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ENVIRONMENT REHABILITATION ON TROTUŞ RIVER VALLEY, AFTER THE 2004 AND 2005 FLOODS

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Abstract

In July 2004 and July 2005, Trotuş river valley was the scenery of some of the most important floods in it's recorded hydrological history, with big destruction on houses, roads and bridges, with human life losses and huge agricultural areas flooded down the river. Most of destruction was not only on Trotuş river valley, but also on small tributaries, as Ciobănuş, Asău, Goioasa etc. The large quantities of torrential precipitation caused the flood on the 28th of July 2004 and 12-13 th July 2005. Another factor that favored this devastating phenomenon (which, besides the damage also caused the death of three people, two in the Agăş locality, on the Trotuş river, upstream from Comăneşti) is the massive deforestation carried out over the last years, especially after the taking into possession of the forests, according to Law 1/2000. Chaotic wood cutting (some of which even led to the total uncovering of mountainsides over quite wide areas), either for wood working companies in the Comăneşti area, or for household use, but especially for smuggling purposes, had as a result the rapid discharge of precipitation water down the mountainsides, the formation of mud streams and floods on the tributary streams in the mountain area of the Trotuş river, and finally, a strong flood wave in the bed of the main river. Nowadays, local, regional and national authorities apply a comprehensive management plan for environmental rehabilitation. By hydrological improvement on small streams and tributaries and discharge control, Trotuş river valley became a safe area, both for environment and it's inhabitants.

Keywords: Trotuş river, tributaries, heavy rains, deforestation, floods, environmental rehabilitation

Against the background of unstable weather conditions, with torrential rain, which released a large quantity of water, the Central Commitee for Defense against Floods issued a flood warning on the 26th of July 2004 stating to the Government, the Ministry of Public Administration and Interior, the Ministry of National Defense, the Civil Protection and to the Prefect's Offices, the possible occurrence of a significant increase in the water and discharge level for the period 26.07-30.07 2004, which would surpass the safety level, especially in the case of small rivers in the hilly and mountain areas, including the Trotuş basin.

This warning was issued against the background of a long period of atmospheric instability in the mountain area of the Western part of the Bacău County. The high discharges of the Trotuş river and its tributary streams produced floods in the localities Agăş, Asău, Brusturoasa, Comăneşti, Ghimeş, Făget, Palanca, Straja, Tg. Ocna, Viişoara and other 50 localities, due to abundant precipitation (104 l/sqm at the Poiana Uzului weather base, on the 28th of July 2004). Damage was caused to 1,874 houses and house annexes, 216 hectares of cultivated land, 122 kilometers of county roads, 167 bridges and footbridges, 10 mean stress lines, 3 wood working companies in the entire hydrographic basin of the Trotuş river. The flood wave had an impact over the entire area up to the inflow of the Trotuş in the Siret, damaging 21 households with annexes and 8 kilometers of streets in the Adjud locality. The analysis of the data delivered by the Siret Directorate of the Romanian Inland Waters Administration, proved that the precipitation registered on the 28th of July 2004 in the entire Trotuş basin, amounted to considerable quantities. 11 of the 21 hydro-meteorological monitoring stations in the area registered passing showers of torrential rains with large quantities of water in 24 hours. The largest quantity of precipitation registered among the weather bases located in the high Carpathian and Under-Carpathian area of the Trotuş basin was the one registered at the Poiana Uzului weather base, close to the Dărmăneşti locality, on the Uz Valley - 104 l/sqm in 24 hours, while the multi-annual precipitation average registered at this weather base is 622,8 l/sqm, and the maximum quantity registered in the year 1991was 140 l/sqm. The other hydro-meteorological monitoring stations also registered considerable precipitation (table no. 1). The large quantities of torrential precipitation caused the flood on the 28th of July 2004. Another factor that favored this devastating phenomenon (which, besides the damage also caused the death of three people, two in the Agăş locality, on the Trotuş river, upstream from Comăneşti) is the massive deforestation carried out over the last years, especially after the taking into seisin of the forests according to Law 1/2000. Chaotic wood cutting (some of which even led to the total uncovering of mountainsides over quite wide areas – as seen in Fig. 1), either for wood working companies in the Comăneşti area, or for household use, but especially for smuggling purposes, had as a result the rapid discharge of precipitation water down the mountainsides, the formation of mud streams and floods on the

tributary streams in the mountain area of the Trotuş river, and finally, a strong flood wave in the bed of the main river.

Fig. 1 Deforestated slopes in Trotuş river valey (July 2005 and July 2012)

This flood wave caused the destruction 69 houses, the flooding of over 620 houses and of over 1000 houses annexes, the destruction of 29 bridges and 256 footbridges (these only on the Trotuş) and the degradation of the crops on a wide area.

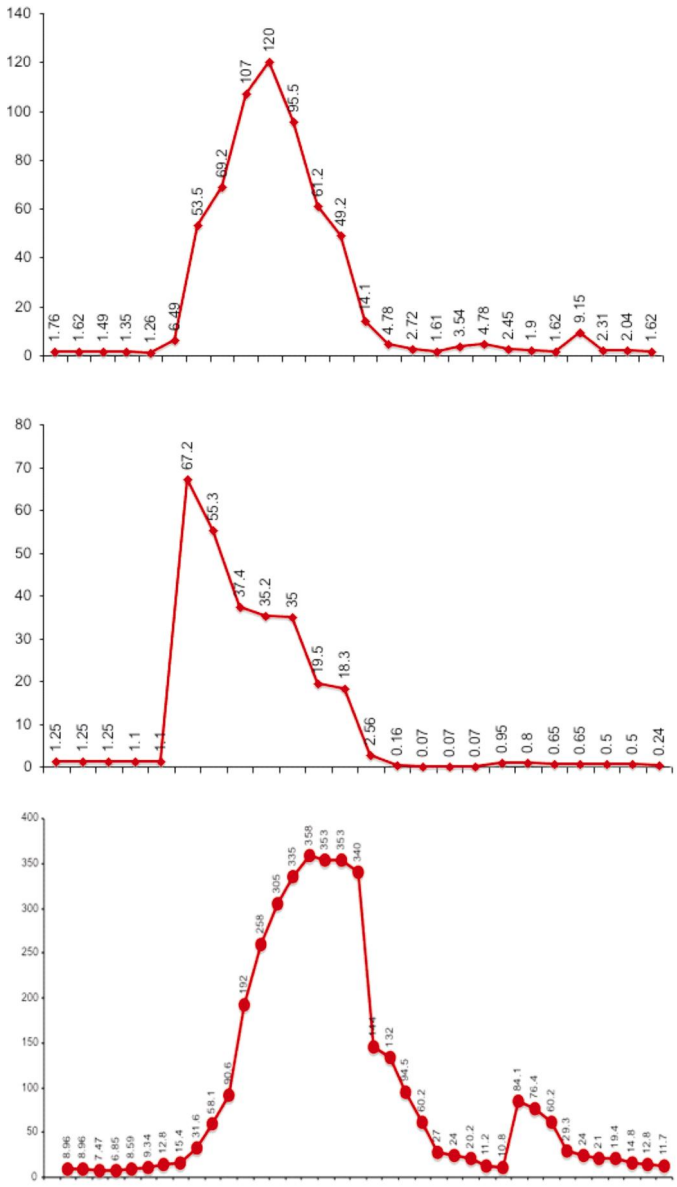

Fig. 2 Graphs of flood wave for Asău, Ciobănuş and Trotuş rivers, at Asău, Ciobănuş and Goioasa hydrometric stations. (26th July 02nd August 2004)

Only in the Agăş locality there were 57 houses destroyed and other 280 flooded, as well as almost 600 house annexes. 125 hectares of arable land were damaged, over 30 kilometers of county roads destroyed and 6 bridges and 64 footbridges were broken by the water. The total amount of the damage in this area reported by the Local Council Agăş to the county authorities was of 264 billion lei. The Directorate for Budgeting and Finance of the Bacău County Council allocated 500 million lei for the clearance of the area affected by the natural calamities occurred in the period 26-30 July 2004 in the Agăş locality.

On the Asău river, at the Asău hydrometrical station, the flood started at 13:00 on the 28th of July 2004, reaching its climax at 14:45. The level had reached a value of 210 cm (exceeding the safety level by 60 cm), and the maximum discharge measured at that moment reached the value of 120 cubic meters/second, whereas the average multi-annual discharge is of 2.08 cubic meters/second.

On the Ciobănuş creek, the flood reached the maximum level (200 cm, 100 cm over the safety level) on the 28th of July at 13:45, the discharge was of 67.2 cubic meters/second, while the multi-annual average is of 1.30 cubic meters/second.

On the Trotuş river, at the Goioasa station, the maximum level of 323 cm (23 cm over the safety level) was also reached on the 28th of July 2004 at 14:00, the maximum discharge being of 6.4 cubic meters/second. The extremely high discharge level was at over 300 cubic meters/second for over an hour between 13:35 – 15:00 (Fig. 2).

Tabel No. 1 Characteristic datas, regarding the hydrometeorologic monitoring network of Trotuş river basin *

No	River	Hydrometric station	MORPHOMETRIC DATAS				MEDIUM VALUES		HISTORIC MAXIMAL VALUES		DEFENDING COTES			28TH JULY 2004 FLOOD			
			River length (km)	Basin surface (kmp)	Medium height (m)	Slope (‰)	Rain med. (l/mp)	Multi annual flow (mc/s)	Rain max. (l/mp) (24 h/Year)	Historic maxim flow (mc/s/Year)	AC	FC	DC	Rain in 24 h (l/mp)	Max. Cote (cm)	Over-taking cote	Max. flow (mc/s)
1.	Trotuş	Lunca de Sus	16	89,2	1140	12	601,7	**0,78**		**23,2/1984**	80	120	200				
2.	Trotuş	Ghimeş-Făget	35	381	1116	12	580,6	**3,54**		**127/1975**	150	100	250				
3.	Trotuş	Goioasa	58	765	1052	7,5	635,9	**6,4**		**195/1984**	150	200	300	88,4	323	23CP	**358**
4.	Trotuş	Tg. Ocna	93	2091	924	2,18	592,0	**17,2**		**722/1961**	200	300	380	62,9	396	16CP	**682**
5.	Trotuş	Oneşti	108	2836	830	2,18	585,3	**25,1**	**64,6/1991**	**1290/1991**	250	300	400	24,5	420	20CP	**869**
6.	Trotuş	Vrânceni	124	4077	734	0,63	523,0	**35,3**	**112,3/1991**	**2500/1991**	250	300	400	15,9	342	42CI	**1.136**
7.	Valea Rece	Valea Rece	22	122	1145	6,5	611,0	**1,27**		**110/1981**	150	200	250				
8.	Sulta	Sulta	25	116	1041	17	576,2	**1,04**		**99,2/1991**	100	200	230				
9.	Ciobănuş	Ciobănuş	32	132	1052	12	626,6	**1,30**		**116/1991**	100	160	200	94,2	200	100CA	**67,2**
10.	Asău	Asău	37	205	951	11	666,8	**2,08**	**116,4/1991**	**183/1997**	150	250	300	61,5	210	60CA	**120**
11.	Uz	Valea Uzului	25	160	1070	8,0	622,0	**1,70**		**196/1975**	200	250	300				
12.	Uz	Cremenea	34	340	1070	8,1	647,3	**4,02**	**124/1991**	**141/1981**	150	200	250				
13.	Uz	Dărmăneşti	42	406	975	2,6	622,8	**4,88**	**140/1991**	**129/1978**	150	200	300	104			
14.	Dofteana	Dofteana	26	110	735	11	697,8	**1,12**	**176,7/1978**	**485/1991**	140	220	300	41,7	270	50CI	**116**
15.	Slănic	Cireşoaia	22	100	775	18	668,6	**1,17**	**140,2/1975**	**148/1975**	150	200	250				
16.	Oituz	Ferăstrău	42	263	810	5,7	708,0	**3,19**	**106,3/1987**	**413/1975**	150	200	300	46,2	122		**13,2**
17.	Caşin	Haloş	36	263	810	8,8	684,8	**2,43**	**100,2/1970**	**497/1972**	250	350	400	54,7	360	10CI	**166**
18.	Tazlău	Tazlău	17	129	793	7,1	603,4	**1,39**	**131/1937**	**698/1970**	180	200	250				
19.	Tazlău	Scorţeni	49	417	574	1,3	636,8	**3,41**	**92,6/1991**	**3901/1984**	150	220	280				
20.	Tazlău	Helegiu	76	999	520	2,2	700,8	**6,92**	**180,2/1991**	**1550/1991**	200	300	350				
21	Tazlăul Sărat	Lucăceşti	29	123	801	11,0	611,0	**1,39**	**160,8/1991**	**457/1991**	150	250	300	25,3	180	30CA	**140**

* Datas delivered by the Siret Directorate of the Romanian Inland Waters Administration

Both the natural components of the environment (knocking down of trees, strand creep, landslides, mud floods) but especially its anthropic component (damage of houses, public roads, etc. we mention the destruction of many households, roads and bridges, crops, flooding of cultivated lands, mudding of fountains, and thus the possible occurrence of epidemics), were very strongly affected by these phenomena.

In 2005, the situation repeted, with almost same causes:

- large amount of rainfalls which, for the first six months of 2005, was above monthly amounts of 2004 (as seen in Table No. 2);

Table No. 2 Values of monthly amounts of rainfalls at Tg. Ocna meteorological station for the first six months of 2005 (comparison with multiannual averages)

County	*Station*		*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*Amount*
BC	Tg. Ocna	2005	27.1	34.5	11.7	54.3	108.5	116.7							352.8
BC	Tg. Ocna	normal	23.9	22.3	26.2	52.1	76.5	97.0	91.7	69.0	42.0	28.6	29.4	21.1	579.8

- huge amounts of precipitation for a small period of time (11 – 21.07.2005) (Fig. 3)

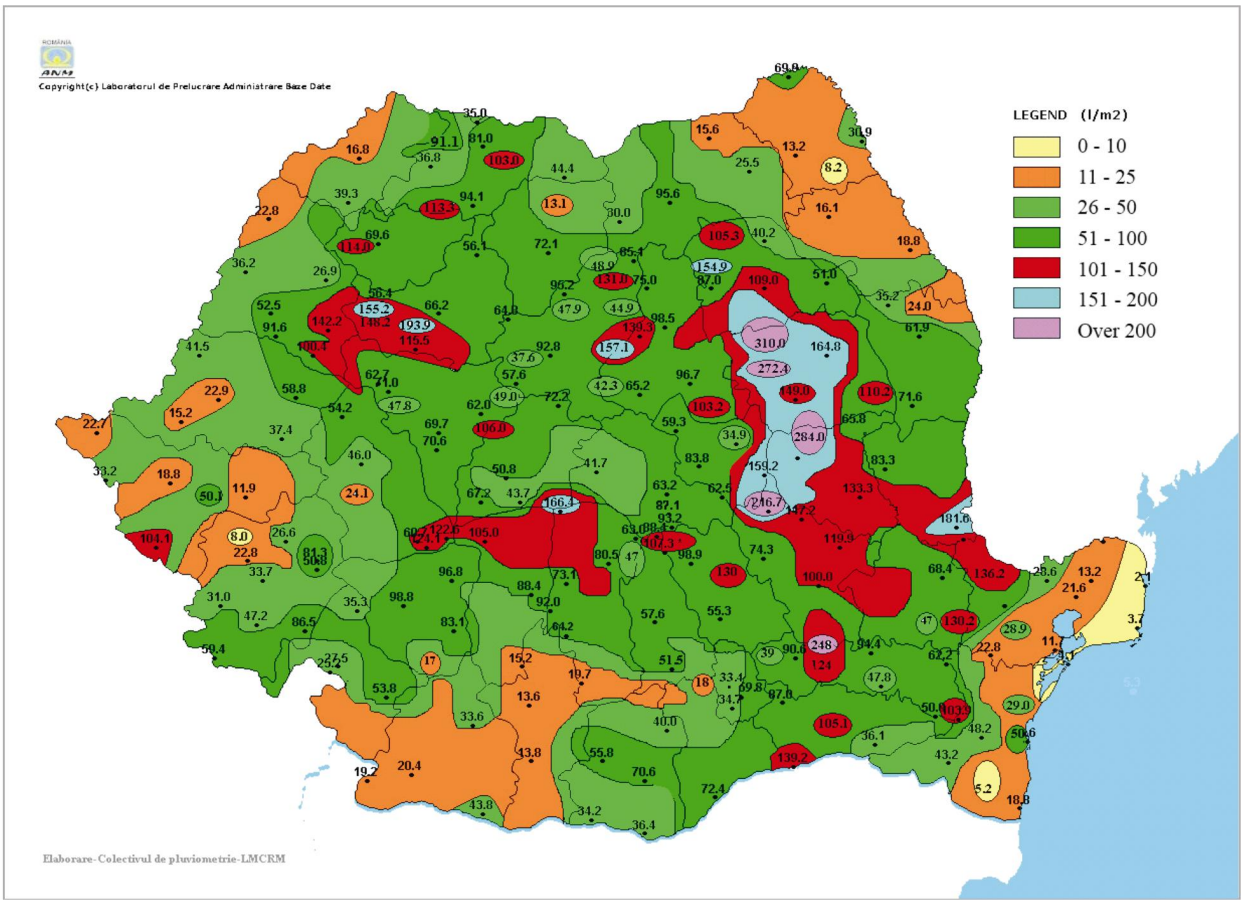

Fig. 3 Rain falls in Romania, between 11.07.2005 (09:00 AM) and 21.07.2005 (09:00 AM). As seen, Trotuş river valley received, again, the biggest amounts of water compared with the rest of the territory

- Chaotic wood cutting, either for wood working companies in the Comăneşti area, or for household use, but especially for smuggling purposes, with a devastating consequence: rapid discharge of precipitation water down the mountainsides, formation of mud streams and floods on the tributary streams in the mountain area of the Trotuş river, and finally, a strong flood wave in the bed of the main river.

This 11-13 July 2005 flood wave caused the destruction of 305 houses, the flooding of over 5.125 houses and of over 1.750 houses annexes flooded and destroyed (Fig. 4); also, there were some other effects: destruction of 89 bridges and 221 footbridges (these only on the Trotuş), 10 meters of railway, 1 railway bridge, 1 km of national road destroyed (Fig 5) and over 4.000 ha farmland flooded. 1.360 inhabitants were moved in Trotuş river basin.

Nowadays, situation is stil critic in the area. Although there was a lot of investments (up to 350 mil. lei) in order to prevent floods and to protect inhabitants, villages, roads and other major objectives in Trotuş river valley, in case of huge amounts of rainfalls, similar with those in 2004-2005, this events will repeat. Dispite of some important environmental recoverings on small afluents (Asău, Ciobănuş) and minimal hidrotechnical improvments in rivebeds for most of the small basins, deforestation still remain the major threat for the inhabitants of upper Trotuş.

Fig. 4 Destroyed houses in Comăneşti city, on the Trotuş river banks, and in Ciobănuş village, July 2005

Fig. 5 Adjud – Ciceu railway and Comăneşti – Ghimeş national road (in the neighborhood of Ciobănuş village), July 2005

„Romanian Inland Waters" Administration, Siret District, along with Bacău County Coucil and local authorities is now implementing the Management Plan of the Siret River Basin, in order to aplly the EU Water Framework Directive (2000/60/EU), wich includes a lots of actions (national, regional and local) for enviromental reabilitation of river basins and a good quality of inland waters up to 2015.

For Trotuş river basin, includin small afluents, this action plan includes reabilitation of riverbeds, raises of dams on the riverbanks and completly damming the sectors with high flooding risk, engeneering and hidrotechnic works inside the riverbeds of small tributaries and on the slopes with distructive potential (as seen in Fig. 6)

Fig. 6 Rehabilitation of rivers in Trotuş river basin (Trotuş at Comăneşti, Straja and Slănic tributaries), July 2012

REFERENCES

„Romanian Inland Waters" Administration, Siret District – *„Flow values of rivers in Trotuş river basin, for 26th July – 02nd August 2004 period*", Bacău, 2004;

Directorate for Budgeting and Finance of the Bacău County Council – *„Budget rectification raport, for Agăş Local Council*", Bacău, 2004;

Ministry of Environment – „*Hydro-meteorologic situation and environment quality for 28.07.2004, 7:00 hours – 29.07.2004, 7:00 hours period*", Bucureşti, 2004;

Ministry of Environment – „*Hydro-meteorologic situation and environment quality for 29.07.2004, 7:00 hours – 30.07.2004, 7:00 hours period*", Bucureşti, 2004;

„Romanian Inland Waters" Administration, Siret District – *„Flow values of rivers in Trotuş river basin, for 11th – 14th July 2005 period*", Bacău, 2005;

Popa, I. (2005), *„State of the Trotuş valley environment, after the July 2004 floods*", Annals of „Valahia" Univfersity of Târgovişte, Geographical Series, Tome 4-5, 2004-2005, page 229-233;

Gâştescu, P., Popa, I. (2006), *„Floodings in Romania, Causes, efects, strategies"*, TERRA, review of Romanian Geographical Society, year XXXV (LV), 2005, page 37-42, CD PRESS Publishing House, Bucharest;

www.meteoromania.ro, National Meteorological Administration website.

www.mmediu.ro, Ministry of Environment and Forests website;

www.das.rowater.ro, „Romanian Inland Waters" Administration, Siret District website.