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## DEGRADATION, REHABILITATION, AND CONSERVATION OF SOILS

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# Geoinformation Mapping of Soil Erosion in the Middle Volga Region

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**Abstract**—The results of a medium-scale geoinformation mapping of soil erosion on an area of about 150 000 km<sup>2</sup> in the Middle Volga region are analyzed using the catchment-based approach. A quantitative index of the development of soil erosion on the agricultural lands is suggested. It reflects the intensity of soil erosion on slopes within the river catchments. A computer-based vector map of the boundaries of 3331 elementary catchments has been developed. It represents the territorial units for the analysis of soil erosion. Archive materials from the former institutes for land survey have been used to compile a series of the maps of soil erosion in river catchments on a scale of 1 : 200 000. The zoning of erosional processes has been performed, and the natural and anthropogenic levels of soil erosion in different basins have been estimated. The analysis of these materials shows that the topography and agricultural activity of humans are the major factors controlling the development of erosion. The maximum development of soil erosion in the studied region is typical of the subzone of broadleaved forests.

**Keywords:** basins, soil erosion, geographical information systems (GIS), mapping, zoning, index of erosion, eroded soils

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## INTRODUCTION

The major purpose of this study was to analyze spatial patterns of soil erosion on agricultural lands in the Middle Volga region. This specified the level of generalization of the maps. The cartographic geoinformation method was used. The characteristics of soil erosion were determined for small catchments that served as elementary territorial units for the mapping. The intensity of erosional processes on slopes in the Middle Volga region is very high; this region is often called the “erosional pole” of the East European Plain. Plain territory and fertile soils of this region have always been attractive for people [6] and favored the extensive agricultural development of the territory. Large-scale deforestation (Fig. 1) [3, 9] and soil plowing in place of former forests have led to the development of agrogenic erosion, the formation of gullies, and the accelerated soil loss exceeding the natural (geological) rate of soil loss by several orders of magnitude. Soil scientists have always been keen on erosional processes on slopes, as it is one of the major factors of soil degradation [8, 12, 19, 40].

However, the number of sources covering the regularities of soil erosion in the studied region within the particular catchments is limited. Most often, the catchment-based approach is applied to assess gully erosion, though the areas affected, the volumes of transported soil material, and the total geocological effect of sheet erosion are much higher than those of

gully erosion. The application of catchment-based approach to study regularities of the soil erosion development and spatial distribution is grounded in the fact that the transformation of surface runoff from the divide towards the bottom of the valley takes place within the particular catchments. This is reflected in the intensity and morphological manifestation of soil erosion on the slopes. In plain humid regions of the temperate zone, river catchments represent the most widespread type of geosystems. Therefore, the application of catchment-based approach seems to be feasible to study the regularities of erosion development. River catchments are suitable for mapping on different scales owing to the hierarchical arrangement of the hydrographic network, which makes it possible to follow the principles of generalization of the maps with due account for their scale. River catchments can be delineated on the maps and serve as elementary territorial units for mapping soil erosion. Their delineation can be based on the modern geoinformation technologies, including automated delineation on digital elevation models. This possibility makes it easier to prepare and analyze data on the intensity of soil erosion within large territories. A separate task is the creation of a specialized geoinformation system based on modern information technologies and oriented towards mapping and spatial analysis of soil erosion.

The materials devoted to spatial assessments of soil erosion in the Middle Volga region can be subdivided