Analysis of Infiltration and Surface Runoff in River Njoro Watershed Using a Rainfall Simulator

M. O. Okelo
Egerton University, Kenya

J. O. Onyando
Egerton University, Kenya

W. A. Shivoga
Egerton University, Kenya

C. M. Gichaba
Egerton University, Kenya

S. N. Miller
University of Wyoming

The XXI International Grassland Congress / VIII International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

Analysis of infiltration and surface runoff in river Njoro watershed using a rainfall simulator

M .O . Okelo[1] , J .O . Onyando[1] W .A . Shivoga[1] C .M . Gichaba[1] and S .N . Miller[2]
[1] Egerton University P .O Box 536 , Njoro E-mail : malafred@yahoo .com , 2 University of Wyoming , Rangeland Ecology and Watershed Management , Department 3354 , 1000 E . University Avenue , Laramie , WY 82071

Key words : runoff plots , rainfall simulator , infiltration , runoff

Introduction Land use influence on hydrology has generated interest worldwide , especially in developing countries , where forest areas have been converted to other land uses including , agriculture and grazing . Hydrological changes in River Njoro watershed have been attributed to deforestation , intensive cultivation , and overgrazing . These changes have led to increase of surface runoff and reduction of infiltration . The objective of the study was to assess the effect of land use treatment on infiltration and surface runoff using a rainfall simulator and runoff plots .

Materials and methods The study area is in Njoro , Kenya . The catchment is bound by (0°15′S , 0° 25′S , 35° 50′E , 36° 05′E) . Soils in the region are Ultisols and Entisols . The mean annual rainfall is 939 .3 mm . The assessment was done on runoff plots . The plot dimension was 0 .4 m by 0 .25 m giving a plot size of 0 .1m^2 . There were 5 land use treatments set in a randomized complete block design with 3 sites (replicates) . Rainfall was applied at an average rate of 10mm/h for 3 minutes on three plots using the Kamphorst rainfall simulator (Kamphorst , 1987) . Surface runoff and infiltration from the 15 plots of the different landuses were measured . Soil characteristics including antecedent moisture conditions , organic matter , bulk density , soil texture , and soil pH from soil samples of 0-10 cm depth were measured at each site . Data was analyzed using ANOVA and treatment means separated using Duncan's Multiple Range Test (Steel and Torrie , 1980)

Results and discussions Table 1 below shows infiltration and surface runoff from every land use area and other soil properties . Runoff was higher in grazing , agricultural and deforested areas than the other sites . Surface runoff was high in grazing land (23 .78mm) , while the indigenous forest recorded the lowest runoff (0 mm) . Statistical analysis revealed significant differences between grazing land use and other land use areas except agriculture ($p<0$ .05) . Significant differences also existed between agriculture and the deforested land use areas , plantation forest and indigenous forest . There were significant differences in infiltration between indigenous forest and all the other land use areas . There were also significant differences between plantation forest and the other land use areas . However there was no significant difference in infiltration between agriculture and grazing land use types . Indigenous forest recorded the highest infiltration value (43 .5mm/h) whereas grazing land use recorded the lowest mean value (20. 2mm/h) .

Table 1 *Mean surface runoff , infiltration and soil properties in five land use types in the River Njoro watershed .*

Landuse	Bulk density g/cm^3	Organic matter	% moisture	Soil pH	Soil texture	Mean surface Runoff (mm)	Mean infiltration (mm/h)
Agriculture	0 .85	5 .7	23 .47	6 .2	Clay loam	18 .74	25 .4
Grazing	1 .05	5 .0	22 .41	5 .9	Clay loam	23 .78	20 .2
Plantation forest	0 .95	6 .2	23 .52	6 .4	Clay loam	6 .99	37
Deforested	0 .78	10 .1	29 .2	5 .8	Sandy clay loam	17 .72	26 .2
Indigenous forest	0 .74	9 .4	24 .7	6 .2	Sandy clay loam	0 .31	43 .5

Conclusions High infiltration and low runoff was recorded in indigenous and plantation forest land use areas . This was due to high vegetation and litter cover and their associated properties . Areas characterized by intense interference of surface cover conditions like agriculture and grazing recorded low infiltration and high runoff . The reduction of runoff and increase in infiltration is effective where there is vegetation and litter cover . These findings have implications for hydrological modeling in the River Njoro watershed . More studies on infiltration and runoff using other methods are needed .

References

Kamphorst , A (1987) A small rainfall simulator for the determination of soil erodibility . *Netherlands Journal of Agricultural Science* .35 :407-415 .

Steel R .G , Torrie J .H . (1980) . Principles & Procedures of Statistics . A Biometrical Approach . (2nd Edition) .McGraw Hill International Editions , Singapore .