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STUDIES ON THE LAND IMPROVEMENT PROTECTION WITHIN THE PROCESS OF ARRANGEMENT OF STOENESTI HYDROLOGICAL BASIN

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Abstract: The work refers to the problem of damage of the lands as a result of the floods occurred in the lately years in BH. Stoenesti. The surface considered in this study is of 2521 ha. The referred land is crossed by the feeders of Dambovita River in the Northern sector of Arges River which lead to the setting off of the new processes of soil damage as well as the reactivation of the old ones resulting in the malfunction of the objectives in the related area. In the late years the extreme weather conditions – heavy rains, high variations of temperature in short periods of time, strong winds etc – occurred more frequently than the multiannual averages which resulted in the increase of the heavy rain amounts within the local hydrographical network with negative effects on the local objectives.

Keywords:liquid flow,slope, basin area, leakage coefficient

BACKGROUND

The demand of actions with stream correction works appeared following the heavy rains recorded between 2004 -2005 which resulted in occurrence of new processes and phenomena of land damage as well as the recurrence of the old one with negative effects on the normal operation of the local objectives, i.e. forestry roads, National Road Târgovişte-Câmpulung, stock of wood and agriculture, inside and outside village areas of Stoenesti locality, the current hydro technical system etc. These phenomena occur mainly depending on the physical-geographical characteristics of the hydrographic network and basin as they are dependent on the: surface and the shape of the basin, versants slope, main river slope, density of the drainage network, rate of forestation, land using, soil structure and the area geological characteristic in case the rock is exposed as they influence the flow of the surface drainage (the outlet function); the speed of the drainage concentration in the hydrographical network (transfer function) as well as the speed of the down river flood (spreading function).

The production function is strongly dependent on the soil structure and on the land use (including the rate of forestation) which ultimately determines the storage capacity of the non-saturated area. The versants and basin's slope, its shape, the density of the drainage network, the slope of the hydrographical network influence the transfer and spreading functions. The negative effect natural factors depend on the initial humidity of the soil in the basin, rocks' friability, existence of the in depth erosion forms (flood trenches, cloughs, streams) whereas the man

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action effect factors depend on the lack erosion protection measures and correction of the flood effects, excessive deforestation along with the breaking of the forestry norms of cutting or of wood waste storage as well as inappropriate agriculture practices. The lack of erosion protection measures result in the increase of the flood occurrence and solid material drag along. The irrational deforestations along with the inappropriate agriculture practices result in the increase of the drainage flow rate with direct influence on both the amount and on the maximum flow rate of the flood, namely on the solid material dragging along.

CALCULATION OF THE LIQUID FLOWS

The methods of calculation of the maximum flow rates of the floods are referred as "Rational formula 1" and "Hourly rain formula", below presented:

Rational formula 1

$Q_{max1\%} = 0.167 \cdot c \cdot i_{1\%} \cdot S$ (1)

Where:

$Q_{max1\%}$ = maximum flow rate at the probability of 1% (m^3 / s);

c = average drainage rate; $i_{1\%}$ = rain intensity with probability of 1% (mm / min);

S = surface of hydrologic basin (ha).

Following calculation elements were used:

Table 1

No.	Specification	Valea Râiosu	Valea lui Andrei	Valea Hota-rului	Valea Măga-rului	Valea Vâja	Valea Țâbra	Valea lui Brusture	Valea Armă-sarului	Ravena Parcela 144	Valea Runcu-lui
0	1	2	3	4	5	6	7	8	9	10	11
1	S = Surface of the basin (ha)	971.7	40.3	155.5	130.5	547.6	432.2	199.9	56.7	24.6	288.3
2	La = Length of the main stream (km)	5.1	1.4	2.5	2.1	4.5	5.2	2,9	1.3	0.6	2.7
3	∑l = Length of the feeders (km)	40.6	0.7	6.2	5.2	18.7	20.7	3.4	-	-	4.6
4	i_a = average slope of the river bed (%)	17	25	25	26	21	18	19	28	31	20
5	i_v = average slope of the versant (%)	41	47	47	52	50	48	41	43	44	41
6	c = drainage rate	0.42	0.41	0.42	0.42	0.41	0.40	0.41	0.43	0.43	0.42
7	$i_{1\%}$= rain intensity (mm / min)	1.69	2.69	2.31	2.47	1.83	1.73	2.01	2.37	2.67	2.01
8	$Q_{1\%}$ = maximum flow (m^3 / s)	114.2	7.5	25.3	22.4	69.4	50.3	27.7	9.7	4.7	40.4

Formula of the hourly rain

$$Q_{\max 1\%} = 0.167 \cdot c \cdot i_{1\%} \cdot S \quad (2)$$

Where:

$Q_{max1\%}$ = maximum flow rate at flood of 1% probability (m^3/s);

H_{60} = amounts of precipitations in 60 minutes (mm); c = average drainage rate;

n = exponent considered on the Romanian territory; S = surface of the small hydrographic basin (km^2)

Table 2

No.	Specifications	Valea Râiosu	Valea lui Andrei	Valea Hota-rului	Valea Măga-rului	Valea Vâja	Valea Țâbra	Valea kui Brusture	Valea Armă-sarului	Ravena Parcela 144	Valea Runcu-lui
0	1	2	3	4	5	6	7	8	9	10	11
1	S = surface of the basin (km^2)	9.717	0.403	1.555	1.305	5.476	4.322	1.999	0.567	0.246	2.883
2	H_{60} = Amount of the precipitations (mm)	115	115	115	115	115	115	115	115	115	115
3	c = drainage rate	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
4	n = sub-unitary exponent	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
5	$Q_{1\%}$ = maximum flow (m^3 / s)	57.3	6.6	18.8	16.6	41.6	36.2	22.3	8.8	4.3	28.3

CALCULATION OF WASH TRANSPORT

The wash transport was calculated through the analytical methods using the following formula:

Wash transport from the versants

$$W_{av} = a \cdot b \cdot \sqrt{i_v} \cdot \sum S_i \cdot q_{1i} \qquad (3)$$

a = coefficient depending on the calculated average length of the versants;

b = coefficient depending on the main bed’s length and the basin’s structure;

i_v = average slope of the versants;

S_i = surfaces having the same erosion coefficient (ha);

q_{1i} = erosion coefficients on surface (m^3 / year / ha).

Wash transport on rives’ beds

$$W_{aa} = b \cdot \sum L_i \cdot q_{2i} \cdot \sqrt{\frac{i_a}{i}} \qquad (4)$$

b = coefficient depending on the length of the main river bed and the structure of the small basin;

Li = length of the river bed sectors having the same wash grading and same river beds widths affected by damage (km);

q_{2i} = erosion coefficient of the river bed for the sectors having the same width and grading (m^3/an/km);

i_a = average slope of each river bed sector having the same width;

i = average slope originated from the same chart.

Wash transport during rain for safety verification

$$W_{al}=10 \cdot b \cdot F(P-Z-I) \qquad (5)$$

b = coefficient depending on the average slope of the main river bed and on the percent of the excessive damaged lands from the basin surface;

F = surface of the small hydrographic small basin (km^2);

P = amount of the precipitations resulted from the calculation rain on 30 minutes period (mm);

Z = amount of the precipitations kept by the vegetation and the land’s irregularities (mm);

I = amount of the precipitations absorbed in the soil (mm).

The values of the main calculation elements regarding the wash transport are provided in the Table 3.

Table 3

No.	Specifications	Valea Râiosu	Valea lui Andrei	Valea Hotarului	Valea Măgarului	Valea Vâja	Valea Ţâbra	Valea lui Brusture	Valea Armăsa-rului	Ravena Parcela 144	Valea Runcului
0	1	2	3	4	5	6	7	8	9	10	11
1	a	1.03	0.98	0.94	0.94	1.07	0.90	1.23	1.45	1.42	1.39
2	b	0.85	0.99	0.94	0.96	0.87	0.85	0.93	0.99	1.00	0.94
3	i_v	0.41	0.47	0.47	0.52	0.50	0.48	0.41	0.43	0.43	0.41
4	$q_{1\ med}$	1.65	1.42	1.65	1.45	1.40	1.57	1.26	1.14	1.22	1.12
5	S	971.7	40.3	155.5	130.5	547.6	432.2	199.9	56.7	24.6	288.3
W_{av}		**900**	**38**	**155**	**123**	**505**	**360**	**185**	**61**	**28**	**270**
1	L	45.7	2.1	8.7	7.3	23.2	25.7	6.3	1.3	0.6	7.3
2	$q_{2\ med}$	2248	19.78	17.01	18.13	23.19	25.29	25.26	28.59	22.81	34.99
3	i_a	0.17	0.25	0.25	0.26	0.21	0.18	0.19	028	0.31	0.20
4	i	009	0.11	0.10	012	0.13	0.13	0.09	0.13	012	0.12
W_{aa}		**1.200**	**62**	**220**	**187**	**595**	**650**	**215**	**54**	**22**	**310**
1	b	4.39	479	490	4.59	4.54	5.60	4.79	4.86	3.58	3.55
2	F	9.717	0.403	1.555	1.305	5.476	4.322	1.999	0.567	0.246	2.883
3	P	48.7	48.7	48.7	487	48.7	48.7	48.7	487	48.7	48.7
4	Z	14	13	14	13	16	17	17	17	11	11
5	I	15	15	15	15	15	15	15	15	15	15
W_{al}		**8,400**	**400**	**1,500**	**1,240**	**4,400**	**4,040**	**1,600**	**460**	**200**	**2,320**

RESULTS AND COMMENTS

The system of measurements required to enhance the hydrological amount of the auxiliaries in the referred territory by their rational using includes the following minimal provisions:

- Forestation of all the damaged lands or exposed to damages by absence of vegetation on the high slope versants, on the less stabile lands exposed to land slide process, landfall and erosions as well as on the river banks and wash deposits with the aim to stabilization and their reintroducing in the production circuit;

- Protection of the stock of wood by adoption of long term regeneration treatments or continuous regeneration which, although more complex in terms of technology, ensures the continuity of the soil's protection function for the forestry vegetation;
- Prevention of the pasturage within the young forests which requires special protection such as: young plantations, plantations on damaged lands having high slopes, weak soil (consisting of less humus and more gravel, sand and rock), etc;
- Execution in due time of treatment and management works on the young fosters – provided by the current arrangement regulations;
- Adopting of new technologies of operation of the wood materials aimed to protecting the other vegetation storey in order to prevent the erosion processes or the increase of the already existing ones;
- Enrichment of the vegetal layer of the grass lands by elevation works, application of fertilizers and land arrangements;
- Operation of the other auxiliaries within the hydrographic basins through local arrangement works aimed to preventing the occurrence of new forms of damage processes.

As a result of starting and increasing the soil damaging phenomena as well as the intensification of the wash transport phenomenon, due to heavy rains, the necessity of reinforcement works on the versants, river beds and banks became obvious.

The significant issues regarding the land arrangements on the hydrographic basins are the following:

-The drainage regulation works on the basins', regulation works on the river beds, protection dam works against floods and flow regulation works by accumulation lakes. Regulation of the drainage on versants and erosion protection works which should represent the first and the most important actions regarding the overall arrangement of the hydrographic basins. The role of these actions is not only to have a significant contribution on the regulation of the liquid drainage but also of the solid one as they determine the efficiency of the rest of the works of rivers' beds regulating, embankment works and accumulation works. They also ensure the conditions of soil's improvement and protection.

As the lithological layer consists of alternate layers of cemented sedimentary rocks, type aggregation and marl along with metamorphic rocks type marl slate this layer is subjected to alteration and decomposing phenomena mostly when the upper soil layer and the vegetation were removed due to natural factors or roads construction.

Another factor responsible for the degradation occurrence is the leaning of the geological layers resulted from the orogenesis phenomenon and which could mostly determine the versants' stability. Considering the aforementioned the completion of the actual hydro technical system is required by development of new retention capacities and reinforcement works. The arrangement works carried out on the streams will contribute to the retain of an amount of about 37,750 m^3 of wash of gravel and wood collected behind the dam by reinforcement of the river beds and banks, forestation of the damaged lands within the stock of wood. Also, the forestry roads on a 4.2 km sector, including 11 small bridges as well as 0.5 km of public roads are to be protected through the execution of the proposed works. Following proposals shall be considered for the solving of these issues:

- Adoption of several measures aimed to allowing the rational operation of the utilities within the small hydrographical basins in order to prevent the increase of their damage;

- Clear of the river beds' central area of forestry vegetation and the possible wash deposits, at least the working area, in order to fast drainage of the water from the basin and to prevent the rivers' beds clogging;

- Execution of certain transversal hydro technical works aimed to reinforce the rivers' beds and of the banks until the natural vegetation growing which will retain the wash and for regulation the flood waters on controlled streams within the forestry road area.

Conclusions and recommendations

The damage process of the hill area of Romania represents a process of brutal alteration of the natural ecosystems with major, negative effects on the long term operation of the stock of wood.

The ecological rehabilitation of the lands affected by various form of erosions represents a national strategic objective for whose achievement the national, regional and local authorities should make all the necessary steps and efforts.

In Arges County the rehabilitation techniques which should be applied in order to fulfill the above mentioned objective are complexly approached, at the level of small hydrographical basins, and include: specific agri-forestry rehabilitation measures and works, local erosion protection works, arrangement of the hydrographical network which includes in depth erosion areas.

The herein work presents the main damaging processes of the lands within B.H. Stoenesti which are responsible for the decrease of the concentration period and favor the soil erosion as well as increase of the flow's turbine effect on the water stream. Specific measures are recommended to limit these effects.

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