)

The volume of sediments accumulated in the lake, calculated as the difference between the volumes at normal service levels in 1979 and 2009, is of 5.71 millions of m^3, the corresponding silting degree being of 26.5%. The annual average silting rate is relatively low (0,59%). (Moigrădean, 2013)

CONCLUSIONS

The floods recorded in the Upper Crasna Basin between 1974 and 2010 had social, economic and ecological effects. The most important effects which directly influence the population of the basin are the economic ones leading to the damaging of houses, economic units or agricultural land. The great number of such damaged objectives shows the fact that the population still uses dangerous terrains for building homes or for agriculture. Vârşolt reservoir is of great importance for the mitigation of the effects of floods, as we can totice that the most important floods took place before it was finished in 1979, upstream of it or on Zalau river.

The number of cases of bank errosion increased in the last years according to the general tendency of errosion exacerbation. It affects both banks and is quite agressive dominating the classes with high and very high intensity.

The silting rate of Vârşolţ reservoir is not a very significant one. It has a silting time of 252 years, which means an acceptable span towards the characteristics of the reservoir's catchment area so it can best serve its purpose of reducing the effects of floods on Crasna River.

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