EFFECT OF IRRIGATION WATER ON SOIL CHEMICAL PROPERTIES AND RAIN WATER HARVESTING IN ISINYA, KAJIADO COUNTY

CHEROBON EVERLYNE KOECH

A56/73159/2012

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL RESOURCE MANAGEMENT

DEPARTMENT OF PLANT SCIENCE AND CROP PROTECTION

FACULTY OF AGRICULTURE

UNIVERSITY OF NAIROBI

SEPTEMBER 2016

ABSTRACT

Food insecurity is one of the major global problems that demands strategic intervention in the face of increasing human population and climate change upon the limited land and water resources. One strategy has been to open up more land in the arid and semi-arid lands (ASALs) for crop production through irrigation. Kenya has over 83% of the land mass in the ASALs. However, past research studies indicate that irrigation in ASALs faces challenges in availability, quality and quantity of irrigation water. Most sources of irrigation water in the ASAL include boreholes, wells and runoff water stored in water pans. The study was conducted in Isinya Sub County, Kajiado County with principal aim of promoting sustainability of dry land irrigation agriculture in Isinya Sub-County. Specific objectives were; (i) to determine the suitability and quality of irrigation water from boreholes and runoff water stored in dams, (ii) to determine the effect of the irrigation water on the soil chemical properties and (iii) to assess the amount of rain water that can be harvested from a typical greenhouse roof top and the costs of storing that water in a customized man made underground ditch. A total of 36 soil and 20 water samples were collected using random sampling design from irrigated farms located in Kitengela and Isinya Divisions of Kajiado County. The samples were carefully packaged and labeled and taken to the laboratory for analysis of the chemical properties. Three greenhouses were purposively selected in Isinya and Kitengela sites to set up rainwater harvesting experiment. Gutters and pipes were installed to collect rainwater which was being collected to a ditch from where daily water levels were measured. Daily rainfall data was also recorded using rain gauges set on the experiment site. All the data collected were analyzed using both descriptive and GENSTAT statistical analysis packages. Generally, 8 water samples (40%) from both pans and boreholes were non saline, 9 samples (45%) were moderately saline and only 3 samples (15%) were severely saline. On the basis of SAR 10 water samples (50%) had low SAR while 7 samples (35%) had moderate SAR and 3 samples (15%) had a high SAR. On the basis of the combination of SAR and EC_w 10 samples (50%) were suitable while 10 samples (50%) were unsuitable. On the basis of Chloride toxicity 14 samples (70%) were suitable for surface irrigation, 5 samples (25%) moderately suitable while one sample (5%) was found to be unsuitable for surface irrigation. On the basis of sodium toxicity 9 water samples (45%) were suitable for irrigation while 8 samples (40%) showed moderate tendencies towards sodium toxicity. The rest

3 samples (15%) were toxic and unsuitable for irrigation. On the basis of bicarbonate toxicity only one water sample (5%) was suitable and it was sourced from a dam. Two samples (10%) were moderate and were also sourced from dams. The rest 17 (85%) were found toxic and unsuitable for irrigation. In evaluating the effects of irrigation water on soil chemical properties, the results from the ANOVA indicate that the changes in soil pH EC toxic elements as a result of irrigation was not significant after irrigating with borehole and dam water but indicated significant changes for sodium and its SAR value from irrigation with borehole and dam water. The results for rainwater harvesting found that from a typical greenhouse rooftop that it is possible to harvest an average of $0.00075m^3$ of water when it rained 1mm of rainfall falling on $1m^2$ of Greenhouse rooftop. These results demonstrated a positive correlation between daily amount of rain harvested and daily rainfall measurements. It also found that it costs Kenya shillings 4850 to store same amount of water in a plastic tank compared to Kenya shillings 972.85 using a dugout ditch. The study concluded that water from boreholes and dams were both found to be suitable while others were unsuitable and that Isinya region faces sodium hazards in the any irrigation scheme. Rainwater harvesting also offers a viable option in addressing water scarcity in the region. In view of this it is recommended that for sustainable smallholder irrigation, farmers carry out preliminary study of the proposed irrigation water and the soils of the proposed farm in order for them to design a sustainable irrigation management system. The farmers will be able to anticipate changes as a result of irrigation and take corrective measures to ensure sustainability. It was also recommended that farmers explore the option of rainwater harvesting from greenhouse tops as a viable venture combined with storing the harvested water in a customized dug out ditch.