

SOIL EROSION IN UPPER CRASNA BASIN

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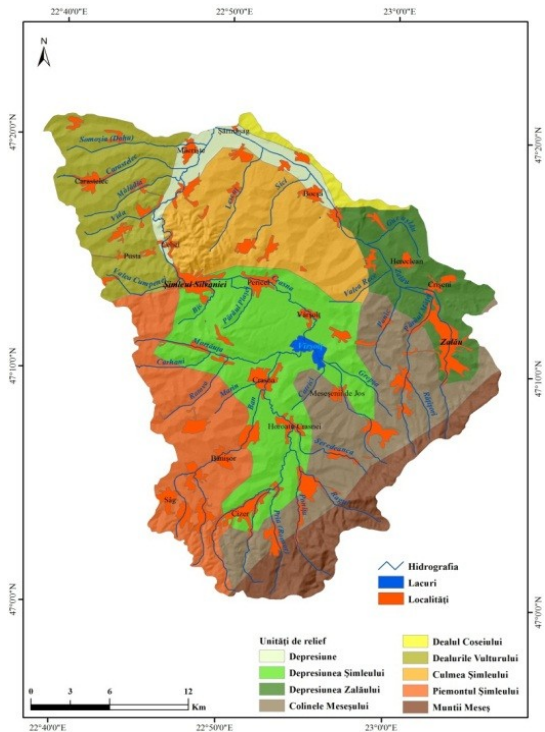
Abstract. Soil Erosion In Upper Crasna Basin. The assessment of soil erosion in the Upper Crasna Basin was made by means of the ROMSEM model based on the universal relation used by the Soil Conservation Service in USA, taking into consideration the climatic conditions in Romania. It uses specific coefficients such as rain erosivity, soil erodability, the correction coefficient for the effect of cultures, the correction coefficient for the effect of anti-erosional works, the topographic factor. The values of the annual erosion were between 0 and 23,18 t/ha/year. There were defined six value classes, with different shares within the basin. Over half of the surface of the basin (63,31 %) is represented by terrains with very low erosion (between 0 – 0,05 t/ha/year). Only 0.24 % of the surface (1.9 km) represents surfaces with erosion of over 6 t/ha/year meaning that the problems are punctual and the solutions need to be found at a local level.

Key words: soil erosion, USLE, rain erosivity, soil erodability, specific coefficients, protection measures

1. INTRODUCTION

Being situated in the North-Western part of the country and having an area of 804.04 km², the Upper Crasna Basin develops entirely within the Sălaj County. It includes several landforms with distinct geographical features: mountains in the South-Eastern part, hills and depressions in the central and Northern one (fig.1.)

Figure 1. The localization of the Upper Crasna River Basin



The population of the two towns and 14 villages counts 127.421 inhabitants, who exert a quite strong human pressure upon the studied territory. The average population density (158.4 inh/km²) is over the national average and has a quite irregular distribution (Fig. 2).

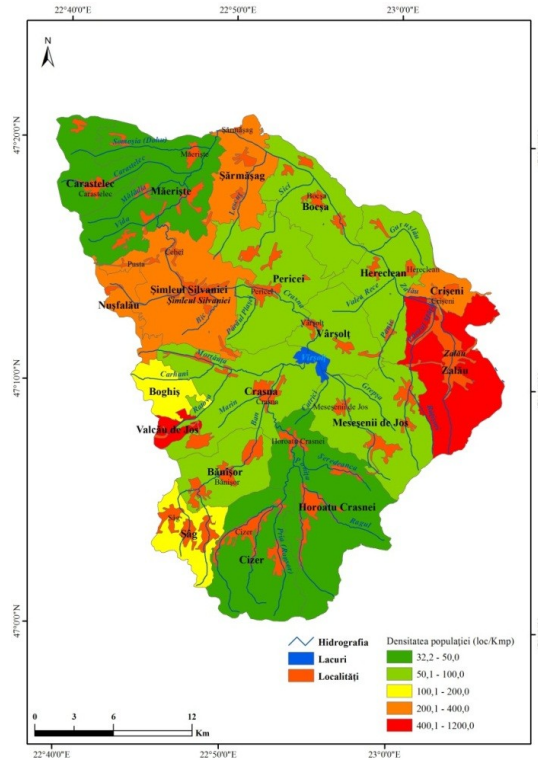


Figure 2. The map of the population density in the Upper Crasna Basin.

2. DATA BASE AND METHODS

The ROMSEM model (Romanian Soil Erosion Model) was created by using an empiric model and it is based on the equation created by Moțoc M. et al in 1973, revised in 1979 and reconfirmed in 2002. It is based on the universal relation used by the Soil Conservation Service in USA, taking into consideration the climatic conditions in Romania.

The general equation was adapted to the specific conditions in Crasna Basin, using in this respect a data base containing:

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- Primary data (soil types, data referring to land-use and the drainage network). In order to obtain these data the drainage network has been extracted from the topographical maps at the scale of 1:25 000, maps that had been georeferenced before in the system Stereo 70.
- Raster data (the digital elevation model, the erosion coefficient established on the basis of rain erosivity, the correction coefficient for the effect of anti-erosional works). In order to generate DEM at a resolution of 4 m the drainage network and the necessary perimeters have been drawn.
- Derivate data (the correction coefficient for soil erodibility, the land-use/vegetation factor and their management, the correction coefficient for the effect of anti-erosional works, slope length, slope inclination).

The rain erosivity coefficient calculated on the basis of rain (climatic) aggressivity, for Crasna Basin, has a value of 0,067.

Regarding soil erodibility the values of the used factors were established taking into consideration the Romanian pedo-climatic characteristics and have values between 0,8 and 1,1

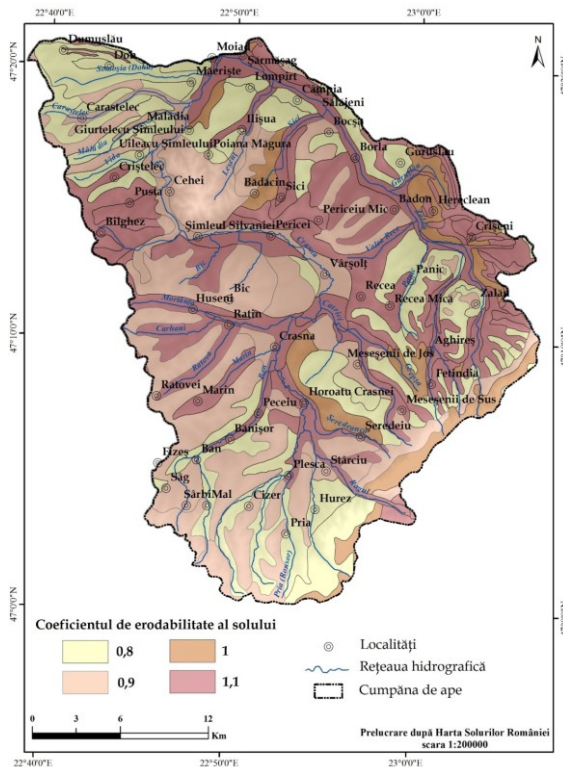


Figure 3. The map of the distribution of soil erodability coefficient

The vegetal protection factor is included in this model because of the anti-erosional role played by vegetation. The used values were between 0 și 1.

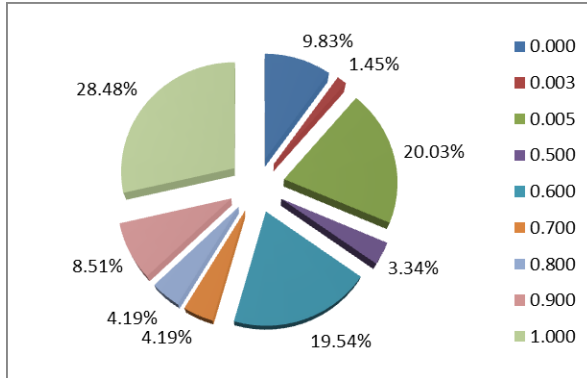


Fig. 4. The areas occupied by various cultures and the corresponding correction coefficients for their effects

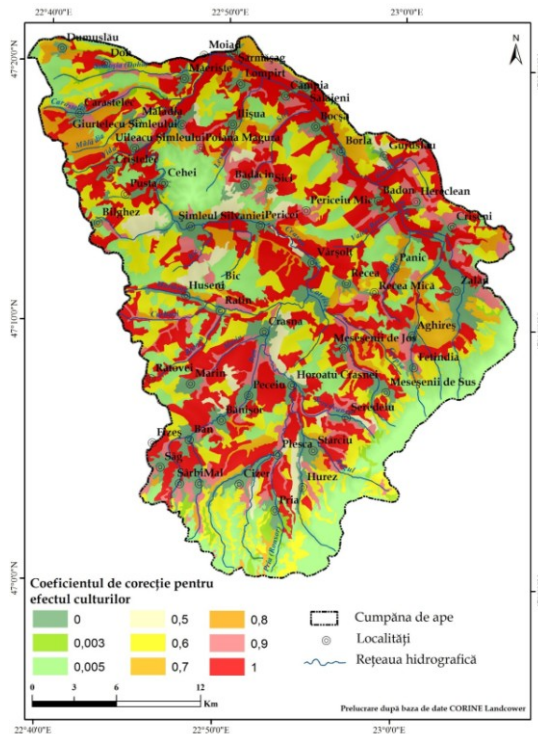


Figure 5. The map of the distribution of the correction coefficient for the effect of cultures

Although the benefits of the anti-erosional works are well-known, there are very few of them in the research area, so the correction coefficient for the effect of anti-erosional works was given the value 1, in order not to influence the final result of the modelling.

This topographic indicator takes into consideration the length of the slopes and the declivity. The highest values are recorded in the higher areas in Meseş and Plopiş Mountains and in Simleului Hillock, while the lowest in the river meadows of the main water courses, Crasna and Zalău.

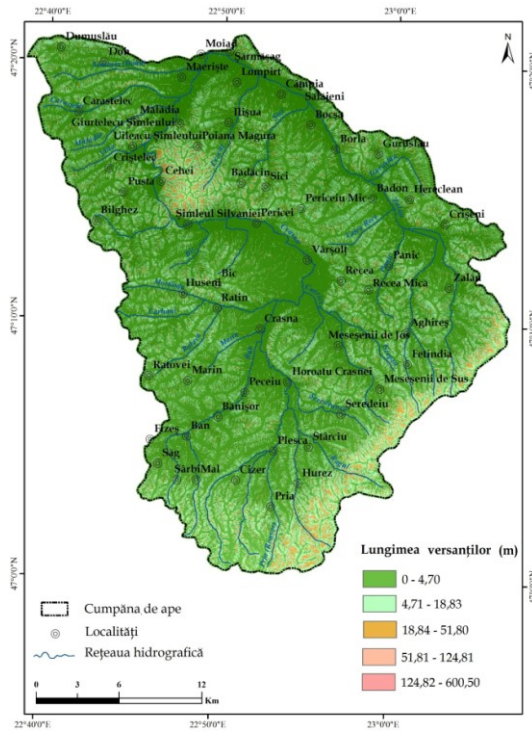


Figure 6 The map of the distribution of the topographical factor – slope length

3. RESULTS AND DISCUSSION

3.1 The values of soil erosion

Having the entire database converted in raster format, helped by the Raster Calculator function in the Spatial Analyst module, the value of the potential soil erosion was calculated, using the formula:

$$E = K * S * C * C_s * L^m * L^n,$$

Where: E – average annual erosion (t/ha/year)

K – the erosivity coefficient established on the basis of the climatic erosivity

S – the correction coefficient for soil erodability

C – the correction coefficient for the management factor of the coverage and the characteristics of vegetation

C_s – the correction coefficient for the effect of the anti-erosional works

L_m – the length of slopes (m)

L_n – slope declivity (%)

In Upper Crasna Basin we obtained values of the annual erosion between 0 and 23,18 t/ha/year. There were defined six value classes, with different shares within the basin.

Over half of the surface of the basin (63,31 %) is represented by areas with very low erosion rates (between 0 – 0,05 t/ha/year). These can be found in the forested areas in Meseş Mountains and Simleului Hillock, where the vegetation cover ensures a good protection against erosion and along the water courses where the low erosion rates are explained by the very low slopes.

A third of the surface (30,61%) is occupied by the share with low erosion (0,05 – 1.5 t/ha/an), represented by areas covered with vineyards, orchards and secondary pastures that offer an average protection against erosion.

Higher erosion rates (between 1,5 – 3 t/ha/year) are recorded on the agricultural lands (arable, with complex crops) which are the most vulnerable to surface erosion. This range of values has a share of 4,91% of the surface of the basin.

These three ranges together with the one with values between 3,1 – 6 t/ha/year (0,93% of the surface) hold 99,76% of the surface of the Upper Crasna basin. So, almost of the entire researched area is situated below the accepted erosion limit for the Romanian territory established by Motoc M. et al. (1979) as between 2 – 8 t/ha/year.

Higher values are recorded only sporadically, the range of values between 6,1 – 9 t/ha/year holding 0,21% of the surface, meaning 1,66 km², while the maximum range with values between 9,1 – 23.18 t/ha/year holds only 0.03%, meaning 0,24 km². In conclusion only 0,24% of the research area (1,9 km²) is represented by surfaces with problems regarding soil erosion, meaning that the management of these situations needs to be done at a local level by finding punctual solutions for surface soil erosion reduction and possibly the reconversion of degraded lands.

The territorial repartition of the soil erosion values calculated by means of USLE model is shown in figure no 7.

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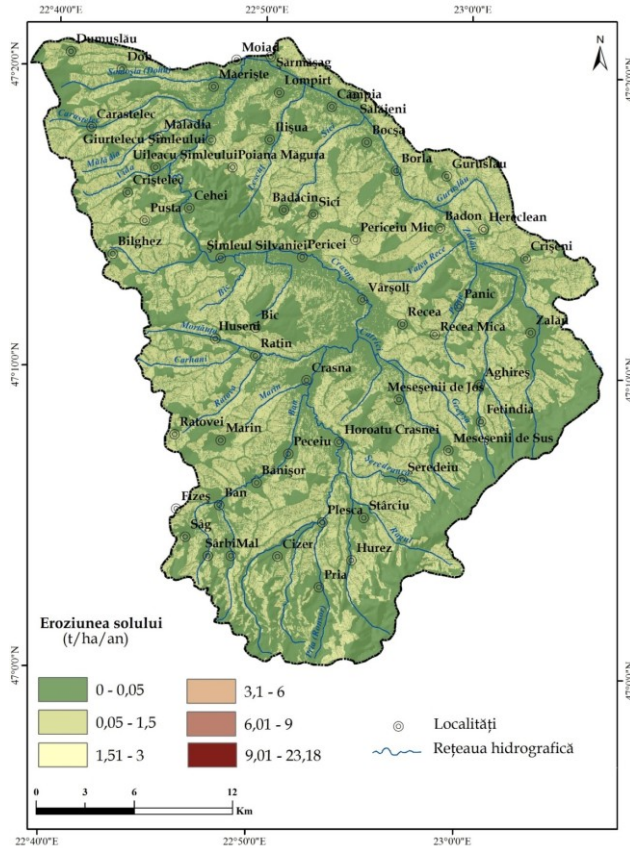


Figure 7. The map of the distribution of average soil erosion after applying the USLE model

3.2 Soil erosion prevention and control measures

In order to exclude the causes of the agricultural land degradation in the researched area and to ensure optimal conditions for their use and to ameliorate their quality, the land improvement specific works follow two main directions:

a. The reduction of surface soil erosion by:

Works executed at the interception and directed water drainage network, including: grass and mechanically consolidated outlets, interception channels (clay waves), evacuation channels, concrete falls on outlets, the padding of the channels with stones, collecting drainages, absorbing drainages, visiting places for drainages, eviction apertures for drainages, modeling and leveling the gradients of the slopes.

Works executed at the communication network with an anti-erosion purpose, including: road improvement, side channels for roads, padding with stones of side-channels, concrete falls on side channels, tubular footbridges, stone bridges, paved roads

b. The reduction of deep soil erosion by works such as: protection plantations, the consolidation of the peaks of the torrents, concrete thresholds and crosses, stone masonry and gabions, simple and double cleonages.

The purpose of the above mentioned works is the reduction below the accepted limit of the silt transport on slopes and torrents, the stopping of landslides by the regularization of slope drainage and the collection of slope springs, the stopping of the evolution of torrents and their stabilization, ensuring a proper road network for the access to the agricultural lands in the area, avoiding the damages for agriculture and other economic fields in the area.

4. CONCLUSIONS

In Upper Crasna Basin soil erosion has annual soil erosion values between 0 and 23,18 t/ha/an, but over half of the surface of the basin (63,31 %) is represented by areas with very low erosion rates (between 0 – 0,05 t/ha/year. Only 0.24 % of the surface (1.9 km) represents surfaces with problems regarding soil erosion meaning that the management of these situations needs to be done at a local level by finding punctual solutions for the reduction of surface erosion and possibly changing the destination of the degraded lands.

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