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Relationship between land cover change and the appearance of water logging and salinisation

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Forest is an important element for regulating water flow, affecting the hydrological system above and below the soil surface. By improving the soil structure, deep tree roots can increase the retention potential of soil. Deforestation on hill slopes leads to higher surface runoff and erosion due to the decreased infiltration and water holding capacity of the bare soil and a reduced transpiration as compared to forested areas during dry periods.

The present study investigates the relationship between the land cover change, especially deforestation, and the appearance of water logging within arable land in Raya-Valley, Tigray, North Ethiopia. The objective was to find a plausible explanation of the influence of land cover change on the hydrological cycling and more specific on water logging and salinisation. To comprehend the problem, farmers were interviewed and secondary data were collected to reconstruct the history of land cover change in the study area. Physical and chemical analysis of soil and water samples were carried out (i.e. pH value, EC, grain size, mineral analysis, total N & C, etc.) to describe the present stage.

Farmers explained that for reclamation of agricultural land large areas of the Raya-Valley floor were deforested in the last decades. By 1995, the forest in the study area was totally degraded and the slope vegetation was cut down. Soil sampling revealed that the valley floor is dominated by heterogeneous layers of coarse and fine sediments with a high proportion of smectite.
The land cover induced change in hydrology caused the water table to increase, which induced the water logging of 40 hectares agricultural used land. The water logging problem is aggravated by an increasing salinity level of the top soil. Under the climatic conditions of the region, increased groundwater levels cause an increasing upward soil water movement from the ground water table and a potential salt accumulation at the soil surface.

Our explanation is related to the role of forest vegetation of amount and spatial distribution of the components of the water balance (by increasing the surface runoff and decreasing the transpiration). The water balance is further influenced by the change of hydraulic properties of the top soil layers. Due to soil consolidation less water is infiltrating and vertical leaching during rain storm events is inhibited. The latter may be mitigated under agricultural use by establishing a drainage system.