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RESEARCH CONCERNING THE EFFECT OF THE TORRENTIAL HYDROGRAPHIC NETWORK MANAGEMENT WORKS IN THE UPPER WATERSHED CÂRCINOV RIVER

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Abstract: *Taking into consideration the measurements data one has established that the siltation created by the transverse hydrotechnical works done in the superior watershed of Cârcinov river siltation are extending on a torrential valley length of 840 meters, covering a surface of 1.5 hectares and engaging/accumulating an alluvia volume of approximately 5600 cubic meters. For the three analysis parameters (siltation length, siltation surface and siltation volume) one has established mean unitary values on classes of the clogging height, thus considering that the polynomial function best approximates the general tendency of this mean's variations.*

Key words: *works effect, torrent control, hydrotechnical works.*

1. Introduction

As it is known, the effect of work management on the torrential network from the small predominantly forested watersheds, can lead to/have multiple effects which manifest themselves on hydrological, antierosional, economical and social plans.

It is difficult to establish a global effect of these works since one does not know at a certain time all the damage to be diminished by doing these works, one can not evaluate in quantity terms all the positive influences of these works at an economical, ecological and social level; these influences manifest themselves at a longer period of time than the works calculated service period and are to be felt not only in the watersheds in which it was done but also in the collector downstream hydrographic watersheds [1], [3], [4], [7], [10], [11].

The effect of the works mentioned above express at least three closely correlated aspects [5], [7]: the hydrological aspect (of reducing the torrential flow), the erosion aspect (of erosion control and of alluvia transportation) and the protection aspect of the objectives endangered by floods.

Since, on short term, the aspect regarding the protection of the objectives endangered by floods is the most important, one the results of a research done on this domain, will by next presented. The research was achieved in a hydrographic area of the

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Fig. 1. *The consolidation of a torrential riverbed through the mean of hydrotechnical works, in the Upper Cârcinov watershed. Photo: Tudose, 2009*

country with an intensely torrential and erosional character, the Cârcinov watershed (Cârcinov a word with Slavonic origin meaning "deforestation") (Figure 1).

2. Research Location and Method

Into the research development all the nine torrential valleys from the river Cârcinov superior watershed have been taken into consideration (upstream of Boţeşti, Argeş), hydrographical networks which have been managed with hydrotechnical works of torrent control since 1984 [6].

During field measurements one has identified 58 hydrotechnical transverse works from which: 24 traverses (41%), 14 sills (24%) and 20 dams (35%).

On the basis of the measurements obtained data, one has estimated the alluvia quantity stopped by these works (through retention and consolidation), the results being expressed using two indicators from anterior research [8], [9]:

- direct retention, assured by the transverse works (dams and sills) and represented in quantity by the siltation volume already formed or in course of formation;
- the consolidation retention, assured both by the transverse works and also by the longitude hydrotechnical works (evacuation canals), represented by the alluvia volume which would have been drawn and would have been transported from the torrential hydrographic network to be managed, in the hypothesis that the works at which we refer would have never been done.

As a consequence, the consolidation of the torrential hydrographic network has three components [2]:

- the direct consolidation retention by covering the riverbeds, expressed in the consolidated length and surface of the managed hydrotechnical works in the so called placement (both for the transverse works and for the longitude ones);
- the indirect consolidation retention, by siltation, which is a consequence of direct retention and it is measured by length and surface of the siltation of the transverse hydrotechnical works;

- consolidation retention due to reciprocal sustainability done by the traverses; it has been evaluated for the riverbed length resulted from the condition that, at a no slope between two successive traverses, the eroded depth of the traverse's vertical on upstream does not pass one meter.

From the three retention by consolidation components we are only interested as far as the following only in the indirect consolidation retention (by siltation), being a consequence of the direct retention. One can express this component by the length and surface of the siltation formed by the transverse hydrotechnical works.

Consequently, one has quantified three elements throughout field observation: siltation length (Lat), measured on field with the measuring tape, the siltation surface (Sat), determined as a multiplication between the length and the width of the siltation and the volume between the alluvia and the siltation (Wat):

$$\text{Wat} = 0.167 \cdot \text{Yat} \cdot \text{Lat} \cdot (2b + B), \qquad (1)$$

in which: Yat is the clogged height of the hydrotechnical works; b - the width of the riverbed in the zone of the work placement; B - the width of the valley at the siltation level, measured in the section of the work placement.

With all these elements measured on field and written on special forms, one could build a data basis using the Microsoft Access program, data basis which by different types of interrogations has facilitated the analysis regarding the researches effect.

3. Results and Discussions

3.1. The Length, the Surface and the Volume of the Siltation, On Torrential Valleys

By interrogating the Microsoft Access database (Figure 2), the siltation created upstream the transverse hydrotechnical works from Cârcinov Upper Watershed is extended on 840 m length on the valley, covering a 1.5 ha area and stoking 5 600 m^3 of alluvia volume.

id_lucr	Yat	b(metri)	B(m)	Lat	Panta%	Sat mp	Wat mc
va9B	0,5	19	23	12	3	276	61
va11B	0,8	6	13	27	2	351	90
va12B	0,4	10	13	14	3	182	31
va13B	0,2	10	17	14	4	238	17
va14B	0,8	11	17	12	2	204	63
va15B	0,6	13	16	15	5	240	63
va16B	0,3	10	13	12	4	156	20
va17B	1,1	13	16	30	2	480	231
vs4B	0,4	6	15	13	3	195	23
vs5B	0,8	6	12	10	4	120	32
vs6B	1,5	10	17	38	3	646	352
vs9B	0,5	12	18	20	4	360	70
vs13B	0,8	9	19	40	4	760	198
vco1B	1,5	5	14	18	2	252	108
vco3B	1,5	9	14	23	3	322	184
vpe1B	0,9	12	20	45	3	900	298
vpe2B	1,5	11	25	30	3	750	353
vre2B	0,4	10	18	20	3	360	51
vre4B	0,7	9	12	30	3	360	105
vpe3B	1,5	27	40	25	6	1000	589
vpe5B	2,3	6	12	20	3	240	184
vcl3B	1	10	15	20	4	300	117
vcl4B	1	8	12	15	4	180	70
vro1B	0,6	7	12	15	4	180	39
vro2B	1	9	13	18	4	234	93
vro4B	1	7	17	40	5	680	207
vm1B	1	10	16	20	3	320	120
vm2B	1,5	9	20	30	4	600	286
vm3B	2	9	15	80	7	1200	882
vpu1B	1	6	10	25	3	250	92
vpu2B	1	10	16	25	5	400	150
vpu3B	0,6	8	14	19	4	266	57
vpu4B	0,4	30	40	50	3	2000	334
vpu5B	0,5	10	14	15	3	210	43
Total				**840**		**15212**	**5614**

Fig. 2. *Summed up evidence of Lat, Sat and Wat* [12]

By following the distribution of the three analyzed characteristics (Lat, Sat and Wat) for the nine managed torrential valleys one can see that (Figure 3):

- following the total length of the siltation created by the transverse hydrotechnical works can be detached: Anghel Valley (with 136 m); Purcăreţii Valley (with 134 m); Mălăeşi Valley (with 130 m); Şipot Valley (with 121 m) and Perilor Valley (with 120 m);
- taking into consideration the siltation surface, the hierarchy is different than the previous one since the torrential valleys length interfere strongly influences this surface thus the order being the following: Purcăreţii Valley (with 0.30 ha), Perilor Valley (with 0.30 ha), Anghel Valley/Mălăeşi Valley (with 0.21 ha), Şipot Valley (with 0.29 ha) and Rotării Valley (with 0.10 ha);
- in what the siltation volume is concerned, the detachment is highlighted almost in double value of the two controlled torrential valleys (Perilor Valley, with 1424 m^3 and Mălăeşi Valley with 1288 m^3), these valleys being followed by the Purcăreţii Valley/Şipot Valley with 676 m^3.

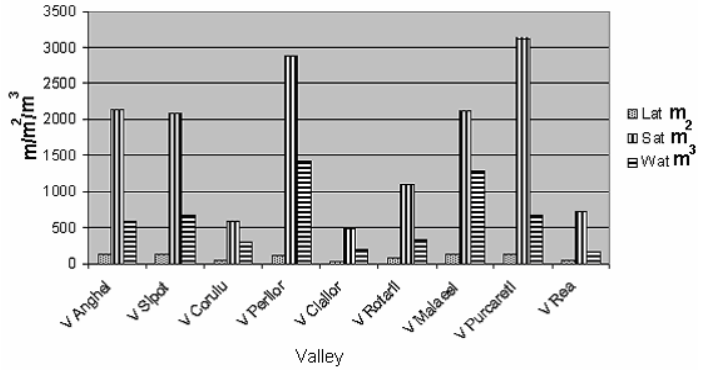

Fig. 3. *Lat, Sat and Wat, in absolute value, for the nine valleys managed on the superior watershed of Cârcinov River*

In order to be able to easily follow the distribution of the three elements mentioned above and to be able to compare then we have used a common representation of the analyzed data, the variables on Lat, Sat and Wat not being considered in absolute value anymore but in percent expression as to the total. One has obtained the Figure 4 where we can see:

- a more evident detachment for Perilor Valley, Mălăeşi Valley and Purcăreţii Valley, from the point of view of all the researched variables;
- the percent proportions (differently represented) contain hierarchies which differ from one valley to the other;
- percent proportions increasing from Lat to Wat characterizing only Perilor Valley where, due to the large width of the riverbeds but also due to the number and/or

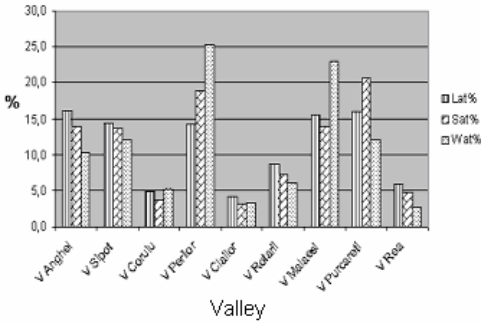

Fig. 4. *Lat, Sat and Wat, in per cent value from the total on the entire watershed*

the height of the works, most evident is the siltation volume, which is followed in order by the siltation surface and the siltation length;

- with a reverse distribution of the analyses variables, meaningly presenting decreasing percent proportions from Lat to Wat (with the evidence of the siltation length and not of the siltation volume) appear at: Anghel Valley, Şipot Valley, Rotării Valley and Rea Valley.

Here we have mostly a larger number of works with a smaller height, part of which not being totally clogged;

- the siltation identified surface with the biggest percent value in the other two detriment was identified in the case of only one valley, Purcăreții Valley; the explanation could be that the large width of the riverbed and the height reduced clogged have determined the large value of the siltation surface compared to the other elements (Lat and Wat).

3.2. The Length, the Surface and the Volume of the Siltation, On Classes of Heights

Further on one has researched the distribution of the three terms (Lat, Sat and Wat), in percent value, on groups of heights of the transversal hydrotechnical works, the group interval being of 0.5 m (Figure 5).

Thus one can notice that the works from the two classes (1.0-1.5 and 1.5-2.0 m) cumulate more than half of the values of terms Lat, Sat and Wat. On the first place we have the works from the sills category (1.0-1.5 m), which participate at a 26% to defining the siltation length, in proportion of 29% to defining the siltation surface and in 32% to defining the siltation volume.

The fact is that at so small heights (1.0-1.5 m) Wat is highlighted as to Sat and Lat is explainable through the fact that not only the height influence decides upon the three terms.

Moreover, we also have influences from other factors such as the riverbed width and the siltation slope. Either, the works from group of height (1.0-1.5 m) are put on torrential valleys where the width of the riverbed (B) is larger than in the case of height group (2.5-3.0 m).

Following, for the three analyze parameters (Lat, Sat and Wat), unity mean values on groups of the clogged height have been established. In this aim one has decided to group the data on classes of height since the initially established range (0.5 m) could not offer explicit results from this point of view. The newly established group range is of 0.3 m.

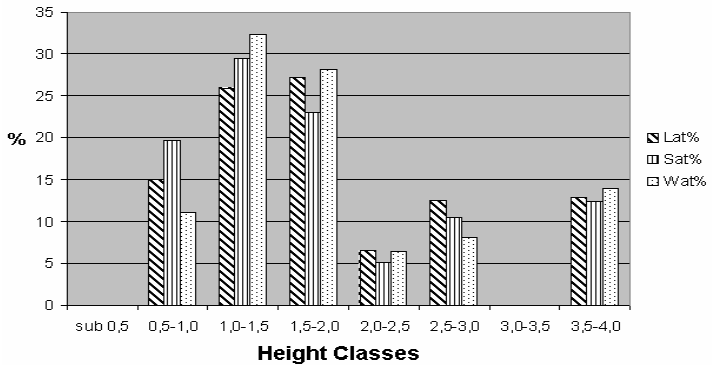

Fig. 5. *Lat, Sat and Wat, in percent value, on height classes*

With these final data we realized the graphics from Figures 6-8, which show us that the increase rhythm of the analyzed parameters is slower in the sills domain and more emphasized in the dams domain.

In what the general tendency of variation of the obtained mean is concerned one has found that the polynomial function best approximates this tendency, the determination coefficient (R), presenting higher values especially in the last case (Wat).

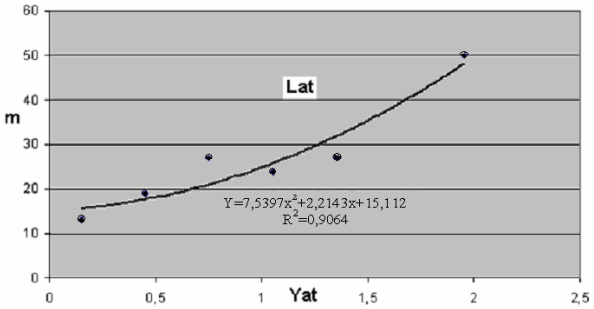

Fig. 6. *The Lat (y) mean on height groups Yat (x) and these mean regression after the polynomial function*

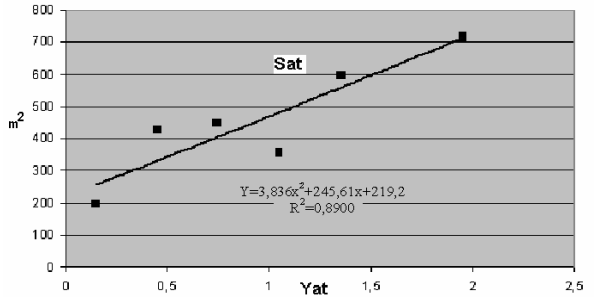

Fig. 7. *The Sat (y) mean on height groups Yat (x) and these mean regression after the polynomial function*

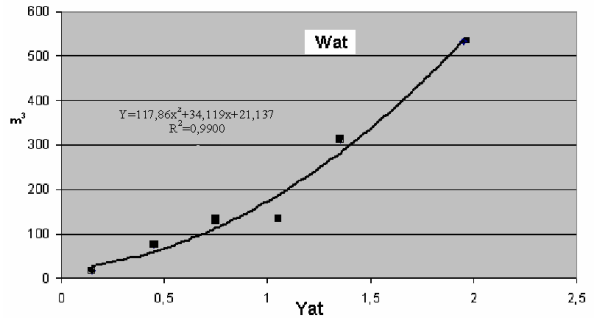

Fig. 8. *The Wat (y) mean on height groups Yat (x) and these mean regression after the polynomial function*

4. Conclusions

On short term, the knowledge development referring to consolidating the torrential hydrographic network is not only justified but also useful, since the resulted data from the quantity research of the effects of the works done on the torrential hydrographic network are relatively little given that the number of managed torrential watersheds is relatively large.

But, with all this opportunity, just a type of research like this cannot also respond also to the extremely important aspect regarding the hydrological effect of the management actions, since, lacking the rain and hydrometric equipment, one cannot register neither on the torrential rain parameters and neither on the registered discharges during torrential floods.

This is why simultaneously with the research of which results are exposed in the presented paper we also have organized hydrological research on experimental surfaces. One opens thus the possibility that the effects of the hydrotechnical works of torrent control to be also analyzed in correlation with the hydrological effects of the forests on the neighbor slopes of the hydrographic network throughout the watershed.

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