Catastrophic changes in landscapes of the right bank of the Volga-Oka rivers in 14-18th centuries

Polina Pushkina1, Svetlana Sycheva1, Nikolay Gribov2, Olga Khokhlova3, and Pavel Ukrainskiy4

1Russian Academy of Sciences Institute of Geography, department of geography and evolution, Moscow, Russian Federation (p.pushkina@yandex.ru)
2Russian Academy of Sciences Institute of Archeology, Moscow, Russian Federation (nnhora@yandex.ru)
3Russian Academy of Sciences Institute of Physicochemical and Biological Problems in Soil Science, Pushchino, Moscow region, Russian Federation (akhokhlov@mail.ru)
4Belgorod State National Research University, Belgorod, Russian Federation (pa.ukrainski@gmail.com)

The landscapes of the Volga-Oka right bank are currently changed by human activity considerably. Most of the forests have been cleared and only preserved in the upper reaches of the ravines and on the valley slopes. The soils are largely eroded. The zone of deciduous forests has actually turned into a natural-agricultural area. A geoarchaeological study carried out jointly with archaeologists from Nizhny Novgorod in the area of the ancient Russian sites of Mordvina Gora and Podvyazye 1 made it possible to determine the beginning and maximum of anthropogenic impact on landscapes, which caused catastrophic changes in biota, soils, and landforms.

During the existence of the ancient Russian settlements of the 14th century in the study area, mixed and broad-leaved tree species grew on light gray forest and sod-podzolic soils (Retisols). The houses were built from oak and spruce. At first, the development of landscapes by the ancient Russian population proceeded along the banks of small and large rivers. Starting from the 14th century and especially sharply since the 18th century, accelerated anthropogenic soil erosion manifested itself. On the watersheds and slopes, the upper part of the soil profile (up to the Bt2 horizon) was destroyed by erosion. As a result, watersheds and slopes decreased by no less than 40-60 cm. Coastal ravines and microdepressions were almost completely filled with colluvium. Mordvin's gully has turned into a flat-bottomed ravine. The sediment thickness in the bottom of the ravine reaches 4.5 m. The depth of dismemberment has decreased by 4-5 m. The relics of the Ah and AE horizons of gray forest soils (Retisols) have been preserved only in a buried state on the slopes and in the bottoms of depressions.

The reasons for the described ecological catastrophe are associated with the imposition of anthropogenic impact (deforestation and plowing of land) on an unfavorable natural background - climate change towards humidification and cooling (wet phase preceding the Little Ice Age). Throughout the forest zone of the Russian Plain in the 14th century, the strategy of placing settlements has been changed. From the riverside settlements were relocated to watersheds since the former habitats - floodplains and low terraces became unsuitable for settlement due to frequent floods and high standing groundwater. Since that time, the widespread development of
watersheds has been taking place for the first time. For life support, ponds were dug near the settlements or ravines, and gullies were blocked by dams, which were subsequently drained and completely covered by sediments.

Accelerated erosion increased significantly in the 18th century due to the further deterioration of the climate during the pessimum of the Little Ice Age, the growth of the agricultural population, and the introduction of the poll tax. It occurred repeatedly with a periodic deceleration of the pace, following low-amplitude climatic rhythms and local factors of agricultural development.

This work was supported by RFBR, grant N19-29-05024 mk.