

ABSTRACT

Aim: To evaluate the spatio-temporal soil moisture storage and retention capacities in semi-arid rangeland ecosystem, Maasai Mara National Reserve (MMNR), Kenya

Study Design: Randomized complete block design (RCBD) of reference Cosmic Ray Neutron Sensor (CRNS) station, ten-(10) spatially distributed (soil moisture and temperature capacitance) probes (5TM-ECH₂O) sites.

Place and Duration of Study: Kenya, MMNR, the oldest natural semi-arid rangeland ecosystem and globally unique for the great wildebeest migration, between May 2017 and April 2019.

Methodology: Soil moisture (SM) variation data was collected using (CRNS) at spatial and point-scale 5TM-ECH₂O probes, and gravimetric water content from (10) spatially distributed stations. Both CRNS and 5TM-ECH₂O probes were used to monitor near-real time moisture levels at different soil layers ranging between 0-5cm, 5-10cm, 15-20cm, 35-40cm, and 75-80cm. Soil physical and chemical properties were laboratory analyzed. Calibration and validation datasets were obtained from 5TM-ECH₂O probe and gravimetric soil samples extracted from respective layers and sites.

Results: The pedological characteristics of the investigated ecosystem soil profile indicate decreased bulk density by 2.1% to 11.12% from upper layers (0-5cm) to deeper layers at (75–80 cm). Across the rangeland, 70% of soil textural classes were sandy clay loam (SCL) with higher clay percent and 30% sandy clay (SC) and soil porosity varied between 30.1% and 51% in the ecosystem. Moreover, volumetric

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water content (VWC) of spatially distributed 5TM-ECH₂O probes ranged between 0.11m³m⁻³ and 0.32m³m⁻³ during wet season with mean VWC of 0.16m³m⁻³, however, the VWC ranged between 0.04 m³m⁻³ and 0.17m³m⁻³ during the dry season with a mean volume of 0.11m³m⁻³ across the rangeland ecosystem.

Conclusion: In this study, SM exhibited an annual periodicity of seasonal variation of spatial and temporal moisture partitioned as moisture gaining, losing, and a moisture stable period. This probably could be a consequence of increased movement of water to deeper layers caused by high precipitation and less evaporative demand caused by lower temperatures. The calibrated CRNS probe provided good estimates of spatial soil moisture variation when calibrated with 5TM-ECH₂O and gravimetric sampling in relation to precipitation events and that deeper soil layers showed higher amount of soil moisture than shallow layers. The findings of the study will provide better formulation of the ecosystem vegetation management policies, conservation and planning for sustainable wildlife tourism industry.

Keywords: Soil moisture, variability, storage, capacities, rangeland, ecosystem