Effect of enclosures on soil organic carbon, microbial population and greenhouse gases in West Pokot

Collins O. Oduor

MSc Soil Science, Dept. Land Resource Management & Agric. Tech., UoN

Supervisors

Prof. Nancy Karanja (UoN)

Dr. Richard Onwong'a (UoN)

Dr. Stephen Mureithi (UoN)

Prof. Gert Nyberg (Triple L)

Dr. David Pelster (ILRI)

Presentation Outline

- Introduction
- Study objectives
- Study design
- Sampling strategy
- Analytical procedures
- Expected outputs

Introduction

Kenya is predominantly arid and semi-arid (ASAL)(82%), livelihoods are natural resource based. Severe soil degradation threatening ASALs ecological sustainability.

Enclosures introduced by Vi-Agroforestry since 1980s to allow revegetation and ultimately as a measure to rehabilitate degraded rangelands.

Knowledge on influence of enclosures on soil carbon fractions and greenhouse gas emission is scattered and remains poorly understood.

Study is essential for the assessment of the contribution of enclosures and similar rehabilitation programs to carbon sequestration, soil biodiversity and improvement in soil quality.

Study Objectives:

Broad objective

To contribute to a better understanding of the influence of grazing enclosures on soil carbon and greenhouse gas emission

Specific objectives

- Determine the influence of enclosure regime on labile soil organic carbon fraction and microbial biomass carbon;
- Determine the impact of enclosure on the population bacteria and fungi;
- Evaluate effect of enclosures on aggregate size distribution and stability;
- Determine the influence of enclosures on emission of CO_2, CH_4 and N_2O.

Study area

Ywalateke, Chepareia Ward, West Pokot County, Kenya

- Higher altitude of Chepareria, AEZ IV

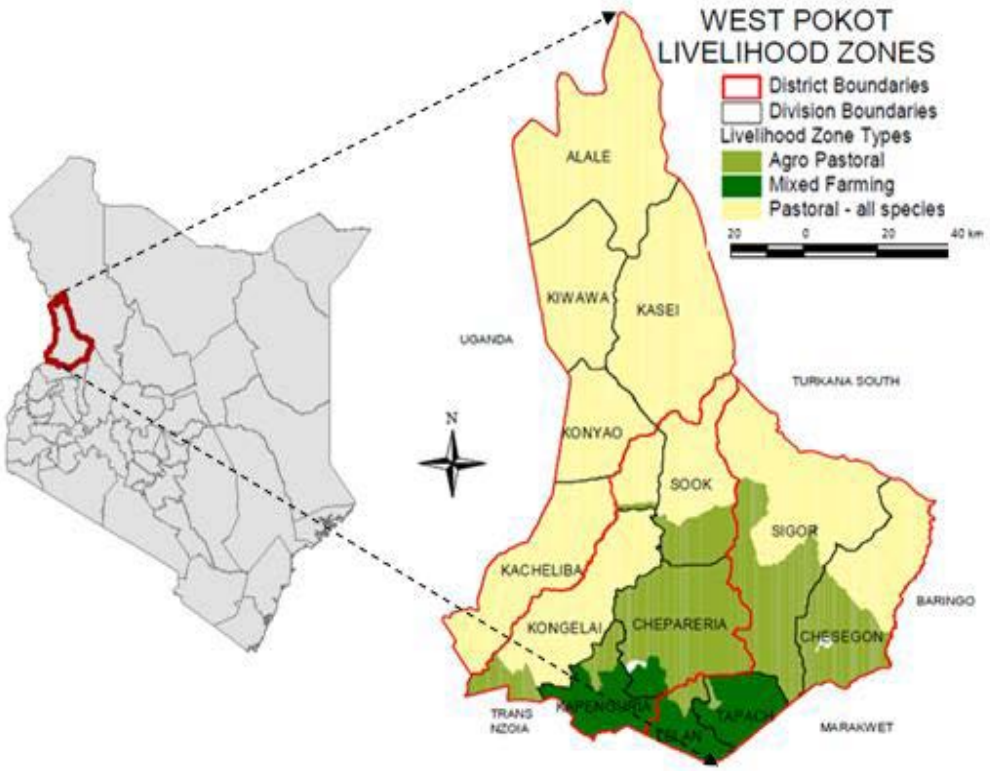
-Rainfall 600 mm per annum

-Grassland with scattered native and exotic tree species

-Soils are rocky, moderately shallow, and well drained (Touber, 1991)

- Sedentary agro-pastoralism

- Massive degradation



Source: Wairore et al. 2015

Study Design

- Randomized design with split plot arrangement, three replicates

	Age of enclosure (Yrs)		
Grazing regime	**3-10**	**11-20**	**21-30**
Grazing dominated (GD)	3	3	3
Contractual grazing (CG)	3	3	3
Open grazing (OG)	9		

Sampling strategy…Obj 1 & 2

- **Plant samples**
- Eighteen (9 GD and 9 CG) enclosures selected
- Line transect method
- Five 0.5 m2 quadrats along the transect
- **Soil**
- Three transect laid in Z-shaped orientation
- Soil sampling to 40 cm depth (0-10, 10-20, 20-40)
- Five sampling points per transect, samples composited to one sample
- Bulk density sampled using core rings
- Aggregates sampled using a shovel

Analytical procedures

- **Plant samples;** Botanical identification, cover (%), Relative abundance (%), Total biomass
- **Soil samples**

Laboratory procedures

Parameter	Method
- Organic carbon	Walkley and Black method
- Carbon fractionation	Physical fractionation method
- Total Nitrogen	Kjeldahl method
- Microbial biomass carbon	Chloroform fumigation–extraction method
- Bacterial and fungal population	Pour plate method
- Aggregate size distribution	Dry sieving
- Aggregate stability	Wet sieving

Sampling strategy…Obj 3

- Three chamber bases installed in each enclosure and age sequence
- Sixteen sampling dates
- Lids will be placed on the chambers base, 30 ml gas sample taken from the chamber headspace using a plastic syringe after 0, 12, 24 and 36 minutes

Analysis

- Rate of rise (k) calculated
- Flux rate f (mg $m^{-2}h^{-1}$) = $\frac{P^* V^* k^* M}{R^* T^* A^* 10^3}$

Obj 3.....cont

Expected Outputs

- Two papers published in peer review journals
- Masters Thesis for Examination

THANK YOU