



Soil as a record of the past: Mass migration as the result of soil exhausting

Jan van Mourik (1) and Sjoerd Kluiving (2,3,4)

(1) University of Amsterdam, Biodiversity and Ecosystem Dynamics (IBED), Amsterdam, The Netherlands (j.m.vanmourik@uva.nl), (2) VU University Amsterdam, Faculty of Arts (Dept of Archaeology), De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands, (3) VU University Amsterdam, Faculty of Earth and Life Sciences (Institute for Geo- and Bioarchaeology), De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands, (4) Research Institute for the Heritage and History of the Cultural Landscape and Urban Environment (CLUE), VU University Amsterdam, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands. s.j.kluiving@vu.nl

An extensive area in Northwest Europe is covered by chemical poor Late Glacial aeolian sands. Till the Bronze Age the soils evolution in the coversand landscapes correlated with the geomorphological structure, Umbric Podzols on coversand ridges, Gleyic Podzols on coversand planes and Umbric or Histic Arenosols in brook valleys. Essential was the storage of nutrients in the biomass of the forest system. The nutrient cycle has been for long time a stabilizing factor in the forest ecosystems, repressing further soil acidification.

Human occupation resulted in transformation of natural to cultural soils. Agricultural management introduced lateral transport of nutrients from the soil system to the market and interrupted the natural vertical cycling. The results were soil exhaustion and acceleration of soil acidification.

1. In the early Bronze Age, shifting cultivation was applied to create small lots of arable land. Burning of forest means acceleration of the release of organic stored nutrients, available for crop production. However, the moderate rain climate of Northwest Europe caused leaching of released nutrients that were not quickly recycled. Nutrient losses stimulated the soil acidification and in very dry seasons even small scale sand drifting could occur. Without any nutrient addition (fertilization), shifting cultivation is not a form of sustainable land use and led to land degradation.

2. In the early Iron Age, the system Celtic field came in use. Systematic transport of nutrients from green strips to production lots and harvesting caused gradual nutrient losses of the soilscape and accelerated the soil acidification; Umbric Podzols degraded to Carbic Podzols. Celtic Field land management was also not a sustainable form of land use and led to land degradation.

3. Later in time, the lateral transport of nutrients increased during application of plaggic agriculture. Soil acidification continued on heath lands, the production area of organic manure. During the period with plaggic agriculture, the soils on arable fields development from Umbric Podzols to Plaggic podzols and Plaggic Anthrosols. Agriculture on such field became sustainable under conditions of a low productivity.

In several archaeological studies there is evidence that the human impact on soils caused significant nutrient losses, soil degradation and diminishing crop production. People had to migrate to another area which a higher soil fertility to guarantee food production. Patterns of migration to fertile areas (if available) have been studied by archaeologists. Lack of space urged people to invent management techniques and equipment to increase crop production inside the occupied area.