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The human impact on soil erosion and gulling in the Moldavian Plateau, Romania

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Abstract: Soil erosion, gullying and landslides have been recognized as the major environmental threats in the Moldavian Plateau of Eastern Romania. Five stages of land degradation over the last two centuries can be depicted, namely: i) a preparing stage for future land degradation (1829–1999) when the most dynamic change of the native landscape was recorded; ii) a transitory stage (1900–1920) associated with the extension of the cultivated land up to 48% of the total area; iii) the climax stage (1921–1970) defined by both the traditional up and down hill farming and the peak rate of land degradation during 1960's; iv) a decreasing tendency of land degradation (1971–1990) as a result of the extension of conservation practices and the rainfall pattern; v) the present-day revival of land degradation associated to the Act no. 18/1991 when up and down hill farming under small plots is on the screen again. The main objective of this study was to define the process: based erosion and sedimentation by providing quantitative information from long-term field measurements in small catchments.

Keywords: land degradation, soil erosion, gullying and sedimentation

Introduction

Land degradation has been recognized as an important environmental threat in the Moldavian Plateau of Eastern Romania. This area of extensive farming extending about 27,000 square kilometers is one of the most severely degraded agricultural areas in the country.Two centuries ago the cultivated land of Moldavia covered only 6 percent of the total area and it rose up to 36 percent at the end of the 19th century. The sharp increase of the arable land and the collapse of the forest are associated to the Land Reform of 1864. One mention must be made, namely it is not appropriate to say that deforestation involved land degradation and, therefore, the agricultural practices that follow deforestation are the main controlling factor.

The prevailing farming system during the 19th century consisted in alternating the crop fields with fallow and there was a periodic cultivation since only 1/3–1/2 of the total arable land was cultivated every year. The most dynamic change of the native landscape and the inadequate agricultural practices resulted in a particular later development of land degradation in the form of soil erosion, gullying and landslides accompanied by deposition in both the reservoirs and along the floodplains (Ionita 1999/2000).

The cultivated land rose to about 50 percent of the total over the period 1900–1920 when the fallow practice diminished and the extension of up and down hill farming became an obvious feature of the agricultural practices. First scientific remarks on land degradation were published at the start of the 20th century. The Land Reform of 1921 opened the climax stage of land degradation with the peak during 1960's when higher precipitation felt. There was no significant change in the land use but the up and down hill farming under small plots is all over. A decreasing tendency of the land degradation occurred during 1971–1990 as a result of the extension of conservation practices and the rainfall pattern. At that time, the land use stratification was as follows: arable – 57%, pastures –16% and only 15% under forests.

The recent revival of land degradation is associated to the Act no. 18/1991 that includes two provisions which are not of a nature to create conditions for soil erosion control. One of these stipulates that the land re-allotment has to be usually done on the old locations. That means the plots will be up and down hill disposed, mainly. The second is referring to the successors' right up to the forth degree. These provisions enable the greatest rate of the land splitting and the up and down hill farming is on the screen again.

The main objective of this study was to define the process – based erosion and sedimentation by providing quantitative information from long-term field measurements in small catchments.

Methods and results

Runoff plot data collected at Perieni-Barlad under slightly eroded mollisol over 30-year period (1970–1999) indicate that soil loss is averaging 33.1 t ha^{-1} yr^{-1} for continuous fallow and 7.7 t ha^{-1} yr^{-1} for maize. The most critical period for soil erosion covers the two months from mid May to mid July (Ionita 2000a; Ionita et al. 2006, Ionita 2007). As to the gully development, 13 continuous gullies were sampled near the town of Barlad (Fig. 1).

Most have catchments smaller than 560 ha. Results indicate that gully erosion has decreased since 1960 (Fig. 2).

The average annual regime of gullying was documented through periodical survey upon six continuous gullies over the period 1981–1996 and showed a pulsatory development. The four rainy years of 1981, 1988, 1991 and 1996 contributed 66 percent of the total gully growth. Another main finding of this 16-years stationary monitoring was that 57% of the

Fig. 1. Puriceni–Bahnari gully, Faciu Hills, Moldavian Plateau of Eastern Romania (April 02, 2010)

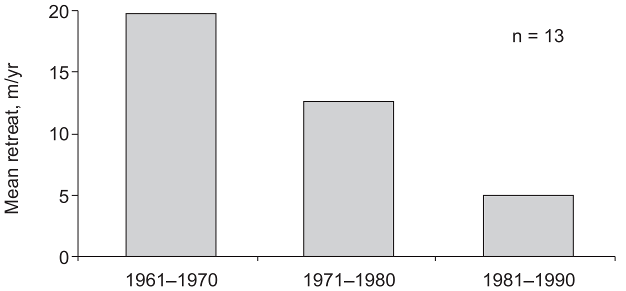

Fig. 2. Measured gully head retreat in the Moldavian Plateau between 1961–1990

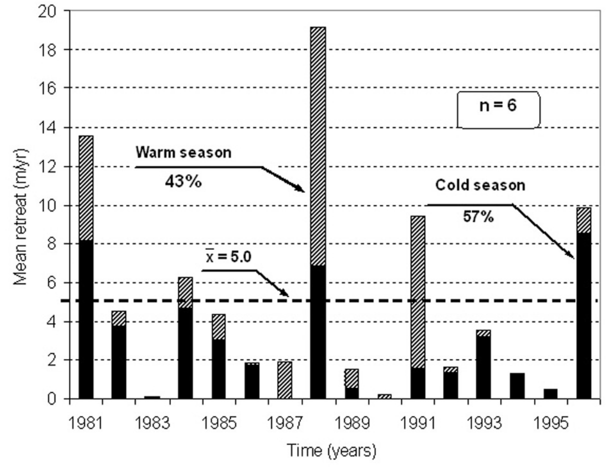

Fig. 3. Measured mean rate of gully head retreat in the Moldavian Plateau over the period 1981–1996 by using the stakes grid method

total gullying occurred during the cold season (Fig. 3). The critical period for gullying covers the four months from mid March to mid July (Ionita 2000b, Ionita 2006, Ionita et al. 2006, Ionita 2007).

The assessment of the mean recent sedimentation rates was undertaken in the basin floor of the discontinuous gullies, in the reservoirs and on the floodplains. Nine reservoirs within seven catchments and other six basins were selected for investigation. These small catchments are tributaries of the Barlad and Elan basins and their size does not usually exceed 10,000 ha.

Three main areas of monitoring discontinuous gullies were explored: classical leveling work, repeated survey through a particular *close stakes grid* and the Caesium–137 technique. By period leveling over previous iron check-plates deployed on the gully basin floor it was possible to monitor sediment

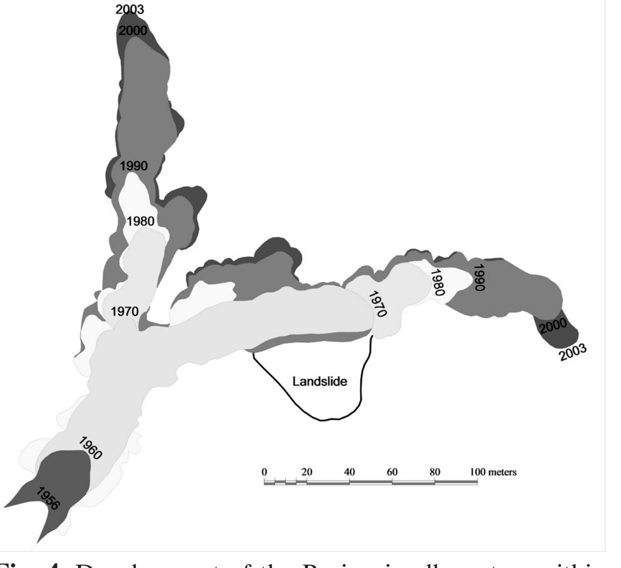

Fig. 4. Development of the Puriceni gully system within Falciu Hills over the period 1956–2003 using aerial photos and topographic leveling

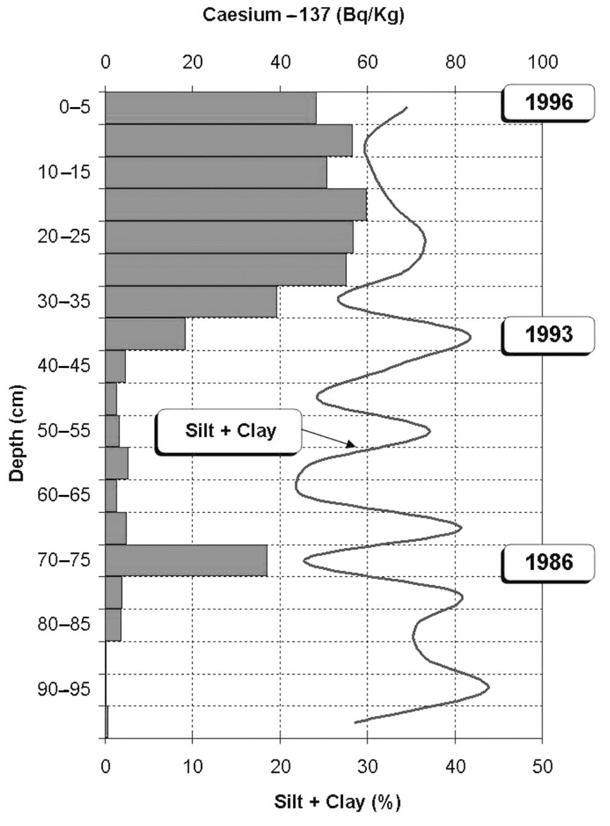

Fig. 5. Depth distribution of 137-Caesium and silt + clay content in the Bibiresti reservoir, Racatau basin, May 13, 1997

deposition. The Caesium –137 technique was also used in the reservoirs and on the floodplains to get information on dating specific levels of sediments and documenting erosion/sedimentation rates.

Results have indicated that over the last half of the century the mean deposition rate was 4.4 cm yr^{-1} for short successive discontinuous gullies. As for the floodplains, the estimates vary between 1.3–9.3 cm yr^{-1} (Ionita & Margineanu 2000).

The estimated mean sedimentation rates in the reservoirs located in two geomorphologic subunits are averaging 7.0 cm yr^{-1} in the Tuto va Rollling Hills and 3.0 cm yr^{-1} in the Central Moldavian Plateau, respectively (Ionita et al. 2000).

The last main changes in the land management, especially arising of the up-and-down hill farming after 1991 caused significant increase in erosion/sedimentation rate in comparison with the previous conservation farming (Fig. 4 and 5).

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