EVALUATION OF SOIL EROSION IN REGHIN HILLS USING THE USLE METHOD

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Abstract: Evaluation of soil erosion in Reghin Hills using the USLE method. Soil erosion is one of the main causes of degradation of large areas of agricultural land, causing great economic loss by removing fertile soil. The Universal Soil Loss Equation (USLE) predicts the long term average annual rate of erosion on a field slope based on rainfall pattern, soil type, topography, crop system and management practices but does not however predict the soil loss resulting from gully erosion.

Key words: soil erosion, Universal Soil Loss Equation, Reghin Hills.

1. INTRODUCTION

Reghin Hills constitue the division of subcarpathian hills alignment axed on Mures Valley, situated on the internal frame of Eastern Carpathian Mountains **(**Transylvanian Sub-Carpathians, Mac, 1972), enclosed between the exit of Mures River from Toplita-Deda gorge sector and the interfluve between Teleac and Călușer Valley, which marks the southern boundery along Ernei locality. They are delimited from Luţ Valley by Bistriţa Hills (N) and Transilvanian Plain (V) and on East they overlap the piedmontan sector of Gurghiu and Căliman Mountains. (Pop, 2001).

In terms of hypsometric values the relief is dominated by altitudinal steps which range between 401-500 m (39,5 %) and 501-600 m (25,5%) and the landscape fragmentation ranges is between 1,2 km/km^2–4 km/km^2.

In terms of climate it falls within the thermal regime specific to the sub-Carpathian hills regime, with avarage annual temperature between 8-10 °C, values which show a decrease from the Mureş Corridor toward the sub-Carpathians (8.9 °C Batos) according to the increase of the altitudes. The avarage annual rainfall ranges is between 500-600 mm in the corridor of Mureş and in the mountain area the values increase to 700-900 mm (Gurghiu) and 800-1000 mm (Eremitu)

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2. MATERIALS AND METHODS

The estimation of average annual soil loss was realized using the the universal Soil Loss Equation (USLE) developed by W.H.Wischmeier and D.D. Smith (1978) which was adapted to the Romanian climatic conditions under the name ROMSEM (*Romanian Soil Erosion Model)*. This model estimates the soil loss taking into account the rainfall erosivity, soil-type, landscape characteristics and land use and it is based on the following formula:**E = K · Ls · S · C · Cs**

The application of the universal equation was realized using the GIS application, with an implementation of thematic layers of raster type, representing the parameters with spatial variability – slope lenght and inclination grade, soil erodibility and the influence of vegetation with a resolution of 100mmx100mm (Fig.1.). The Digital Elevation Model (DEM) was involved in the calculation of the slope lenght, using the formula proposed by Mitosva in 1996. The erosion coefficient value was determined by adding the coefficient of the soil loss

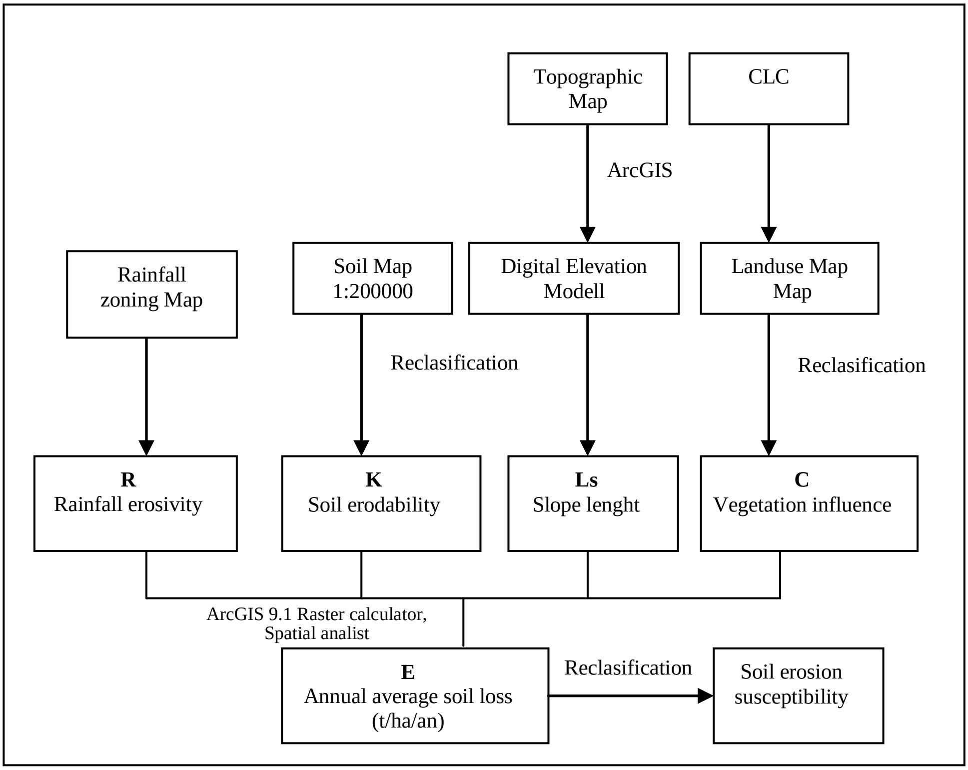

Fig. 1. Scheme of the study for soil erosion susceptibility using the USLE model in Reghin Hills

according to the type of soil (SRTS), the grade of erodibility and their structure, while the influence of vegetation upon erosion was determined by adding the soil loss coefficient for each type of vegetation (IPCA) on the datebase offered by Corine Land Cover 2006.

Mutiplying the grids corresponding to the Ls, S, C and R factors (using the Spatial Analyst module and the Raster Calculator function) we obtained the correction map of the annual avarage quantity of eroded soil and it is expressed in t/ha/year.

3. RESULTS AND DISCUSSIONS

•*The rainfall aggressiveness coefficient (R)* represents the rainfall erosivity, and expresses the erosive force of rainfall in a certain pedoclimatic area, this being calculated by the relation: $K=E*I_{15,}$ where E is the kinetic energy and I_{15} is the intensity of the 15 mm rainfall (mm/hour). According to this index, the rainfall erositity in Reghin Hills is 0.120. (Moţoc 1975)

•*The topographic factor (Ls)* takes into account the length, form of slopes and it conditions the water volume and its speed during rainfalls, amplifying the kinetic energy of water and the soil erosion. (Ioniţă, 2000). The soil erosion varies with the slope length to 0.3 power and with its inclination to the 1.5 power.(Moţoc,1975)

From the analysis of the slope length map results that on 65.5 % of the studied area the coefficient value of the topographic factor ranges between 0.1-5.0 m and is specific to the flood plain of the main rivers, the depressional areas axed on the Corridor of Mureş river –Văleni de Mureş Depression, Reghin Depression, Dumbrăvioara Depression - and the inferior basin of Gurghiu.

The coefficient values of the topographic factor between 5.1-10.0 m represent 17.9% of the area and those between 10.1-20.0 m represent 11.7% of the area and they are specific to the slopes of the main valleys, cuesta fronts (Teleac Hill, Măgura Hill) and diapiric folds (Sânioara Hill, Osoi Hill).

The highest values between 20.0-50.0 m and over 50.0 m have a low pecentage of 4.1% and 0.8% of the area and it is specific to the back slopes of coasts.

The correction coefficient depending on soil erodibility (S) (Fig.2) defines the soil erosion vulnerability and it is influenced by a number of soil attributes: soil texture, soil structure, organic matter and permeability (Ioniţă, 2000) The erosional risk is higher in the case of the soil with a varied or medium texture in the superior horizon and those with a thin loamy and clayey loam texture, in the inferior horizon of soil *„duplex soils"*, which decrease the infiltration capacity of water from rainfall, facilitating the organization of the surface flow and thus the soil erosion. (Faber, Imerson,1982, guoted by Rădoane,1999)

The erosion coefficient values between 0.7-0.85 have a percentage of 2.3% (21.4 km^2) of the studied area and they are specific to the soil with a loamy sand and clayey loam texture in the inferior horizon of soil from the preluvisoil class, the typical preluvisoil type developed in beech forests and mixture forests.

The values between 0.86-0.95 with a percentage of 21.1% (196.6 km^2) is specific to the aluvial soils with a varied texture widespread in the Corridor of Mureş, Gurghiu Valley and Beica Valley, the soils with a loam sand and clayey loam texture from the preluvisoil class, the faoeziom types proper to the soutern part of Bura Hill and those with a loamy sand and clayey loam texture from the dystri-cabmbi soil class specific to the submountainous areas.

The highest frequency registers the values between 0.96-1.00 with a percentage of 76.2% of the studied area and it is specific to the soils with sandy loam and clayey loam texture from the eutic-cambisoil and preluvisoil class, the typical eutic-cambisoil and the typical preluvisoil types proper to the grassland. The most susceptible to erosion phenomena with an erosivity coefficient value over 1.00 are the poor evolved soil with a clayey loam texture specific to faoezioms from the luvisoil (which can be found on the superior terraces of Gurghiu) protisoil, lithosoil, antrisoil, erodisoil classes which have a low percentage of 0.4 (3.73 km^2)of the studied area.

•*The correction coefficient depending on the type of vegetation and the type of land use (C*) (Fig.3) is influenced by vegetation type, vegetation density, the grade of coverage, the type of crops and the management of the cropland. Vegetation is an important factor influencing soil erosion with a contribution to its dicrease by intercepting the rain drops and thus slowing its fall to the ground, to the soil fixation using the radical system by retaining a part of rainfall and thus dicreasing the waterflow speed and the soil humidity due to the consumption of water by plants, thus favouring the infiltration of water in the soil.

The lowest values of erosion according to vegetation and the type of land use between 0-0.005 representing 355.1 km^2 (38.1%) are mostly in nemoral forests, which is characteristic to the interfluve area and in boreo-nemoral forests specific to the sub-mountainous area.The erosivity coefficient values between 0.006-0.20 have a percentage of 9.3% (86.6 km^2) and it is specific to the natural grassland in association with the bush vegetation. The values between 0.21-0.50 characterize the complex croplands, orchards and vineyards and have a percentage of 21.3% of the whole area. In croplands mixed with natural vegetation the erosion values range between 0.51-0.80 and have a percentage of 1.5% representing 14 km^2. The highest values of erosion between 0.8-1.00 are specific to the non-irrigated arable land and have a percentage of 29.8% representing 227,6 km^2 of the whole area.

From the analysis of surface erosion map (Fig.4 and 5) it is noted that on 66,7% of Reghin Hills, representing 621,53 km^2, the surface erosion registers values below 0,1 t/ha/year. These areas are dominant in the flood plain, terrace surface where prevail the crop result and the interfluve with a predominance of forestry vegetation. The erosion values between 0.1-0.50 t/ha/year with a percentage of 20.5% (191.03 km^2) of the whole area are specific to the back slope of coasts with moderate slopes, mostly occupied by grassland in association with complex type of crops.

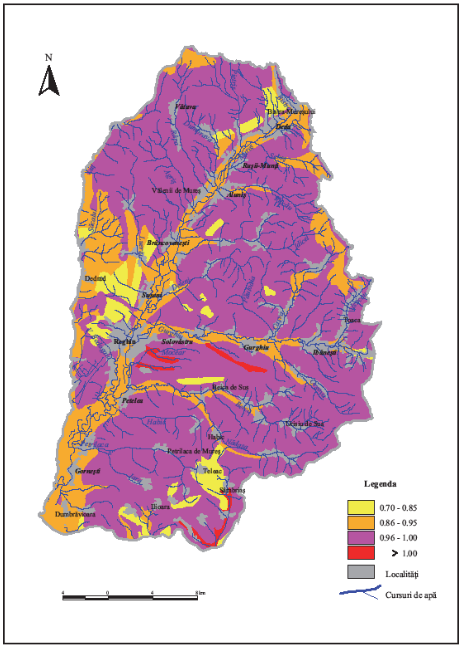

Fig. 2. The correction coefficient according to soil erosion

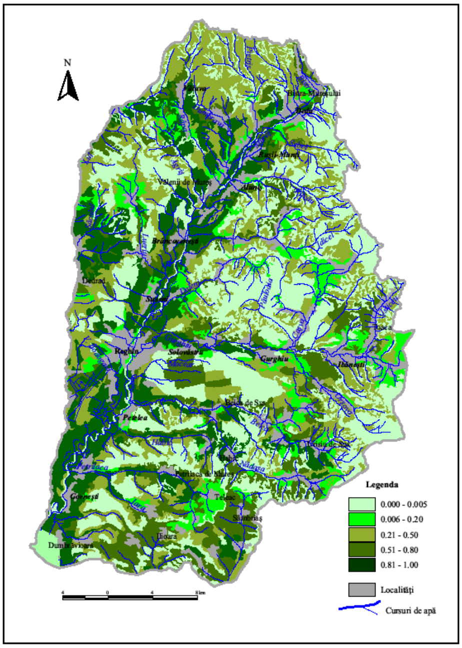

Fig. 3. The correction coefficient according to vegetation type and land use

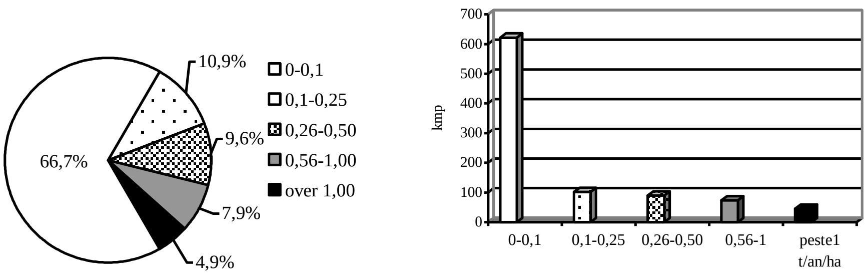

Fig.4. The territorial distribution of effective erosion

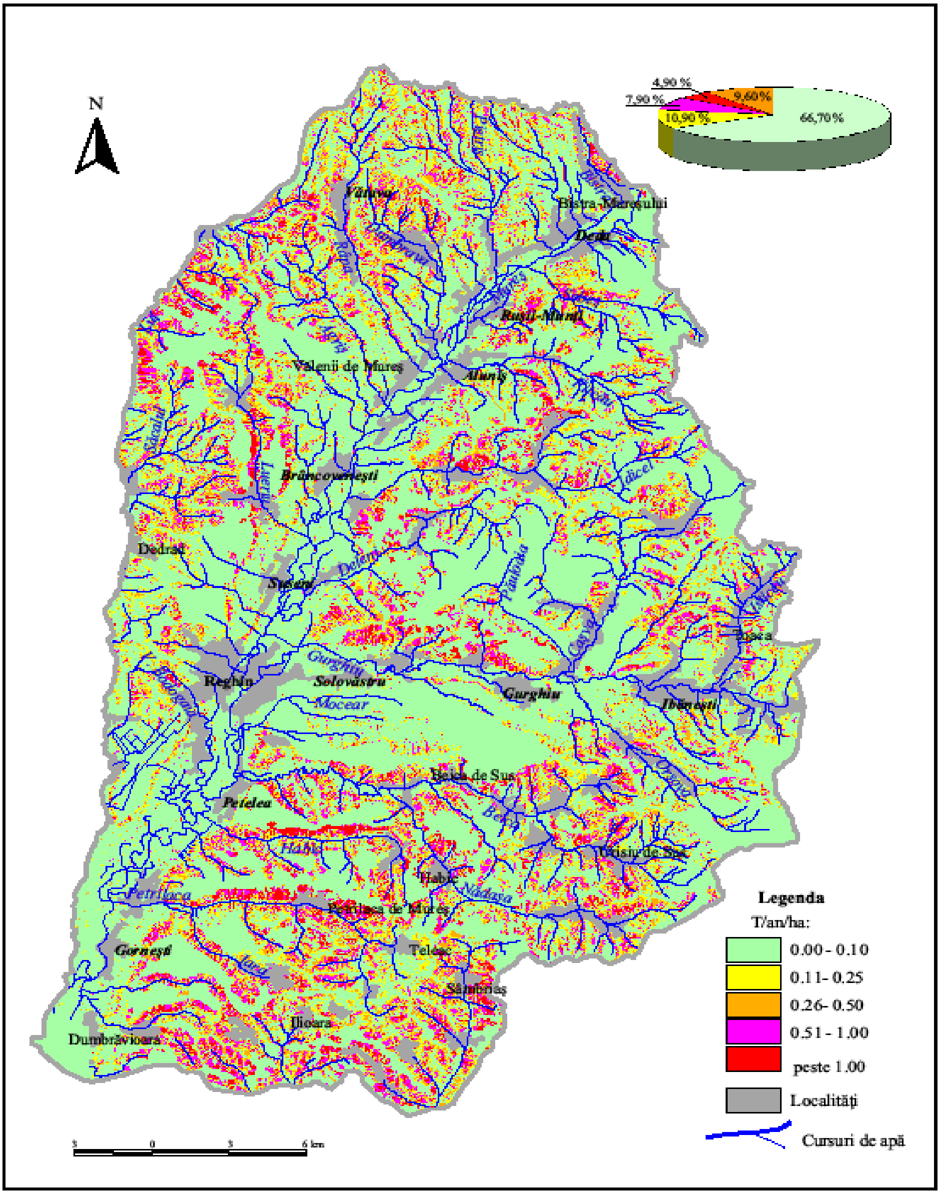

Fig. 5. Land susceptibility to soil erosion.

The highest values of erosion over 1 t/ha/year are registered on an area of 45,66 km^2, representing a percentage of 4,9% of the whole area and it is characteristic to the upper third sector of concave slope and cuesta fronts without vegetation, greatly affected by the sheet flow and by the linear flow erosion.

CONCLUSIONS

The avarage erosion values in the studied area ranges between 0 and 1.2 t/ha/year, values which according to the IPCA methodology are situated in the acceptable limits of erosion (below 3t/t/ha/year). The highest soil loss is specific the non-irrigated arable land, to the complex croplands mixed with natural vegetation and grassland, where the soil evacuation is realized mainly with linear slope erosion processes, a factor which isn't taken into account by the anaysing model applied by us. Without an application of an adecvate technology and of an adecvate project for the erosion control, these lands present a high susceptibility for other potential risks such as mass movement, gully erosion, terrain compaction etc.

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