QUANTITATIVE ESTIMATES OF SEDIMENT DEPOSITED BY SURFACE EROSION AFTER SIMULATED RAINFALLS USING THE HYDROMETER, IN TOROC-DEJ PERIMETER

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Abstract. Depending on the amount allowable soil losses can be used to establish strategies for choosing cultural structures and their relationship, their share in a crop rotation with very good, good or poor soil protection. Following heavy rains, leaks occur as a rolled canvas spread over the land surface. Following leakage of these processes, with streams of water are entrained soil particles and moved longer distances or smaller. Following this process, after a time, depending on the frequency and duration of heavy rains that generate surface runoff, finally, lead to total washing humus accumulation horizons and finally reach the parent rock or rock foundation. Under the indirect method (Equation universal erosion of the conditions in Romania) has determined that the surfaces covered with forest, located on a slope of between 5-10% slope and slope length of steepest slope below 100 m, recorded an annual loss of 0.0067 t • ha^{-1}, respectively on a slope with the largest slope length greater than 100 m is estimated annual quantity of 00.0058 t • ha^{-1}.

Keywords: simulated rainfalls, hydrometer, soil erosion, soil and water runoffs

INTRODUCTION

Degraded lands, as defined in Annex Law no. 46/2008, are land erosion, pollution or destructive action of anthropogenic factors have permanently lost agricultural production capacity, but can be improved through afforestation, namely:

a) land surface erosion and excessive strong;
b) land with erosion depth - wheel track cutting, ravines, streams;
c) land affected by active landslides, collapses, landslides and mud spills;
d) sandy soils exposed to erosion by wind or water;
e) land with clumps of gravel, boulders, debris, rocks and torrential alluvial deposits;
f) lands with permanent excess moisture;
g) land and strongly acidic salt;
h) land polluted with chemicals, oil or noxious;
i) land occupied by mining dumps, industrial waste or household borrowing pits;
j) land unproductive if they are not as natural habitats;
k) land mobile sand, requiring afforestation works to fix them;
l) lands in any of the categories mentioned under a)-k), which were relieved by forest plantations and vegetation that was removed.

As specified DÎRJA and PEPINE (2008) in a forest ecosystem, due to the negative impact of physical agents in nature and those anthropogenic, physical and chemical characteristics of the original soil may suffer substantial changes as a result have partial reduction in some cases all, of its fertility, these degradation processes are classified according to the nature of factors beyond how agents act as follows: erosion processes, processes of land or start driving, salinisation processes and processes the înmlăştinare.

Soil erosion is classified according to the climate, degree of torrential, qualitative classification erosion equation that takes into account factors determining active general and specific (aggressive climate, topographic factor factor factor vegetation and land use and lithology) (MORGAN AND QUINTON, 2001).

Factors influencing soil erosion can be grouped into two broad categories: **natural factors** (climate factors - rainfall, temperature, winds, terrain factors - slope, slope length and shape, exhibition and so on*; lithologic factors* - mother nature rocks, alternating rocks different nature and so on; *edaphic factors* - permeability, texture, structure, content frame etc.) and **anthropogenic factors** or **socio-economic** (DÎRJA, 2000; GOBIN et al., 2004; ECKELMANN, 2006).

The mechanical system that produces soil erosion consists of: agents, factors and indicators, as mentioned Biali and Popoviciu (2006).

Agent fluid is water erosion in three ways: drops of rain, currents dispersed two-dimensional or one-dimensional currents on slopes and focus on certain routes (GOBIN et al., 2004).

Erosion indicators are considered agents of action: indicators droplets dispersed currents and current focus. Rainfall aggressiveness can be expressed by means of indicators derived from the processing pluviogrammes, which is the product of rainfall (mm) and average intensity of torrential rain core (mm · min-1) at 15 or 30 minutes, or when rain variable rainfall intensity, rainfall product of a uniform segment of rain (mm) and average intensity of rain on that segment (mm · min-1) is calculated for each rain erosion and then by summation, we obtain values monthly, seasonal and annual (after Stănescu et al., 1969, quoted by DÎRJA (2000) and BIALI and POPOVICIU (2006)).

Ploile torenţiale, prin caracterul lor local, au un rol hotărâtor în eroziunea pe versanţi şi bazinele hidrologice mici (DÎRJA, 2000), putându-se menţiona îndeosebi pentru bazinele de recepţie mici, sub raportul volumului de scurgeri provenite din precipitaţii, precipitaţiile maxime în decursul a 24 de ore prezintă un interes deosebit (BIALI şi POPOVICI, 2006).

Heavy rains, their local character, have a decisive role in erosion on slopes and small hydrological basins (DÎRJA, 2000), and can be stated especially for small catchments, in terms of volume of discharge from precipitation, maximum precipitation during 24 hours of special interest (BIALI and POPOVICIU, 2006).

Hydric erosion cycle as defined in three phases (DÎRJA, 2000): separation (displacement) transport and deposition. During an extreme event, more than 100 t· ha^{-1} of soil can be detached and carried, although loss of quantities of 2 to 40 t ha^{-1} soil erosion reveals new (ECKELMAN et al., 2006).

In Romania 9.2% of agricultural land is land located on slopes with slope weighted average, and 42.6% are land located on slopes with a weighted average slope greater than 5%.

The specific conditions of our country was calculated space (surface) extension of different classes or categories of "intensity soil losses" by using two databases on two different scales for the categories of slope (100 m grid and 1 km) using the methodology for estimating the risk of degradation of agricultural soil erosion (quantitative, based on physical processes) PESERA and SIDASSS (WEPP methodology) (***research report - RAMSOL 2011).

MATERIAL AND METHOD

The main consequences of ecological imbalances caused by land degradation is to reduce or restore, sometimes to the cancellation of the production capacity of the soil, disturbance regime drainage of surface water and groundwater, changes in microclimate and serious damage to the landscape.

Measured by using hydrometers made experimental stations in Târgu Jiu, Drăgăşani, Călugărească Valley, Podu Iloaiei and Perieni showed that the method emphasizes the role of soil tillage, cover crops and influence the degree of erosion (DÎRJA, 1998) ;

Fig. 1. Hydrometer

Also been estimated by indirect method the amount of sediment deposited annually by the universal equation erosion of the conditions in Romania reviewed motorcycles M. (1973 and 1979), motorcycles and SEVASTEL (2002), after USLE - Wischmeier and Smith (1958), respectively R.U.S.L.E. - Loch and Evans (1995), the land covered with grasslands, with different degrees of erosion and land covered with forests, the formula:

$$\mathbf{E = K \cdot L^m \cdot i^n \cdot S \cdot C \cdot Cs,}\ \text{where:}$$

E = The amount of sediment resulting from surface erosion as an annual average;

K - climatic aggressiveness coefficient - 0.120 (specific area)

L<100m, with m=0,3 and L>100m, with m=0,4 (determined from topographic survey of the perimeter) - slope length on relief homogeneous units

i - Slope gradient on relief homogeneous units - for slope 7% = 14.91, 12% in the slope = 32.87; into the slope 22% = 89.49%

S – Erosion coefficient - 0.9 or 1.0 - for luvisoil fine texture showing varying degrees of erosion (determined after geotechnical study of soil)

C - coefficient expressing cultural influences on erosion - 0.8, and 1.2 - for pastures that have varying degrees of erosion

0.001 the value of C for surfaces covered with forest.

Cs - coefficient measures the impact on soil erosion and erosion works - is equal to 1 (not present works Combating Soil Erosion) 0.001 C value factor for surfaces covered with forest.

Research on drainage, erosion and infiltration with simulated rain plots ecologically restored area ameliorative Toroc - Dej objectives were established:

- Determine the flow of water and soil;
- Determining discharge coefficient;
- Determination of soil water infiltration;
- The speed of infiltration.
- Pursuing the factors graduations number as follows:

Factor A - rain intensity: a_1 - intensity 0.8 mm · min^{-1};

Factor B - soil moisture for hydrology leakage, similar to heavy rains the nucleus in the middle and at the end: b_1 - dry soil;
b_2 - moist soil.

Factor C - slope: c_1 - slope of 7%;
c_2 - 12% slope;
c_3 - 22% slope.

Factor D - control surface:
d_1 - low grass (pasture degraded);
d_2 - good grass (pasture moderately degraded);
d_3 - with under three plantation forest (ecological reconstructed surface.

Observation process infiltration, drainage and erosion was performed using a sprinkler installations, performed using hydrometer with wool yarn. The use of such facilities is preferred method for determining the infiltration layer using water it permits infiltration curves closer to the real ones during the rains. If experimental measurements performed droplets formed at the end wool yarns have similar size with natural rain drops. Infiltration was determined indirectly by calculation corresponding balance equation (Simplified), minus the amount of water leaking fallen obtained.

Hydrometers wired to produce droplets are used to measure infiltration and resistance to soil erosion on small areas less than 1 m^2. I built hydrometer staff within the discipline of "land improvements" of UASVM Cluj - Napoca, existing model S.C.C.C.E.S. - Perieni, Vaslui County and after DÎRJA (1998).

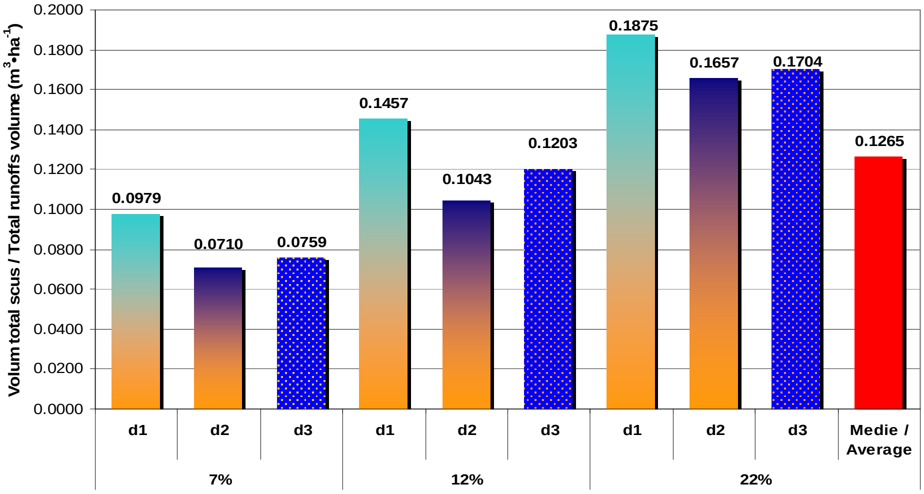
Before each determination was performed first leveling tank and box "sprinklers" that are attached to the same frame. Hydrometer is based on determining the difference between water infiltration time as sprinklers and caused leaking.

Most droplets have a diameter between 3-4 mm, which corresponds to the diameter of raindrops natural rainfall. Both droplet size and intensity of simulated rainfall was checked before other determinations maintaining constant throughout. Their diameter was determined using a bowl of castor oil as droplets fell and checked with a bowl of flour. The fall of raindrops in flour, they form lumps which after drying were sorted by diameter using sieves.

RESULTS AND DISCUSSION

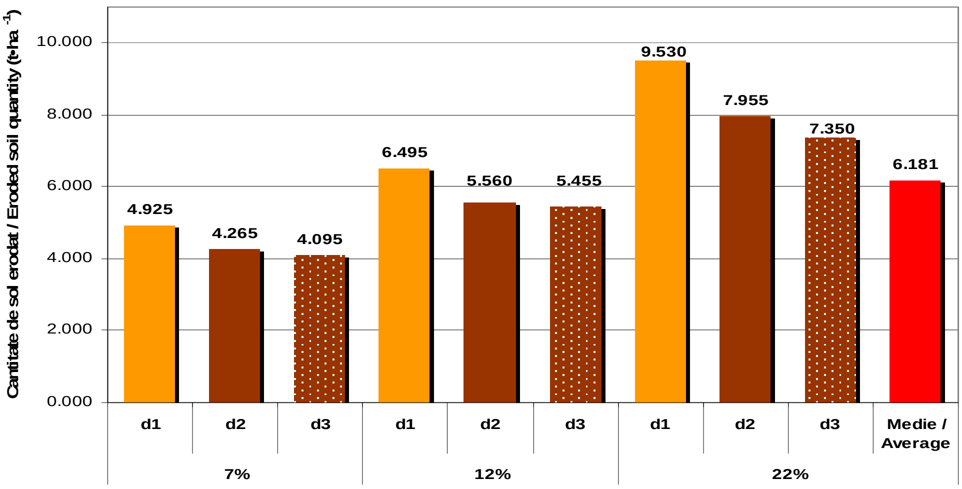
The indirect method was determined that the areas covered by forest, located on a slope of between 5-10% slope and slope length of steepest slope below 100 m, there is an annual loss of 0.0067 t • ha^{-1}, respectively on a slope with the largest slope length greater than 100 m is estimated annual quantity of 00.0058 t • ha^{-1}.

A considerable amount of sediments deposited annually (14.81 t • ha^{-1}) recorded a 7% slope and slope length steepest slope greater than 100 m, with surface covered with pastures showing a strong degree of degradation.



Note: d1 – *Degraded pasture;* d2 – *Moderated degraded pasture;* d3 – *Ecological afforested surface*.

Fig. 2. Mean values of total runoffs registered through 0.8 mm· min^{-1} simulated rains on experimental plots from Toroc-Dej perimeter



Note: d1 - *Degraded pasture;* d2 – *Moderated degraded pasture;* d3 – *Ecological afforested surface*.

Fig. 3. Mean values of soil eroded quantity (t· ha^{-1}) registered through 0.8 mm· min^{-1} simulated rains on experimental plots from Toroc-Dej perimeter

The climate and soil conditions of the perimeter to improve degraded land area Toroc-Dej, a pasture showing a strong degree of erosion on a slope with a slope of 12% and the highest slope length greater than 100 m is recorded annual amount of sediment deposited by 32.66 t • ha^{-1}, considerably large amount compared to the estimated amount of sediment deposited on a surface covered with forest (located in the same soil conditions) and versus 0,0272 t • ha^{-1}.

Degraded grassland surfaces with an average total volume of 0.0978 m3 · leakage ha-1, with about 20% more than the average amount on all types of surfaces with dry soil and wet soil, located on the slope of 7%.

Table 1

Runoff coeficient registered throughh simulated rains with 0.8 mm · min^{-1} intensity on dry and wet soil, from Toroc-Dej plots

Variant		Surface type	Total runoffs (l· $plot^{-1}$)	Water fall (l· $plot^{-1}$)	Runoff coeficient
Slope side 7%	Dry soil	Degraded pasture	88.83	360	0.25
		Moderated degraded pasture	62.51		0.17
		Ecologic afforested surface	70.58		0.20
	Wet soil	Degraded pasture	107.06		0.30
		Moderated degraded pasture	79.44		0.22
		Ecologic afforested surface	81.14		0.23
Slope side 12%	Dry soil	Degraded pasture	140.94	360	0.39
		Moderated degraded pasture	100.46		0.28
		Ecologic afforested surface	117.63		0.33
	Wet soil	Degraded pasture	150.52		0.42
		Moderated degraded pasture	108.04		0.30
		Ecologic afforested surface	122.88		0.34
Slope side 22%	Dry soil	Degraded pasture	180.14	360	0.50
		Moderated degraded pasture	157.18		0.44
		Ecologic afforested surface	166.85		0.46
	Wet soil	Degraded pasture	194.88		0.54
		Moderated degraded pasture	174.26		0.48
		Ecologic afforested surface	174.00		0.48

CONCLUSIONS

Most quantity of sediment deposited annually (88.90 t • ha^{-1}) recorded from an area covered with grass showing a strong degree of erosion, located on the slopes with a slope of 22%, with the greatest length slope greater than 100m.

On slopes with forest area covered with soil conditions: slope of 22%, with semi- and medium texture soils with the highest slope length exceeding 100 m, annual amount of sediment deposited on a surface is covered with forest record amount of sediments deposited annually by 0.0741 t • ha^{-1}).

The environmentally reconstructed surfaces (currently with seedlings less than three years) were collected volume of total leakage (water and soil) lower 0.0110 m^3 · ha^{-1}

dry soil conditions, a smaller footprint 0.0005 $m^3 \cdot ha^{-1}$ in the wet soil conditions, the average obtained from plots located in stationary conditions I.

The environmentally reconstructed surfaces (currently with seedlings less than three years) were collected volume of total leakage (water and soil) lower 0.0058 $m^3 \cdot ha^{-1}$ dry soil conditions, a smaller footprint 0.0005 $m^3 \cdot ha^{-1}$ in the wet soil conditions, the average obtained from plots located in stationary conditions II.

The environmentally reconstructed surfaces (currently with seedlings less than three years) were collected volume of total leakage (water and soil) lower 0.0078 $m^3 \cdot ha^{-1}$ dry soil conditions, a smaller footprint 0.0005 $m^3 \cdot ha^{-1}$ in the wet soil conditions, the average obtained from plots located in stationary conditions III.

The environmentally reconstructed surfaces (currently with seedlings less than three years) were collected volume of total leakage (water and soil) lower 0.0021 $m^3 \cdot ha^{-1}$ in average conditions of wet soil, dry soil, compared the overall average obtained from plots located in three bands stationary conditions.

The total volume drained soil ($m^3 \cdot ha^{-1}$) after the simulated rainfall intensity of 1.5 mm • min^{-1}, the values are average soil moisture status similar heavy rains in the nucleus in the middle and the end. As you can see the experimental plots average total volume of water drained soil is 0.2162 $m^3 \cdot ha^{-1}$, of which 8.391 t • ha^{-1} is the amount of eroded soil.

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