Impact of Salinization in Irrigated Agriculture in Turkana District:

The Case Study of Turkwel Smallholder Irrigation Scheme

Isaac Mbugua Kiiru

A Thesis submitted in partial fulfilment for the degree of Master of Science in Civil Engineering in the Jomo Kenyatta University of Agriculture and Technology

2010

ABSTRACT

Irrigation technology has high potential in enhancing agricultural productivity of arid and semi arid lands (ASAL), which occupies 41% of land globally and 83% of Kenyan land. However, at Turkwel irrigation scheme of Turkana District, an ASAL area, decline in farm productivity was observed, which was suspected to be caused by soil salinity in the scheme. The purpose of this study was to investigate possible causes of soil salinisation and model process of salt deposition in irrigated land at Turkwel irrigation scheme. This was achieved through investigation of nature and effects of Salts Affected Soils (SAS) in the scheme, causes of soil salinization and possible mitigation measures to the salt problem and then developed a model for prediction of salt deposits on the soil surface in the scheme. The study involved sampling of soil inside the scheme and in its neighborhood to determine its physical and chemical properties, while irrigation and ground water samples were collected and analyzed for chemical properties. Lysimeters were fabricated and used to monitor rate of capillary rise and salt concentration in the soil with water table depth and surface conditions. The rate of capillary rise in the soil is governed by the height of capillary that depends on soil texture and density of the ground water. Evapotranspiration influences rate of capillary rise by removing water from the surface before capillary height stabilizes, which depends on the water table depth and climatological parameters such as solar radiation, wind and relative humidity. The soil at Turkwel scheme was classified as sandy loam with 64.5% sand, 23% silt and 12.5% clay, hence heavy textured soil due to its high content of silt and clay, which is associated with high capillary height of water. It was established that the soils of Turkwel irrigation scheme had turned saline, since periodically irrigated fields had an ECe of 8.86 dS/m on the soil surface, which reduced to 6.08 dS/m at a depth of 20 cm from the soil surface. The soil salinisation in the scheme was dependent on land use practiced since soil

surface of non-irrigated and intensively irrigated fields were not saline with ECe of 1.31 and 0.88 dS/m, respectively. However, at a depth of 20 cm for non-irrigated fields, the soil was saline with an ECe of 5.57 dS/m, while intensively irrigated fields were still not saline, with the ECe decreasing gently with depth, attaining an ECe of 0.57 dS/m at a depth of 60 cm. Inspection pits and shallow wells indicated that water table depth in the scheme had risen to 70 cm by 2006, which was above critical water table depth, determined to be 90 cm for the scheme. A model was then developed to predict salt amounts on the bare soil surface, which indicated that salt concentration on the soil surface was dependent on height of capillary rise. The height of capillary rise was inversely proportional to water table depth from the soil surface for bare soil. The possible mitigation measures to minimize soil salinisation in the scheme were identified as lowering water table depth and shortening fallow duration by incorporating cover crop.