Micro-field assessment of soil erosion and surface runoff using mini rainfall simulator in upper River Njoro watershed

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Abstract

The preliminary results of an assessment of land use effect on soil erosion and surface runoff in a severely degraded watershed in Kenya are presented here. Soil erosion and surface runoff was higher in the non-forested lands (deforested, agriculture and grazing lands) than in the forested (indigenous and exotic) lands.

Introduction

Soil erosion and runoff are consequences of integration of several factors and processes within a watershed. The use of a rainfall simulator and runoff plots provides a valuable research tool and are often used in soil erosion and surface runoff studies. The present study used the same method but with a mini-rainfall simulator to study the effects of different land use treatments on soil loss and surface runoff in River Njoro watershed.

Above: *Livestock grazing in plantation forest recently cleared for agriculture.*

Right: *Erosion resulting from slumping in heavily grazed grasslands.*

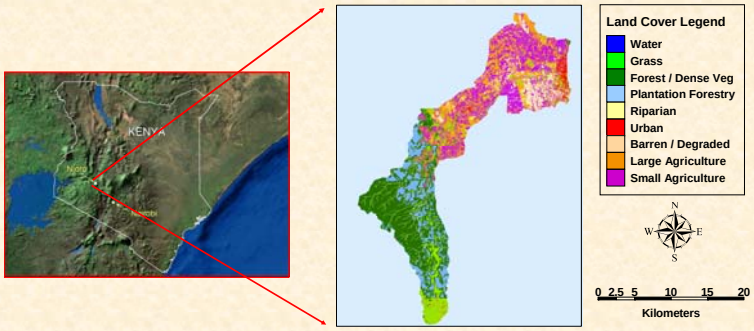
Methods

The River Njoro Watershed

The watershed (0°15´S, 0° 25´S, 35° 50´E, 36° 05'E) is approximately 250 km2 . It is drained by River Njoro, which originates from the eastern Mau hills (3000 masl) and discharges its waters into Lake Nakuru – a famous flamingo habitat.

Data Collection

- Study was carried out on runoff plots used to assess soil erosion and runoff
- Randomized block design; 5 land use treatments, 3 replicates (plots) per treatment
- Plot dimensions were 0.4 m x 0.25 m to give a plot size of 0.1m^2
- Plots were mapped using GPS and plotted in a GIS environment
- For each site rainfall was applied at an average of 10 mm/h on the 3 plots using the rainfall simulator
- Soil erosion and surface runoff generated representing 5 land use types were measured
- Soil characteristics including bulk density, texture, organic matter content and pH were measured for each plot



Classified Landsat Image of Study Area

Data Analysis

- Randomized Complete Block Design (RCBD) and Analysis of Variance (ANOVA) used to test for treatment differences
- Treatment means were separated using Duncan's Multiple Range Test (DMRT)

Results

- ✓ ***Soil loss*** decreased in this order: (1) agricultural land, (2) deforested lands, (3) grazing lands, (4) exotic trees, and (5) indigenous forest
- ✓ There were no significant differences ($p<0.05$) in soil loss among deforested, grazing, exotic and indigenous forest
- ✓ There were significant differences in soil loss between agriculture land use and all other land uses
- ✓ ***Surface runoff*** decreased in this order: (1) grazing land, (2) agricultural and deforested lands, (3) exotic trees and (4) indigenous forest lands
- ✓ Statistical analysis indicate significant differences between surface runoff from all land uses *except* between agriculture and deforested areas and agriculture and grazing lands.

Land Cover	Bulk Density (g/cm^3)	Organic Matter (%)	Soil pH	Soil Texture	Mean Soil Loss (g/0.1 m^2)	Mean Surface Runoff
Agriculture	0.85	5.7	6.2	Clay Loam	86	920
Grazing	1.05	5.0	5.9	Clay Loam	18	1200
Exotic Forest	0.95	6.2	6.4	Clay Loam	2	380
Deforested	0.78	10.1	5.8	Sandy Clay Loam	31	860
Indigenous Forest	0.74	9.4	6.2	Sandy Clay Loam	0	20

Summary

Soil erosion and surface runoff depend on rainfall and several watershed characteristics and management practices, many of which cannot be investigated using a mini simulator

- Results obtained are preliminary and give only a general impression of relative soil loss and surface runoff
- It is recommended that more detailed studies be carried out with a simulator that can generate different rainfall intensities

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