



Human Impact on Transformation of Small Loess Catchment

J. Rejman¹, J. Rodzik², J. Paluszek³

¹Institute of Agrophysics, Polish Academy of Sciences, Lublin, Poland

²Institute of Earth Science, Maria Curie-Skłodowska University, Lublin, Poland

³Institute of Soil Science, Agricultural University, Lublin, Poland

e-mail: rejman@demeter.ipan.lublin.pl

Areas developed from loess deposits and taken under agricultural use characterize intensive changes due to cultivation and erosion. In the effect of these processes, the original soil profile (Haplic Luvisols) is preserved mainly in the upper parts of loess catchments, whilst majority of the area consisted from soils of different erosion degree and colluvials. Complex mosaic of these soils contain a hidden information of primary topography and intensity of geomorphic processes.

The aim of the studies was evaluation of catchment transformation during its agricultural use and assessment of intensity of present-day erosion processes. Studies were carried out in small loess catchment in the Lublin Uplands (Poland), 51° 19' N latitude, 22° 23' E longitude. The catchment of 5.7 ha area is divided among parts of 11 parcels cultivated mostly along slope direction. Analysis of historical land use maps showed that the catchment was taken under agriculture not longer than 170 years, and the last changes in parcels location took place in 1932. DEM of the catchment was developed from topographic map (scale 1:1000) supplied by additional elevation measurements carried with optical tachometer in 130 points. The catchment is characterized by relatively weak relief variation with maximum relative altitude difference of 16.8 m. Transformation of the catchment was evaluated on the basis of soil profile description. To characterize the structure of soil profiles, 456 soil core samples were taken in grids 10x10 m and 20x20 m and described. Grid density was adjusted to the landscape variation. Analyzing depth of soil horizons, initial soil profiles were reproduced in sampling points. Based on comparison of present and former soil profiles,

amount of erosion and deposition was calculated for sampling points, and then using Arc Info tools - for the whole catchment. Taking into account former soil profiles, topographic map before the agriculture use of the catchment was developed. The comparison of initial and present topographic maps enable to assess the change in physical features of the catchment. Studies of present processes intensities included measurements on slope scale (water erosion in system of runoff plots of different length and soil translocation due to tillage operations on slopes) and on catchment scale (soil loss due to harvest and ephemeral channels).

Results of soil profile analysis showed that during the whole period of agriculture use of the catchment, about 14 658 m³ of soil was eroded (being an equivalent to soil layer of average depth of 26 cm). From this amount, about 70% of total eroded soil material was deposited in the catchment and 30% was transported to the adjacent catchment. The maximum relative altitude difference was decreased by about 10% in comparison to primary topography and relief transformation has caused the change of outflow direction, especially in upper part of the catchment. Studies of present day erosion processes showed that processes of soil translocation on short distances prevailed in the catchment. In general, soil translocation due to tillage was higher than water erosion rates, and only in the case of sugar beets, the amounts were similar at conditions favoring water erosion. Soil transport from the catchment due to ephemeral channel took place mainly in the winter-spring and the rates were assessed on 13 t annually (about 0.16 mm of average soil layer). Summarizing, nowadays tillage operations are the main source of soil redistribution in the catchment.