The impact of uncommonly events under „Cuibul Vulturilor" reservoir from Tutova watershed

Gh. Purnavel, E. Filiche, G. Petrovici
Soil Erosion Control Research and Development Centre Perieni, Romania

ABSTRACT

For rural and urban community, placed in hill area, the reservoir represents an important local source of water and in the same time these reservoirs offer a high contribution at regularization of runoff and to decrease the high floods. The problem of soil erosion, sedimentation and water quality degradation of dam storage placed in hill area is ominously in our country. Soil erosion has a great impact on reservoirs, owing to sedimentation and the degradation of water quality.

When there are interest to protect the reservoirs, it must to accord interest "sediments process's" and "sediments storage's" who in the "sediments system" it must be distinctly regarding but, in time and space scale very well defined, and in connections. Another problem who must be considered is the impact of the uncommonly events like fast snowmelt, torrential rainfall and long term rains under these reservoir.

Concerning fertilizer it must be interested in their influence on water quality. The sediments sources analyze must be regarding tow aspects: provide area reported at watershed or the land use and the generating process, concerning fertilizer these must be regarding also tow aspect quantity of the inputs and the effect of water quality.

Key Words: erosion, sediments, effluence, fertilizer, water quality.

INTRODUCTION

For country and urban community, placed in hill area, the reservoir represents an important local source of water and in the same time these reservoirs offer a high contribution at regularization of runoff and to decrease the high floods. Also from this area the reservoirs are important for fish breeding, recreation and other activity from social and cultural life.

Autonomous Administration Romanian's Water considers that on the whole Romania, during 15 years, in reservoirs placed on inner rivers lakes, it was fall about 200,000 millions cube meters sediments (13.4 mil.m^3/ year that means 27% from total years average sediments carry).

The problem of soil erosion, sedimentation and water quality degradation of dam storage is ominously in the world not only in the local area. It requires development of a new global strategy starting with the study of watershed processes and finishing with the draft of land reclamation, exploitation and conservation measures of agricultural lands, of rivers and reservoirs.

Ichim Ionita (1993,1996) considers the fact that only a concept named "sediment systems" can offer an adequate frame for elaborating such strategy who can ensure an adequate frame for elaboration an efficiently strategy. This strategy must assure better processes understanding a pragmatically approach of erosion reducing and reservoir sedimentation. In decision processes from reduce sediments transport, when are interested in reservoir protection, it must accord inters through "sedimentation processes" and "sediments storage" who in sediment system must be looking distinctly but, at time and space scale god define and in connection.

M. Motoc (1984) realise a general view (table 1) concerning provides area reference to lands use and the processes like sediments sources offer total erosion, effluence coefficients and sediment effluence give by sources and processes on Romanian lands.

The analyse of present date (table 1) it come out that: on Romanian lands total erosion is of 126.0 mil. to/year and from these 44.6 mil. to/year there are sediment effluence (0.35 effluence coefficient); provide area point of view: 84.5% (106.8 mil. to/year) are from agriculture area and 15.5% provide from forestry area and bank

rivers; generating processes point of view: about 49.0%-61.8 mil. to/year provide from surface erosion; about 23.6%-29.8 mil. to/year from gully erosion; sheet erosion and gully erosion has a different weight (49.0–23.6%) in total erosion; effluence coefficients on these category are also different (0.26% for sheet erosion and 0.46% for gully erosion), but their contribution at sediment effluence are very near–16.1 million to/year (36.2%) sheet erosion and 13.8 million to/year gully erosion. Following only effluence coefficients, the bigger are for gully erosion (0.46) and for bank and riverbeds erosion (0.54), these tow kind of process erosion take part with 46.3% (20.6 to/year) to total sediment effluence.

Table 1

Erosion and sediments effluence differentiation in Romania (after M. Motoc 1984)

Land use	Total erosion		Effluence coefficient	Sediment effluence	
	mil. to/year	%		mil. to/year	%
Land use category (provide area)					
Arable	28,0	22,3	0,28	7,9	17,7
Pastures	45,0	35,7	0,27	12,3	27,6
Orchards	2,1	1,7	0,29	0,6	1,4
Vineyards	1,7	1,2	0,28	0,5	1,1
Gully erosion (unproductive)	29,8	23,6	0,46	13,8	31,0
TOTAL agriculture area	106,8	84,5	0,32	34,2	78,8
Forestry area (gully erosion and landslides)	6,8	5,4	0,40	2,7	5,9
Bank erosion on rivers	12,6	10,0	0,54	6,8	15,3
Total	126,0	100,0	0,35	44,6	100,0
Erosion forms (generating processes)					
Sheet erosion	61,8	49,0	0,26	16,1	36,2
Gully erosion	29,8	23,6	0,46	13,8	31,0
Landslides	15,0	12,0	0,35	5,2	11,6
Gully erosion and landslides on forestry area	6,8	5,4	0,40	2,7	5,9
Bank and riverbeds erosion on rivers	12,6	10,0	0,50	6,8	15,3
Total	126,0	100,0	0,35	44,6	100,0

In the light of presented problems the study of uncommonly events impact under these reservoirs is a strong necessity because these events increase the gravity of erosion phenomenon who through their consequences guide to degradation of these reservoirs, physical degradation – sedimentation, and chemical degradation – degradation of water quality.

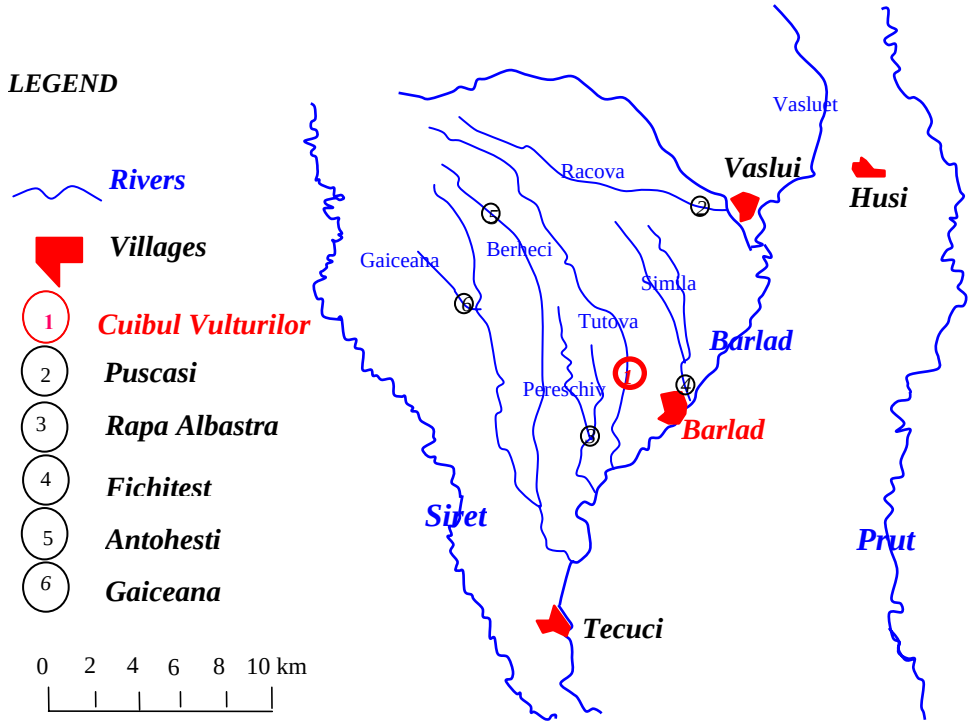
RESEARCH LOCATION

Cuibul Vulturilor reservoir (figure number 1), placed in the lower watershed of Tutova river from Tutova Hills who are placed between Siret and Prut rivers in the south-west of Moldavian Tableland, assure a great part from the drink water for population of Barlad town (about 70 thousandth inhabitants). Water retention is realized from an earth dam (17 meters height and 843 meters length at dam crest) with a central weir and a laterally spillway on the right bank. This reservoir it was taken into exploitation in 1978, with the following characteristics (from Normal Retention Level) provided by project: available water volume – 9,500,000 m^3, dead storage capacity – 300,000 m^3, annual sedimentation ratio – 10,000 m^3.

In 1978, with the help of synthesis hydrological data offered by the National Institute of Meteorology and Hydrology, the National Research and Project Institute for Water Management – Bucharest where made a study regarding the sedimentation of this reservoir who show as:

Figure number 1

Reservoir studded from Barlad river watershed



The affluent flow (in the Tutova control section of the Tutova river – annual mean value) is – 0.86 m^3 per seconds: the alluvial discharge is 0.6 kg per seconds (19.000 to/year) – which corresponds to a specific rate of 0.28 to per hectare and year.

There are two possible sediment deposit area at 3 – 5 km and 7 – 9 km from the dam, whose thickness after 50 years could reach an average value of 1 to 1.5 m's.

The average volume of these deposits area could reach 1000000 m^3, fifty percent of which would be situated under the permanent water area. This study shows that the dead storage capacity of the reservoir - 300000 m^3, will be reached in 30 years of exploitation.

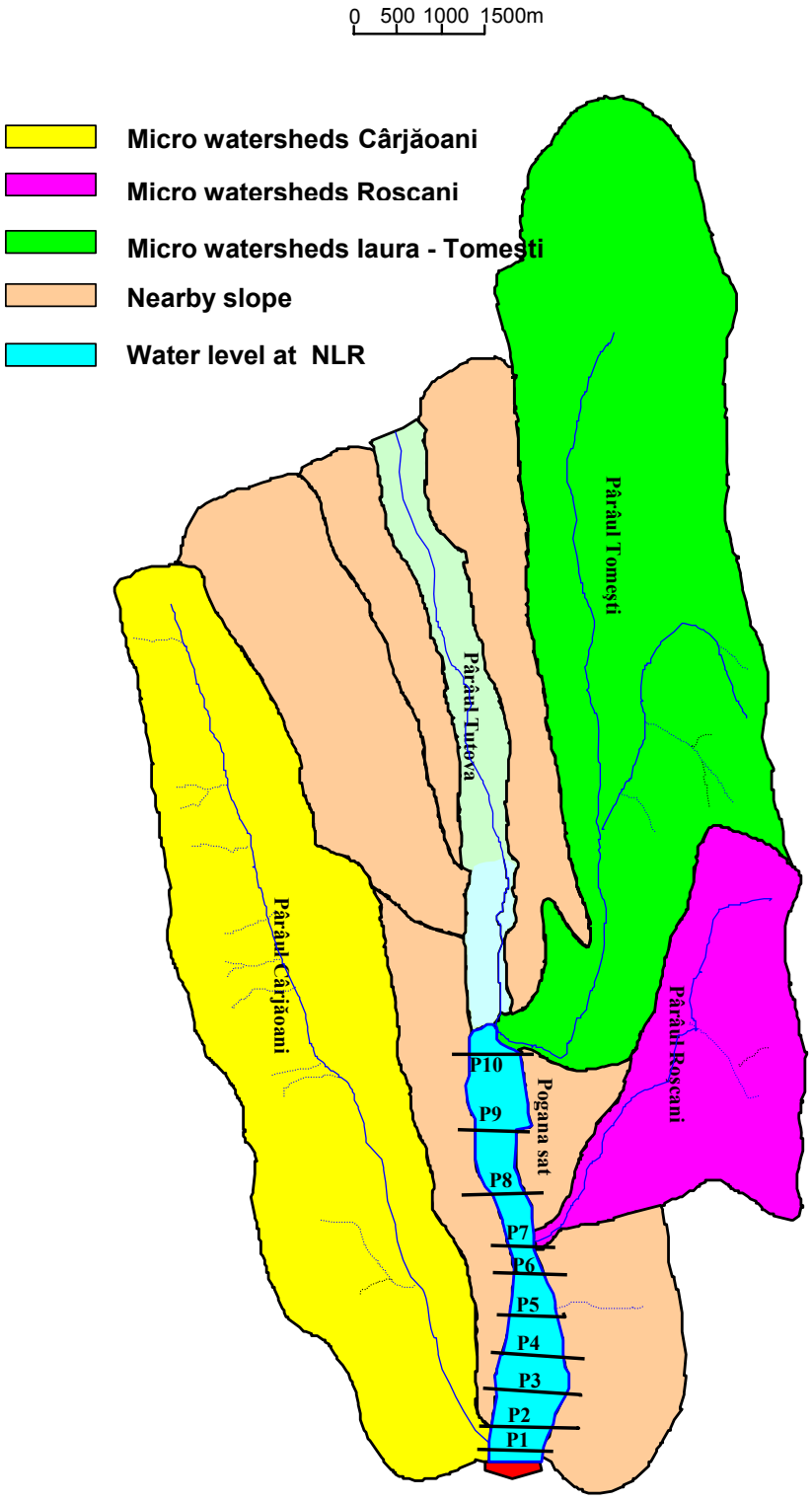
According to annual mean sedimentation ratio in this reservoir yearly enter about 221.430 m^3 sediments but from the area located in the vicinity of the reservoir enter about 98.755 m^3 sediments that mean 65 percent from all sediments step in the reservoir in one year. From these volume of sediments that provide from the area located in vicinity of the reservoir 13.1 percent provide from the hill slopes and 86.9 percent provide from the micro watersheds. This value show that the contribution of the watersheds located in vicinity of reservoir direct overflow in the reservoir is the most important quantitative in comparative with the hill slopes (Purnavel, 1999).

RESEARCH METHOD

It was establish the excessive influence area looking the impact of erosion processes of Cuibul Vulturilor reservoir represented from five areas make up from micro watersheds directly flow into the reservoir (figure number 2), Surface of these area is from 5,727 ha, that represent 10.5 % from all Tutova watershed area (54,000 ha). In these area it was make erosion and sediments effluence determinations who, at least it was analyzed in complex with the rate and mode of reservoir sedimentation's.

Figure number 2

Cuibul Vulturilor Reservoir – excesive influence area



It was catalogued the natural conditions and prevalence dominates erosion's form from watersheds and the effect of these erosion forms, equipped and unequipped, through determinations and examinations on the sedimentation reservoir. At the same time it was establish sedimentation rank and it was also estimate average year ratio of sedimentation. Thus it was praised the different

contribution from proceeding area and generating process to reservoir's sedimentation, the different give than the erosion forms and from the way of erosion equipment or the absence of these. All this to establish a specifically draft frames to decrease more possible the sedimentation process.

It was made an inventory of the uses of lands from these areas are presented in Table nr. 2

Table 2

Cuibul Vulturilor reservoir, land use in the excessive influence area looking the impact of erosion processes

Land use	UM	Total	Din care				
			Cârjăoani	Roşcani	Iaura Tomesti	Left side	Right side
Arable	ha	2800.4	1237.4	254.5	867.7	194.8	196
	%	48.9	66.1	34.3	38.7	37.6	62.0
Pastures	ha	1560.7	302.6	373.2	692.8	122.2	119.5
	%	27.3	16.2	50.3	30.9	23.6	37.8
Total agriculture	*ha*	*4361.1*	*1540.0*	*627.7*	*1560.4*	*317.0*	*315.9*
	%	*76.2*	*82.3*	*84.6*	*69.6*	*61.2*	*89.5*
Forestry	ha	850.4	207.6	46.7	526.9	38.9	30.4
	%	14.8	11.1	6.3	23.5	7.5	8.6
Buildings	ha	260.2	62.6	0.0	51.6	146.1	0.0
	%	4.5	3.3	0.0	2.3	28.2	0.0
Unproductive	ha	255.1	61.7	67.5	103.1	16.1	6.7
	%	4.5	3.3	9.1	4.6	3.1	1.9
Total	ha	5727.0	1872.0	742.0	2242.0	518.0	353.0
	%	100	100	100	100	100	100

It was also made measurements (estimations) from runoff and erosion in these excessive influence area.

These measurements were effectuated at different events (brusque snow thawing, rain events with height quantity or a long standing) that produced runoff and erosion. The measurements were consisting in: following and registration of variable level in reservoir and the registration of water volumes that enter in this, at different events; drawing and analysing water probes entering in reservoir direct from excessive influence area, at different events and rebuild the flood discharge and speedy measurements concerning surface erosion through streaming and gutters.

The detecting and analyses concerning degree of embody with fertiliser elements were made only for letting out water. For detecting and analyse concerning of degree of sediments it was necessary high quantity of sediments for analyses that make these an extreme laborious thing. To supply these detecting of fertiliser carry out of sediments it were make resort to long term measure from standard lots of runoff control from Soil Erosion Control Research and Development Centre Perieni (table number 3).

In the excessive influence area concerning the impact of erosion processes of Cuibul Vulturilor reservoir it was practice a private agriculture system but the large lots are from 0.5 to 1.0 ha and the crops structure is 50% cultivator plants, 40% cereals and 10% pasture, structure tacked in detecting calculations of effluence of fertilisers. During fast snowmelt the cultivator plants were consider to be ploughed (autumn ploughing).

Table 3

Means fertilisers lost at Standard plots erosion control from Soil Erosion Control Research and Development Centre Perieni (a long term annual mean value)

Crop	%	N mineral	P_2O_5	K
cultivator plants	%through water	3.96	16.6	30.7
	%through soil	96.04	83.4	69.3
cereals	%through water	12.1	39.5	65.7
	%through soil	87.9	60.5	34.3
pasture	%through water	62.5	83.8	94.2
	%through soil	37.5	16.2	5.8
ploughed	%through water	1.46	15.25	19.69
	%through soil	98.54	84.75	80.31
crops rotation is 50% cultivator plants, 40% cereals and 10% pasture (torrential rainfall and long term rains)	%through water	13.07	32.48	51.05
	%through soil	86.93	67.52	48.95
crops rotation is 50% ploughed, 40% cereals and 10% pasture (fast snowmelt)	%through water	11.82	31.80	45.55
	%through soil	88.18	68.20	54.45

The sedimentation of these reservoir, at NLR (normal level retention-semi permanent average exploitation level), was set by bathymetric and topographic measurements on a different number of transverse profiles. These profiles were remade first after 4 then after another 3 years (only some of the profiles, seen as typical for the description of the sedimentation process). Also these profiles were remade after a year with different events. In order to achieve these measurements and to re-make them at various intervals (3 or 4 years) transverse profiles were materialised, which cover the whole water table of the reservoir, spaced off 100 to 500m. Along the length of these profiles bathymetric measurements were made every 30m (by means of a cable with fixed spaced floats) on a floating platform mechanically powered. These were followed by topographic measurements on both banks, in order to provide a reliability of 1.0 $^0/_{00}$.

RESULTS AND DISCUSSION

Specifically area's natural conditions reflected in general sedimentation system review it was manifested by the help of tow major elements:

The positioning in a temperate continental climate's: the torrential rain frequency is more than 20% and the aggressiveness rain factor is K_a= 0.13. The Bârlad watershed rivers are operating through: an unstable winter regime and the attenuation of big spring water (about 40% from cases); the winter leakage volume are like in summer (represent 16-22% and respectively 21-22% from yearly leakage volume; the autumn leakage is only 15% from yearly leakage volume; the most yearly discharge flow is produced in only 50% from case in summer.

The control factors regime of sediment production: the leaking coefficients are very high C_s = 0.39-0.42 (slope of 16-38%); the prevalent silting facieses are favour a high density of gully erosion forms (0.8-1.0 kilometres/square kilometre and depth more then 15-20 metres) and area soils moulded in common on feeble bed rooks (gray; brown podsol and podsols; leached chernozems), have an very high erodabillity factor S = 0.8-0.9;

Erosion from excessive influence area concerning sediments transport

The studies of uncommonly events impact under these reservoirs were made during the fast snowmelt from february-march and during the long term rains.

In the area regarding sediments transport of reservoir, there are all erosion forms less then landslides. On the agricultural land with same slope sheet erosion

was between 10 to 12 to/hectares on equipped lands and was between 30 to 35 to/hectares on unequipped lands. Sheet erosion on the unequipped area is about three times large then sheet erosion of equipped area.

During the fast snowmelt from february-march 1996 (in the same area) it was making on the left bank upstream of dam, a slope gully (about 235–250 meters length, 4-10 meters depth). From this slope gully, in reservoir, it was entering 5,400 m^3 sediments (estimated) (picture number 1 and 2).

Picture nr.1

Picture nr. 2

Concerning the gully erosion in the third lower part of equipped slope gully every year it appear under washing processes materialised through 3–4 rapids from 0.5–1.5 meters. As result of these rapids where eroded about 80–120 m^3/rapid of material who are going to the reservoir like sediments. On the valley gully, equipped with crossing sedimentation control works, the alluvial deposits usually are at the level of the weir but scouring phenomenon is appearing on the intervals of sedimentation control works. These scouring phenomenon produce about 2,400-m^3/km length that is going to the reservoir like sediments.

The alluvial and fertiliser effluence from excessive influence area

Analysing waters sample gathered (picture number 1 and 2) and processes their results it was determinate the rank of embody with sediments and fertilisers who at least make possible the estimation of sediments and fertilisers effluence from each micro watersheds (table number 4)

Picture nr.3

Picture nr. 4

The runoffs were considered to be produce on all surface of influence area at the same time with same amplitude. In these hypothesis making the ratio between the water volume coming into reservoir and surface of these excessive influence area were determinate the runoff volume afferent of each micro watersheds.

Tabelul 4

The alluvial and fertiliser effluence from excessive influence area of Cuibul Vulturilor reservoir Tutova watersheed

Specification	MU	Left slope	Roşcani	Iaura-Tomeşti	Cârjãoani	Right slope	Rank to ha	Total surface
Surface	ha	518	742	2242	1872	353		5.727
Fast snowmelt from february-march 1996								
Water volume going into the reservoir	mc	40,313	57,746	174,482	145,687	27,472	77,82	445,700
Sediment effluence	mc	7,209	28,219	5,831	22,024	2,807	11,54	66,090
Elements going in through water								
$N_{mineral}$	kg	82.04	91.51	360.72	233.62	54.97	0.14	822.85
P_2O_5	kg	8.48	12.60	48.40	50.26	3.48	0.02	123.21
K_2O	kg	155.19	366.04	1.660.69	1.277.57	106.73	0.62	3.566.22
Elements going in through sediments								
$N_{mineral}$	kg	603.40	673.05	2.653.02	1.718.22	404.28	1.06	6.051.97
P_2O_5	kg	18.00	26.74	102.75	106.71	7.38	0.05	261.59
K_2O	kg	166.79	393.40	1.784.82	1.373.07	114.71	0.67	3.832.78
Elements going in through water and sediments								
$N_{mineral}$	kg	685.44	764.56	3.013.74	1.951.84	459.24	1.20	6.874.82
P_2O_5	kg	26.47	39.34	151.14	156.98	10.86	0.07	384.80
K_2O	kg	321.98	759.43	3.445.50	2.650.64	221.44	1.29	7.399.00
Long term rains 1996 121,6 mm Cuibul Vulturilor reservoir area								
Water volume going into the reservoir	mc	24,132	34,567	104,447	87,210	16,445	46,59	266,800
Sediment effluence	mc	7,281	33,165	7,222	29,470	76	13,48	77,214
Elements going in through water								
$N_{mineral}$	kg	59.11	38.25	184.50	80.22	35.10	0.07	397.17
P_2O_5	kg	4.87	7.01	18.43	22.92	2.79	0.01	56.02
K_2O	kg	67.42	113.60	593.83	658.52	40.82	0.26	1.474.19
Elements going in through sediments								
$N_{mineral}$	kg	393.14	254.37	1.227.16	533.52	233.46	0.46	2.641.65
P_2O_5	kg	10.13	14.56	38.32	47.64	5.80	0.02	116.46
K_2O	kg	64.65	108.93	569.40	631.43	39.14	0.25	1.413.55
Elements going in through water and sediments								
$N_{mineral}$	kg	452.25	292.62	1.411.67	613.74	268.56	0.53	3.038.83
P_2O_5	kg	15.00	21.57	56.76	70.56	8.59	0.03	172.48
K_2O	kg	132.07	222.54	1.163.23	1.289.95	79.95	0.50	2.887.75
Water volume going into the reservoir	mc	64,445	92,313	278,929	232,897	43,917	124,41	712,500
Sediment effluence	mc	14,490	61,384	13,053	51,494	2,883	25,02	143,304

In 1996 at uncommonly events that cause runoff phenomenon it was realised different runoff coefficients 0.67 at fast snowmelt and 0.38 at long term rains. Also the sediment effluence is different 46.12% at fast snowmelt and 23.88 % at long term rains. Though sediment effluence is little at fast snowmelt about 70% from fertiliser effluence were realised then because predominant was sheet erosion in contrast with long term rains when the sediment effluence is bigger predominant was gully erosion

who liveliness sediments from banks and bottom of gully poor in fertiliser (table number 5).

Table 5

The alluvial and fertiliser effluence, percentage on events, from excessive influence area of Cuibul Vulturilor reservoir Tutova watersheed

Fertiliser element	Left slope	Roşcani	Iaura-Tomeşti	Cârjãoani	Right slope	Total surface
Fast snowmelt from february-march 1996						
$N_{mineral}$	60,25%	72,32%	68,10%	76,08%	63,10%	69,35%
P_2O_5	63,83%	64.59%	72.70%	68.99%	55.84%	69.05%
K_2O	70.91%	77.34%	74.76%	67.27%	73.47%	71.93%
Efl. Aluv.	49.75%	45.97%	44.67%	42.77%	49.53%	46.12%
Long term rains 1996 121.6 mm Cuibul Vulturilor reservoir area						
$N_{mineral}$	39.75%	27.68%	31.90%	23.92%	36.90%	30.65%
P_2O_5	36.17%	35.41%	27.30%	31.01%	44.16%	30.95%
K_2O	29.09%	22.66%	25.24%	32.73%	26.53%	28.07%
Efl. Aluv.	50.25%	54.03%	55.33%	57.23%	50.47%	53.88%

Tablel 6

The alluvial and fertiliser effluence, percentage on source area, from excessive influence area of Cuibul Vulturilor reservoir Tutova watershed

Fertiliser element	Left slope	Roşcani	Iaura-Tomeşti	Cârjãoani	Right slope
Fast snowmelt from february-march 1996					
$N_{mineral}$	9.97%	11.12%	43.84%	28.39%	6.68%
P_2O_5	6.88%	10.22%	39.28%	40.80%	2.82%
K_2O	4.35%	10.26%	46.57%	35.82%	2.99%
Efl. Aluv.	10.91%	42.70%	8.82%	33.32%	4.25%
Long term rains 1996 121.6 mm Cuibul Vulturilor reservoir area					
$N_{mineral}$	14.88%	9.63%	46.45%	20.20%	8.84%
P_2O_5	8.70%	12.51%	32.91%	40.91%	4.98%
K_2O	4.57%	7.71%	40.28%	44.67%	2.77%
Efl. Aluv.	9.43%	42.95%	9.35%	38.17%	3.70%
Total events in 1996					
$N_{mineral}$	11.48%	10.66%	44.64%	25.88%	7.34%
P_2O_5	7.44%	10.93%	37.31%	40.83%	3.49%
K_2O	4.41%	9.55%	44.80%	38.31%	2.93%
Efl. Aluv.	10.11%	42.83%	9.11%	35.93%	3.95%

Concerning source area (table number 6) of sediments 14.06% provide from the nearby reservoir water slope and 85.94 % provide from micro watershed who entering direct into the reservoir.

The source of fertiliser are more non homogeneous because the land use of source area are different. From the nearby slope provide 18.82% from $N_{mineral}$, 10.93% from P_2O_5 and 7.34% from K_2O. From micro watershed who entering direct into the reservoir provide 81.18% from $N_{mineral}$, 89.07 from P_2O_5 and 92.66% from K_2O.

During these uncommonly events water quality from reservoir are not affected in the plug area (water from reservoir are utilised like drink water source from Barlad town.

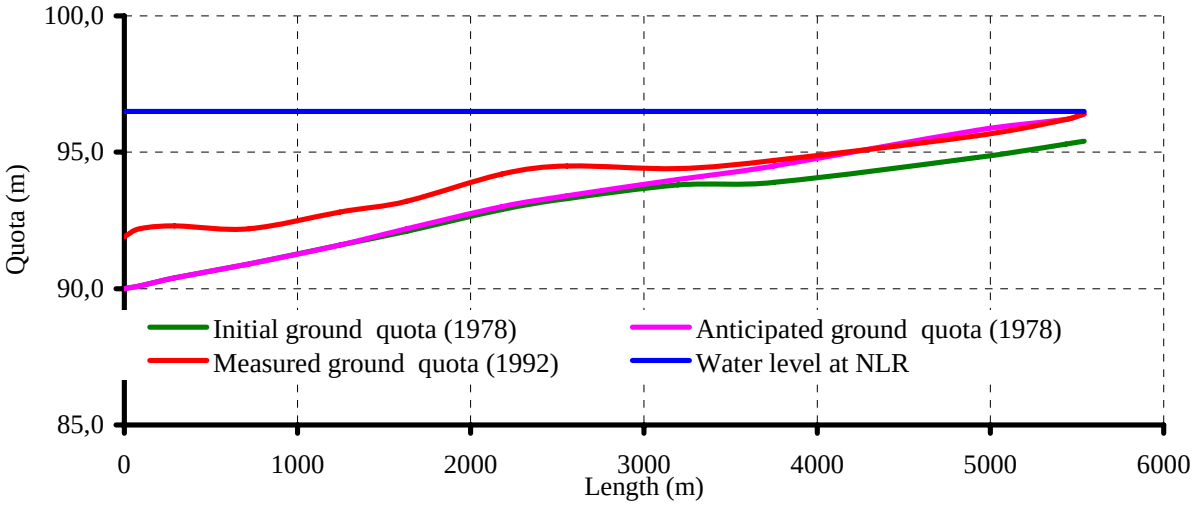
Rank and distribution of sedimentation

According to annual mean sedimentation ratio in this reservoir yearly enter about 221,430 m^3 sediments but from the area located in the vicinity of the reservoir

enter about 143,304 m^3 sediments that mean 65 percent from all sediments step in the reservoir in one year. From these volume of sediments that provide from the area located in vicinity of the reservoir 13.1 percent provide from the hill slopes and 86.9 percent provide from the watersheds. This value show that the contribution of the watersheds located in vicinity of reservoir direct overflow in the reservoir is the most important quantitative in comparative with the hill slopes (Purnavel, 1999).

Concerning the distribution of sediments it were analysed comparatively the longitudinal profile (Figure 1) and two cross profiles (Figure 3 and 4), which were considered typical for the description of the sedimentation process. This analysis outlines the thickness and the distribution of sediments.

Figure 1 Longitudinal profile through Cuibul Vulturilor reservoir



The thickness of the deposited sediment throughout the length of reservoir has maximal values close to dam, thinning out to the end of the reservoir.

On the small reservoir (depth of water between 2 to 4 meters) with the watershed identifying with excessive influence area regarding sediments transports the results remark a relative uniform distribution of sediment deposits on longitudinal and cross profiles. On bigger reservoir, where the excessive influence area regarding sediments transport is between 2 and 10 % from watershed area, but these are order of same thousand hectares (comparatively with all watershed of the small reservoir) situation are different. The restoration of bathymetric and topographic profiles (picture number 5 and 6) from 1992, on the same alignments, in 1995 and 1997, permitted, by comparing them, to differentiate the thickness of deposited sediment at different areas of the reservoir. The initial profile from 1978 was realised with the help of topographical plans (scale 1/5,000).

Picture nr. 5

Picture nr. 6

The cross profile **P_1**, situated in the area of direct influence of watershed Cârjăoani (with a valley gully as the predominant form of erosion):

- After fourteen years of exploitation, the deposits are unevenly with a thickness of 2.5 m on the left bank, 1.8 m in the central area and 3.5 m on the right bank. In this case the average annual ratio of sedimentation was 0.16 – 0.13 – 0.25 m. throughout the length of the profile.

- In one year, with uncommonly events, the deposits were relatively evenly distributed 0.20-m on the left bank, 0.35-m in the central area and 0.6-m on the right bank. That mean the average annual ratio of sedimentation is of 2 or 3 bigger throughout the length of profile;

Figure 2 Cross profile P1

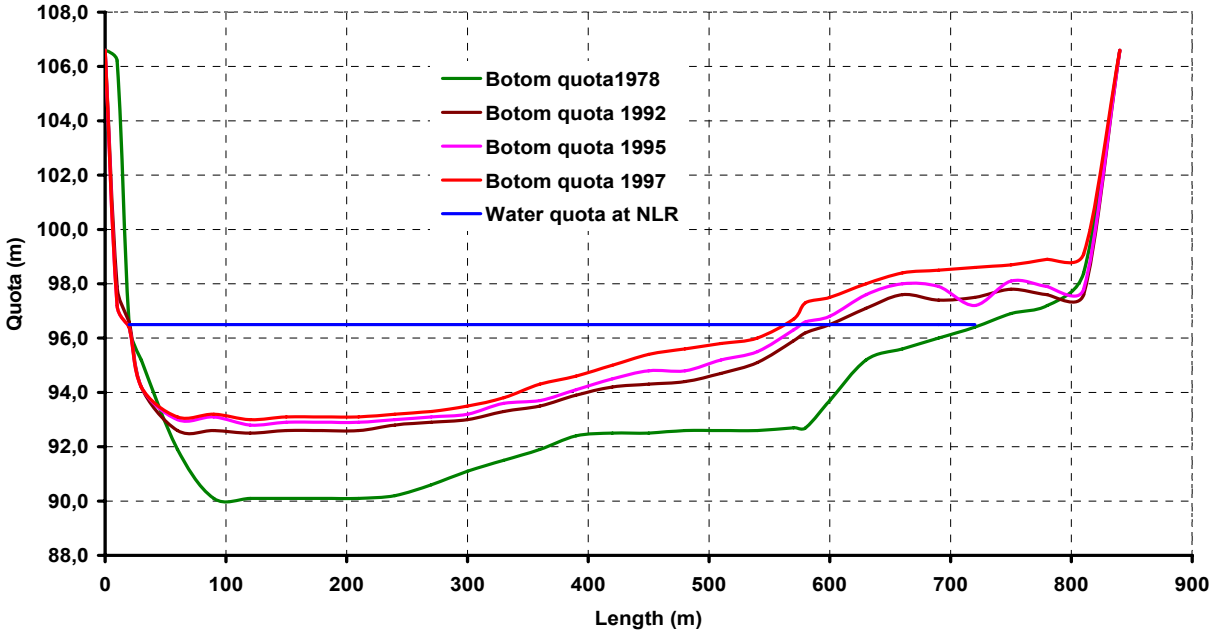
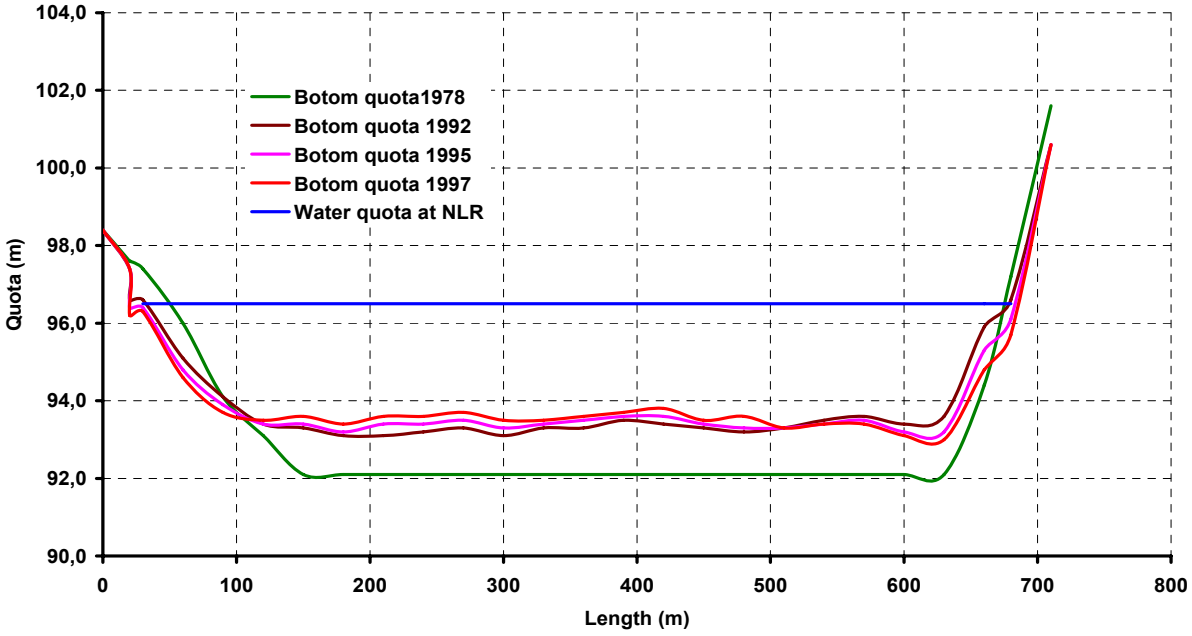


Figure 3 Cross profile P4



The cross profile **P_4**, situated in an area without the direct influence of a watershed area, only with the influence of a nearby hill:

- After fourteen years of exploitation the deposits were fairly evenly distributed with a thickness of 1.2 m on the left bank, 1.4 m in the central area and 1.5 m on the right bank. The average annual ratio of sedimentation was 0.09 – 0.10 – 0.11 m. throughout the length of the profile;
- In one year, with uncommonly events, the deposits were fairly evenly distributed 0.11-m on the left bank, 0.12 m in the central area and 0.14 m on the right bank. The thickness of the sediment grows to the centre of the profile and fingers out to both banks, as the result of the lower charges of hill stream flows.

Conclusions

In unequipped area sheet erosion were about three time bigger then same erosion on equipped area with erosion control works;

In influence excessive area there are an high level of risk to formed of the slope gully in placed with concentration of letting out (micro depressions and exploitation road placed up and down of slope);

In the absence of a good erosion control works on gully erosion in the third lower part of equipped slope gully every year it appear under washing processes;

Unusually events have an essentially contribution in sedimentation process of reservoir through higher sediment effluence comparatively with mean annual sediment effluence who usually is take in calculation to establish the sediment volume in projection of reservoirs;

The excessive influence area represented by area placed nearby of permanent water level contributes with more then 65% at sediment retrieving and implicit at sedimentation phenomenon:

The greatest sediment volume from this area is from micro watersheds that directly enter into the reservoir (86.9%) comparatively with nearby slope (13.1%);

During the fast snowmelt enter about 70% from fertilisers (69% $N_{mineral}$, and P_2O_5 respectively 72% K_2O) that because predominate form of erosion are sheet erosion in contrast with long term rains were the predominate form of erosion was gully erosion who carry out solid material from bank and bottom of gully;

The essential contribution in fertiliser it was confer, like in the case of sediments, by micro watersheds with directly enter into the reservoir, between 81% and 91%;

For a good protection of reservoirs the priority are the equipped with erosion control works and a good erosion exploitation of excessive influence area, these area usually are about 10% from all watershed who supply the reservoirs.

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