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Gully erosion in the Pereschiv catchment of Eastern Romania

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Abstract: Spindle-shape in form the Pereschiv catchment is located in the Tutova Rolling Hills, Southern Moldavian Plateau, and covers 23,267 ha. Based on both the aerial photos and field data a number of 847 gullies, stretching on 512 ha (2.20% of the total) have been identified. Of this gullied area, 34.5% (177 ha) is under 737 valley-side gullies, while 65.5% (335 ha) is under 110 valley-bottom gullies. As for 54 representative valley-bottom gullies by comparing their present state with the previous one, derived from topographical maps (based on successive aerial flights from 1960, 1962, 1974, 1977, 1981), it was possible to estimate gullying indicators, such as gully-head advance and areal gully growth. Finally, the gully erosion rate was estimated at 9.8 t ha^{-1} yr^{-1} that represents 56% of the total erosion within the study area.

Keywords: aerial photos, gulling, gully-head advance

Introduction

Spindle–shape like in form the Pereschiv catchment is located within the Tutova Rolling Hills, South-Western Moldavian Plateau, and covers 23.267 ha where only 12.2% is under forest. Clayey-sandy Miocene-Pliocene layers with a gentle dipping of 7–8 m km^{-1} NW-SE has outcropped from sedimentary substratum as a result of erosion (Hârjoaba 1968). Slopes within the plateau are mantled by mollisols, namely: chernozems – 22%, faeozems – 19% and forestry soils mostly as preluvosols – 24%. In addition, the azonal soils (e.g. regosols and erodosols) controlled by erosion amount 22% of the total (Niacsu 2009).

The native vegetative cover was dramatically changed over the last two centuries in the favor of the agricultural land, mainly cropland. The improper human activity such as the up and down hill farming and inadequate road network resulted in a significant development of soil erosion and gullying.

The main objectives of the study were to estimate the main characteristics of gullies development rhythm, and to identify the causes that triggered such an active evolution.

Results and discussion

Based on both the aerial photos and some field data, through GIS approach a number of 847 gullies that are stretching on 512 ha (2.20 % of the total Pereschiv basin) have been identified. Of this gullied area, 34.5% (177 ha) is under 737 valley-side gullies, while 65.5% (335 ha) is under 110 valley-bottom gullies (Fig. 1).

By means of the aerial photos, delivered during 2005 in the scale 1:5,000, a number of 54 representative valley-bottom gullies have been selected.By comparing their present state with the previous one, derived from topographical maps at similar scale (based on successive aerial flights from 1960, 1962, 1974, 1977, 1981), it was possible to estimate gullying indicators, such as gully-head advance and areal gully growth.

Based on these indicators two main groups have been identified, namely: the first group of 11 gullies described by a fast development and the second group of 43 gullies with lower gullying rates. As for all 54 gullies, the average gully-head advance is 7.5 m yr^{-1} but with a noticeable difference between the two groups: 22.6 m yr^{-1} for the first group and only 3.6 m yr^{-1} for the second one, respectively.

The correlation between the average gully-head advance and the areal gully growth shows a clear

Fig. 1. Erosion forms: 1 – man made canals, 2 – valley-bottom gullies; 3 – historical road gullies along valley-bottom; 4 – valley-side gullies

growing trend of the gully surface at the same time with the gully-head advance (Fig. 2).

The areal gully growth is showing a similar pattern: the average value was 168.3 m^2 yr^{-1}, but in the first group of 11 gullies that value increased to 579.1 m^2 yr^{-1} and decreased to 63.2 m^{2}yr^{-1} in the second group.

Figure 3 shows that, in time, only for the second group, the areal gully growth curve is settling down. Once with the gully development, for the same gully, the gully indicators are decreasing.

The difference between the two groups of gullies is due to their position within this basin and their stage of evolution. The most dynamic gullies can be found on far away from their source and along valley bottom. The other group of gullies that are more advanced but less dynamic and have lower values of the gully indicators, due to their proximity by the source and lower drainage area.

The most significant development has been occurred in the Hreasca gully (Ionita 2000). Here the gully-head advance was 45.3 m yr^{-1} over the period

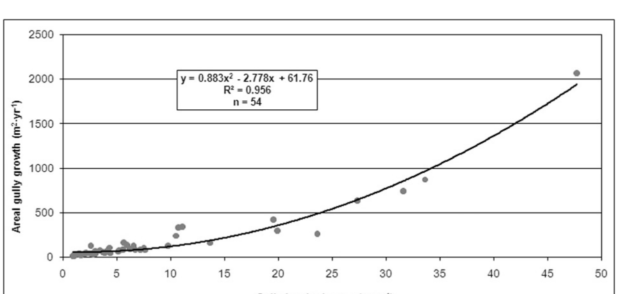

Fig. 2. The correlation between the average gully-head advance and the areal gully growth

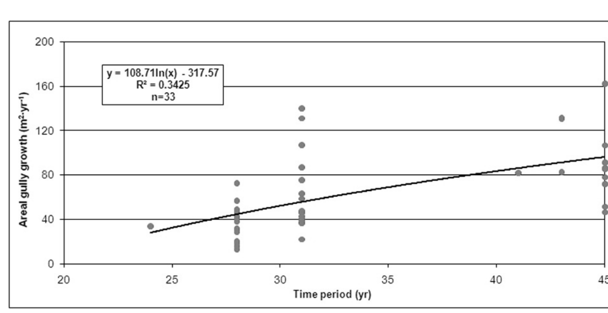

Fig. 3. The correlation between the time period and the areal gully growth

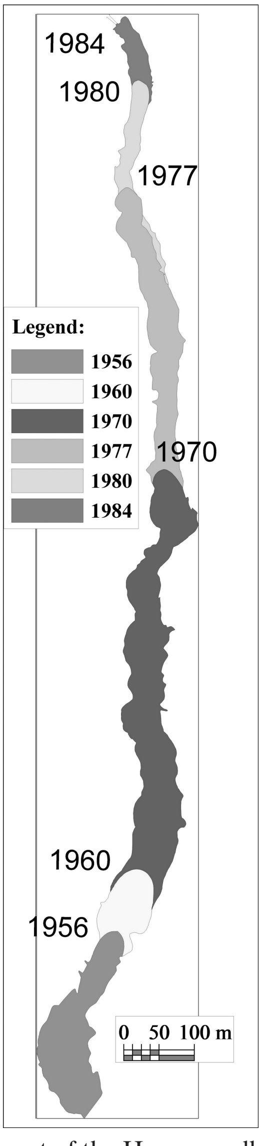

Fig. 4. Development of the Hreasca gully over the period 1960–1984 (Ionita 2000)

1961–1984 and around 93.2 m yr^{-1} during the rainy years 1966–1970 (Fig. 4).

Finally, the value of gully erosion rate was estimated at 9.8 t ha^{-1} yr^{-1} (228,561 t yr^{-1}) that represents almost 56% of the total erosion within the Pereschiv basin.

The contribution of Hreasca gully represents over 20,270 t yr^{-1} that means 9% of gully erosion and 5% of total erosion within the entire basin.

Therefore, the high values of the gully erosion rates are associated to a set of very favorable conditions:

- spindle like in shape catchment;
- prevailing of sandy lithology;
- a blanket of severe eroded forest soils;
- prevalent arable land use;
- small concentration time of the run-off;
- stream-flow is entirely passing through the gully head;
- the wet state of the gully base.

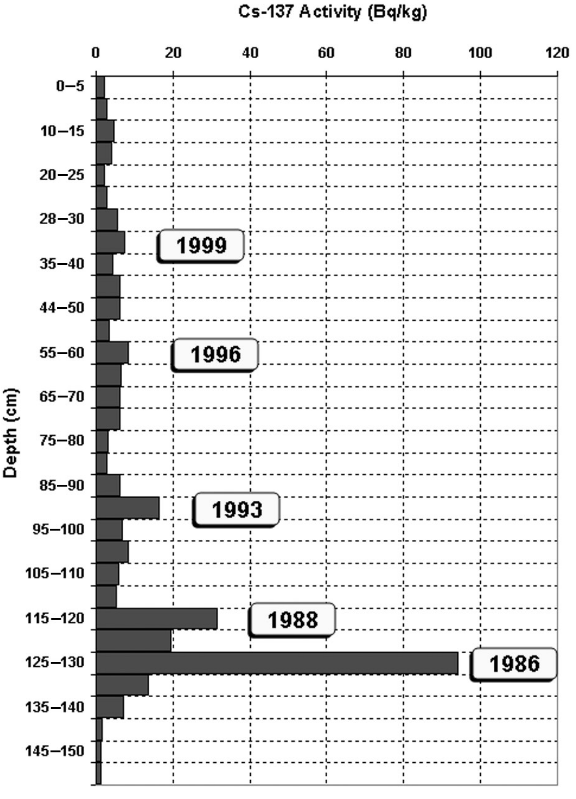

Fig. 5. Caesium – 137 distribution in the Pereschivu Mic floodplain, August 28, 2006

The high rate of gullying triggered a significant sedimentation rate along floodplains. The use of ^{137}Cs technique in the areas of deposition illustrates that since 1986 the mean rate of aggradation was 6.1 cm yr^{-1} within the lower catchment, and going further the estimates run to 9.3 cm yr^{-1} over the period 1963–2006 (Fig. 5).

Acknowledgements

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