Evaluation and Controlling of Agricultural Hillside Erosion Based on Integrated GIS Methods

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INTRODUCTION

The aims of our study were to survey the spatial distribution of physical and water management properties of soils in order to examine erosion risks in orchards and to supply complex research evaluation activities for further studies.

The research field was an 80 hectare Bosc and Williams pear orchard in the South Western part of Hungary. Row distance is grassed, and the orchard is irrigated. To evaluate the effect of erosion, three dimensional digital terrain models were produced and GPS based soil samples were taken from the surface at 12 locations. Soil samples were taken with the consideration of different terrain profiles. Both soil physical (soil plasticity) and chemical (pH, NPK and soluble microelement contents of soils) characteristics of the samples were measured in the laboratory. Spatial distributions of the measured characteristics were produced using raster interpolation in Surfer 9 software

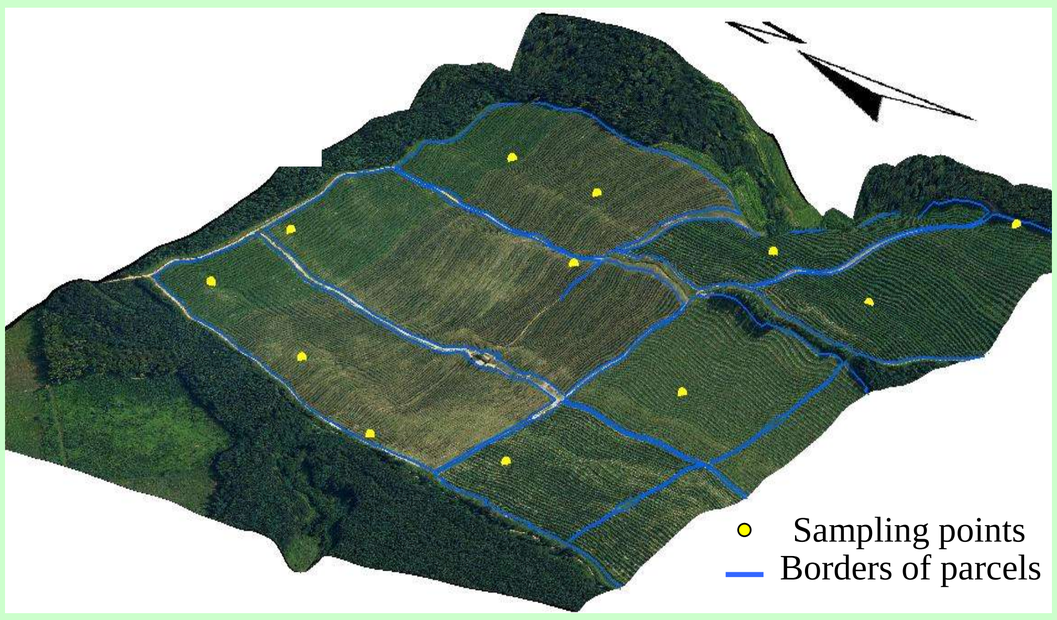
MATERIALS AND METHODS

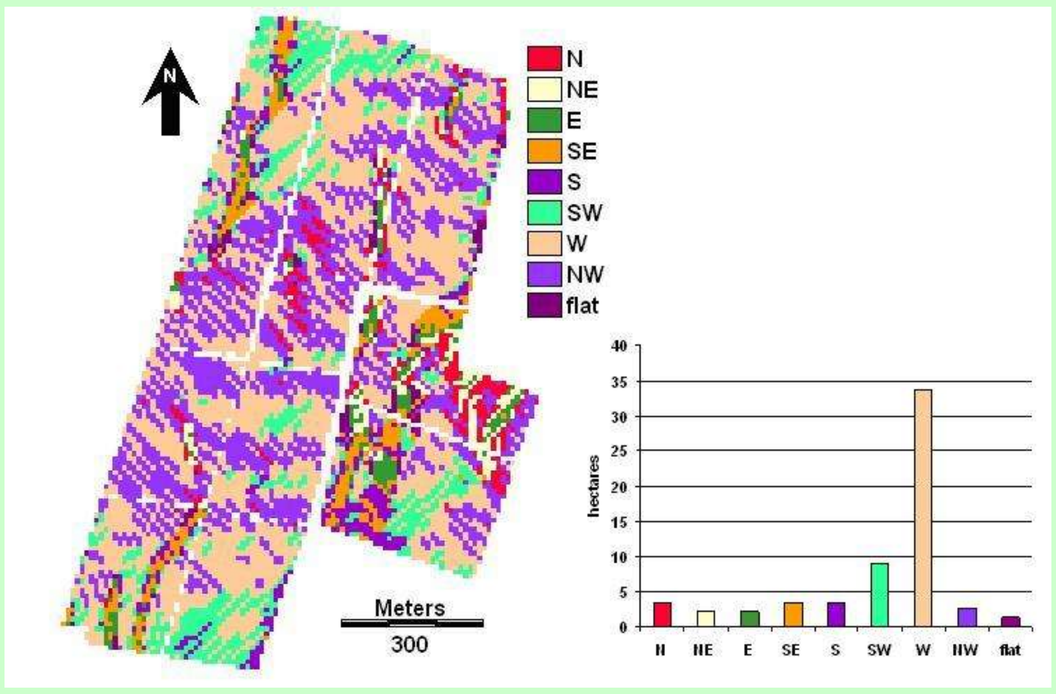
The research field was a 80 hectares Bosc and Williams pear orchard in the South Western part of Hungary. Row space is grassed, and the orchard is irrigated. To evaluate the effect of erosion, a three dimensional digital terrain model was produced. Topographical maps with 1:10.000 scale in Hungarian EOV coordinate system were used as a basis of the vectorization. The methods used survey point elevations and contour lines digitized from existing maps describing terrain surface. The vectorization and kriging interpolation was carried out in ArcGIS 9.3 and IDRISI ANDES software ambient.

GPS based soil samples were also taken from the surface at 12 locations. The real time field work was applied with processing of MobileGIS ArcPad 8 and Digiterra 6 software. In the case of spatial data Trimble Juno PDA with integrated GPS was used, and real time DGPS correction in Terrasync Office environment was applied based on the Trimble Pathfinder geostation archives. Soil samples were taken with the consideration of different terrain profiles. Both soil physical (soil plasticity) and chemical (pH, NPK, and soluble microelement contents of soils) characteristics of the samples were measured in the laboratory. Spatial distributions of the measured characteristics were produced using raster interpolation in Surfer 9 software ambient.

Results and discussions

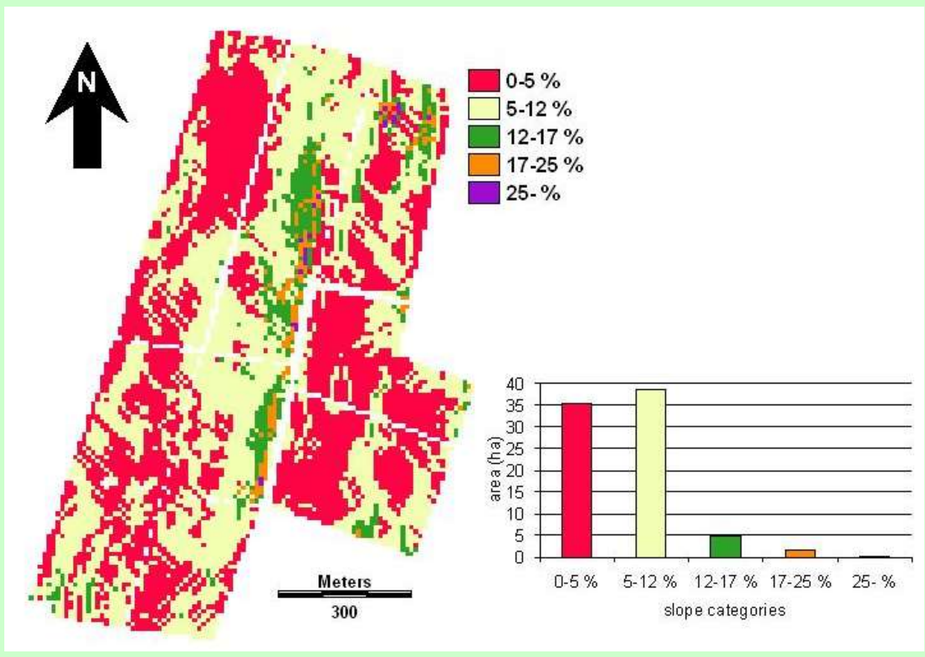
The 3-dymensional digital elevation model (DEM) was interpolated from vectorized topographic maps and field measurements. Then the orthophoto of the examined site was added to the DEM by double exaggeration factor, in order to emphasize the surface differences (Figure 1.). The vectorization and kriging interpolation was based on 28332 vertex points considering altitude attributes. At the examined site, the lowest point was 152.5 m above sea level, while the highest point was 211.25 m.

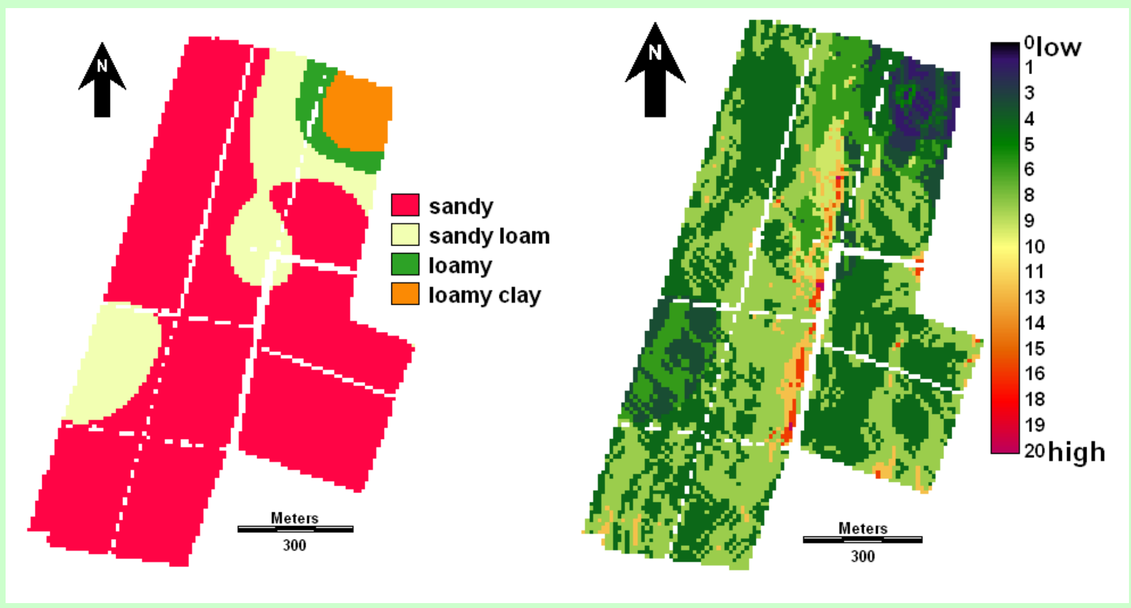




Risk of sheet erosion is considered within 56.01% of the site (slopes steeper than 5%). Besides sheet erosion, considerable risk of rill erosion appears at the steepest slopes (12 % or more), which comprise only 8.22 % of the orchard (slopes greater than 25 % steepness cover the 0.5

% of the site;





In order to reduce the effect of erosion and the amount of runoff the slope length has to be decreased. Utilizing the potential of farm roads and tracks in erosion control, the levels of the existing farm tracks should be developed with reverse slope to control the collection and channeling of runoff (Figure 5.). Open side, vegetated, mowable drains are required only on the upper side of the roads. Vegetated stormwater drains are also required, leading water from the drains through culverts and drop inlets.