

**ASSESSMENT OF LAND USE CHANGE, SOIL CONSERVATION
TECHNOLOGIES AND PERFORMANCE OF MAIZE AND BEANS
IN A SEMI-ARID ENVIRONMENT:
THE LONGONOT CASE STUDY**

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ABSTRACT

A study was carried out at Longonot in the Kenyan Rift Valley, where land use and land cover (LULC) change has affected land productivity and the livelihoods of people who live in the area. The research was based on three hypotheses, namely:

- i. Change in land use and land cover has accelerated land degradation in Longonot through water and wind erosion.
- ii. Soil conservation technologies would increase the amount of water stored in the soil for crop production.
- iii. Short duration crops that are early maturing would utilize the early season rains and increase the output of crop harvested.

The main research objective was to assess the change in land use, soil conservation technologies and performance of maize and beans under the semi-arid environment of Longonot, Kenya. The specific objectives of the research were to:

- i. Determine the influence of LULC change on land degradation.
- ii. Evaluate soil moisture storage under different soil conservation treatments.
- iii. Evaluate the performance of maize and bean varieties in the semi-arid environment.

The research work was done in two parts: the first part involved field research where experiments were set up in the field for four seasons namely the short rains of 2002 (SR 2002, October 2002 - March 2003), Long rains of 2003 (LR 2003, April - September 2003), short rains of 2003 (SR 2003, October 2003 - March 2004) and long rains of 2004 (LR 2004, April - September 2004). The rainfall received in the four seasons was 205,

504, 201 and 189 mm respectively. The second part of the research work involved time series analysis of aerial photographs and satellite images and laboratory analysis of soil samples.

There were two sets of field experiments: one was maize and bean experiment where the crops were planted as pure stand. The experimental design was randomized complete block laid as split plot and replicated three times. Nitrogen fertilizer was applied to the main plot while maize and bean varieties were allocated to the sub-plots. Data was collected on cumulative dry matter and final crop yield. Data on canopy interception of photosynthetically active radiation (PAR) was also taken and correlated with soil moisture and crop yield.

The second field experiment was on soil moisture storage under different soil conservation treatments (terrace, grass strip, hedgerow and tied ridges) and including a control with no conservation treatment. The experimental design was randomized complete block and replicated three times. Aluminium access tubes were installed in every plot. Data on soil moisture content was collected with a neutron probe at 14-day intervals after crop emergence.

The data collected from the field was analyzed using Genstat version 6.1. Analysis of variance was done and the means separated with least significant difference (LSD).

Assessment of LULC change was done by carrying out manual interpretation of aerial photographs and satellite images of from 1970 to 2000. The LULC classification was done and the information used in Geographical Information System (GIS) to compare the diverse data sets and to calculate the area under different land use systems in different years.

At Longonot, there has been accelerated LULC change in the last 35 years since 1970. During the period from 1970 - 2005, more than 54 % of land in the study area had undergone drastic land use and land cover changes by conversion of forests and grasslands into settlement and agricultural use. The greatest change was deforestation in the upland and the escarpment. The annual rate of deforestation was 1.5 % for a period of 35 years from 1970 and the trend was still continuing by the time of this study. From the result obtained in land cover change, it was predicted that by the year 2060, the forest cover in the area would be less than 5 % from the current 14 %.

The result of soil conservation treatments showed that tied ridging was the most effective technology for the area. There was more water stored in tied ridging than in any of the other soil conservation treatments. Maize yield was also higher by 60 % and 50 % in long rain seasons in 2003 and 2004, respectively in the plots with tied ridges than in the other conservation treatments.

Short duration crops are suited for the area due to the nature of rainfall amount and distribution. The rainfall was concentrated within the first 20-30 days after crop

emergence. Maize was adversely affected by late season drought and therefore high risk of crop failure. Bean crop entered reproductive phase when there was still some moisture in the soil and matured within 60 days.

Inadequate soil water was the main limitation to crop yields. Tied ridging if incorporated into the agronomic practices would increase soil moisture storage for higher crop yields.