KENYA AGRICULTURAL RESEARCH INSTITUTE
NATIONAL AGRICULTURAL RESEARCH LABORATORIES

KENYA SOIL SURVEY

FIELD EXCURSION GUIDE FOR A WORKSHOP BETWEEN KENYA SOIL SURVEY AND THE LAND RESOURCES SPECIALISTS OF KAJIADO DISTRICT, KITENGELA, 18th - 22nd September, 1995.

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Introduction

The pressure of population on land and water resources in Kenya is high and increasing while arable agricultural land is scarce. The total area of Kenya's landmass is 582,600km^2, 83% of which is classified as Arid and Semi-Arid Lands (ASALs). ASALs are low production rangeland zones where rainfall ranges from 300 to 900mm and have between 75-180 plant growth days (pgd) p.a.

Kajiado District has a total landmass area of 22,106km^2, of which 94% is ASAL. It is therefore essential to make the best possible use of the district's fragile/limited natural resources for maximum production on a sustained basis.

One of the main objectives of the national agricultural policy is self sufficiency in food production. The land (and particularly soils) is a major component of the bio-physical environmental factors that determine the productive capacity and potential. Kenya Soil Survey (KSS) of the Kenya Agricultural Research Institute (KARI) is mandated to carry out inventory on soils, vegetation/present land use and socio-economic studies of the country. The information so obtained can then be used for the evaluation and better management of the existing natural resources in order to realize the anticipated production while conserving them in a sustainable manner.

This field excursion is intended to expose the participants to some of the environmental parameters (soil, vegetation, climate and current land use patterns) in parts of Kajiado District. There are five sites (stops) along the excursion route: Isinya-Namanga-Amboseli National Park - Selengei and back to the hotel at Kitengela via Sultan Hamud.

The major soils in Kajiado District include: well drained, deep, red clay soils (Luvisols); imperfectly drained to poorly drained, deep, very dark grey to black, cracking clay soils (Vertisols); well drained, shallow, dark reddish brown to dark brown, rocky and bouldery, gravelly clay loam (Cambisols and Leptosols); saline (Solonchaks); sodium affected (Solonetz) soils; alluvial (stratified) soils (Fluvisols) and the young volcanic soils (Andosols). The soils are developed on various parent materials derived from metamorphic, volcanic and sedimentary rocks. Erosional and volcanic plains cover most of the district.

The problem soils in the district include solonetz and solonchaks and to some extent vertisols in terms of management. Most of the soils in the district are naturally fragile and prone to water and wind erosion and therefore call for careful management practices. Like other ASALs, most of the soils in Kajiado have topsoils with a low organic matter content which tends to form a strong surface crust under raindrop impact. This can increase both the runoff and the erodibility of the soil. Part of this erosion stems from natural causes but of more importance, however, is man-induced erosion.

This field trip highlights the fragile natural balance between the soils and other environmental factors (vegetation, climate and land uses) - extensive grazing on Group Ranches, National Parks/Game reserves and small scale irrigation.

The discussions at the various sites (stops) are intended to stimulate participants to come up with suggestions and recommendations regarding better use and management of the district's natural resources. This might assist in the formulation of landuse/land management policy for ASALs.

Stop 1: Isinya- rain water harvesting (altitude 1640m).

Rainwater harvesting is a technique for harnessing available rainfall with a view to concentrating run-off water into a smaller receiving area . This way, soil moisture is enhanced which leads to an extension of the growing period of an area. This is one of the adaptive research projects being carried out by Kenya Soil Survey.

There are several methods of rainwater harvesting, but the technique used at Isinya site is that of micro catchment. The crop being grown at this site is maize.

The site is on a black cracking clay soil (Vertisol). This is one of the typical soils occurring in this part of Kajiado district. A soil profile (pit) has been dug at the site to show the type of soil on which the project is sited.

The following are some general characteristics of Vertisols (Black Cotton Soils):

Characteristics

- dark cracking clays
- imperfectly to poorly drained
- expand and contract (shrink) with changes in moisture content
- heavy clay texture
- high chemical fertility

Distribution

- mainly in semi-arid, arid and very arid areas
- they are also found in Kano, Mwea, Athi plains, Yatta, Nanyuki, Rumuruti areas etc.

Limitations

- Low permeability (susceptible to waterlogging and flooding).
- salinity problem when irrigated with saline water
- difficult tillage (optimum moisture for cultivation)
- difficult to leach excess salts due to low permeability
- prone to erosion especially gully erosion

Landuse

- Used for grazing livestock and wildlife (ASAL areas)
- growing of paddy rice (Mwea, Kano etc.)
- used for rainfed agriculture (maize, sunflower, beans etc.)

The area falls under agro-climatic zone V-4 which classifies as semi-arid (average annual rainfall 450-900mm and average annual potential evaporation (Eo) 1650-2300mm). It is warm with mean annual temperature of 19°c (18-20°c). Land use is mainly arable farming plus ranching (free grazing).

Issues raised

1. There was concern raised over KSS's collaboration in this research with the local farmers (including Boma farms), extension agencies and ASAL.

2. In view of climatic status of this region, have such water harvesting techniques been applied elsewhere (locally and/or internationally) and how successful have they been; and is this technique a duplication of terracing already being practised in the country?

3. The need to protect the research plots from outside interference to ensure accuracy of results.

Stop 2: Mr. Pierro's Farm -Isinya (altitude 1640m)

This site is located on a farm where the following crops are grown: citrus fruits, bananas, sweet pepper, kale, spinach, maize, and napier grass. They are grown under both irrigated and rainfed agriculture. The soil type is a vertisol. During the farm tour, the farmer briefed the participants on the management practices carried out on the farm. The farm lies in the same agro-climatic zone as stop 1 and has similar land use.

Issues raised

1. Need for a powerful pump.

2. Concern on the quantity and quality (Salinity and sodicity) of the irrigation water.

3. Timeliness of planting and selection of appropriate crop varieties (both of which require extension services) to ensure maximum use of the limited rainwater.

4. Care should be taken to avoid considering the farm as a demonstration model to the local would be farmers in view of the rather poor management practices (crop variety selection and husbandry) and the high cost of inputs vis-a-vis the expected yields.

Stop 3: Amboseli National Park (altitude <1000m).

This is an exclusively game park area where there are numerous numbers of grazers and browsers. The soils at the site are sodium affected (Solonetz). The poor soil physical conditions presented by these soils especially when wet (poor aeration) lead to their management problems for arable (crops) farming.

The following are some general characteristics of Solonetz (Alkali soils):

Characteristics

- has high Exchangeable Sodium Percent (ESP >15%)
- pH 8.5-10
- shows columnar structure
- impermeable on wetting due to clay dispersion

Distribution

- occurs in association with solonchaks in semi-arid, arid and very arid areas (North Eastern, Eastern Rift Valley and Coast Provinces.

Limitations

- high sodium content which results in unstable soil structure, poor aeration and low permeability -(Internal drainage almost impossible).
- high Na+ levels preclude uptake of other nutrients
- susceptible to erosion
- Irrigated schemes, sodium can cause collapsing of irrigation canals and drainage ditches

Reclamation

- addition of gypsum (replace Na^+ with Ca^{2+} or leaching with dissolved Ca^{2+} in soil solution.

Landuse

- used mainly for extensive grazing both domestic and wildlife
- used for irrigated agriculture e.g. growing cotton (Hola and Bura schemes).

The shallow soils at the site (petrocalcic layer at <40cm depth) give very weak foothold for trees some of which eventually dry up.

In a large part of Amboseli National Park, Solonetz occur in association with salt affected soils, the Solonchaks.

The following are some general characteristics of Solonchaks (Saline soils):

Characteristics

- contain soluble salts (CO_3^{2}, SO_4^{2-}, Cl^-) of Ca, Mg, Na
- ECe > 4.0 mmhos/cm
- pH < 8.5
- Solonchaks with ESP > 15% are Saline-Alkali soils

Distribution

Found mainly in Marsabit, Tana river, Garissa, Turkana (Chalbi desert) and Kajiado districts.

Limitations

- High levels of salt content which is toxic to crops
- Causes plants to suffer physiologic drought

Reclamation

- Leaching of excess soluble salts
- Good quality water required
- Deep ground water level

Landuse

- Used mostly for sporadic grazing for both livestock and wildlife.
- Source of salt lick
- Salt tolerant crops eg. spinach, grasses and Barley may be grown.

The site is in agroclimatic zone V1-2 which classifies as arid (average annual rainfal 300-550mm and Eo 1900-2400mm). It is warm with a mean annual temperature of 23°c (22-24°c). Land use in the area is wildlife conservation for tourism.

Issues raised

1. Concern was raised as to why some particular species of Acacia were drying and dying out.

2. Varied explanations were voiced as to the cause:-

   i. rising water table, followed by high evapotranspiration translates into high salt concentration within the rooting zone.

   ii. Consequently from (i) above, the plant's roots loose water into the soil (plasmolysis) continually to the point of eventual death.

   iii. Pests attack.

   iv. Elephants scratch themselves against some trees thereby bruising them and causing enhanced loss of water which eventually leads their dying out.

   v. Roots impeded by the shallow soil depth with pectrocalcic layer.

Stop 4: Selengei Group Ranch (altitude 1190m)

The site represents one of the major soils (Luvisols) in Kajiado district. Luvisols are soils of varying depths with moderate-high natural fertility. The most conspicuous management problem of Luvisols is their susceptibility to erosion.

The following are some general characteristics of Luvisols:

Characteristics

- Generally, moderately deep to deep soils
- High base status
- Low amounts of organic matter (characteristic of ASALs)
- Strong surface sealing/crusting thus susceptible to water erosion.

Distribution

- both humid, sub-humid and ASAL areas

Limitations

- High degradational hazard (surface cover, land use and climatic conditions)
- Compact (clayey) subsoils restricts rootability

Landuse

- Arable cropping or extensive grazing depending on climatic conditions.

The main land use is ranching. It falls in agro-climatic zone V-2 which is semi-arid.

Issues raised

1. The ecological implications of subdividing or not subdividing Selengei Group Ranch borrowing experiences from other Group Ranches in Kajiado.
2. Concern was raised on over-stocking leading to severe soil erosion.
3. Need for research in maximising Biomas production and conservation of the natural environment. The relevant government/non-governmental organisations to assist in establishing tree and fodder nurseries and demonstration sites.
4. Also raised was community wildlife and the establishment of wildlife sanctuaries.

Stop 5: **Irrigation spot along Kilimanjaro-Machakos-Kajiado water pipeline (altitude 1150m).**

This is one of the many small scale irrigation spots along the Kilimajaro-Machakos-Kajiado water pipeline. The farm is used for the growing of irrigated crops which include cabbages, kales, tomatoes, sweet peppers, bananas, carrots, onions and spinach.

Located at cattle watering points, such irrigation spots are beneficial to the local community living along the pipeline. They are cost effective since the farmer operating the watering point pays only a nominal fee to the National Water conservation and Pipeline (cost shares with the Pipeline Project). The site falls in the same agro-climatic zone as stop 4.

Issues raised

1. Dietary differences amongst the local people bring to surface very acute marketing problems.

2. Lack of extension support services.

3. Although the project appears initially viable, the soils may become saline with continued irrigation.