

# Tillage and weed control on medium potential lands in Kenya

by

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## Abstract

*Kenya has a high diversity of physical relief, climate and soil types that influence the types of crops that can be grown and the tillage systems that are feasible. This paper analyses factors which influence the low rate of adoption of animal-powered and tractor tillage. Human concentration on small pockets of land is a major constraint to the introduction of mechanised tillage. Low produce prices reduce the ability of farmers to increase farm income and invest in tillage implements. Some of the tillage implements introduced have been inappropriate, and this has discouraged subsequent acquisition of new implements. Low levels of education affect awareness of new tillage options. Cropping seasons are short and create labour bottlenecks which increase monetary costs. Herbicide use is constrained by high costs. There is an urgent need to improve animal draft power packages for tillage, and research will continue to play a vital role in this.*

## Introduction

Kenya is a small country in East Africa covering an area of about 582 000 km<sup>2</sup>. Over 75% of the land surface is classified as arid and semi-arid, with very low agricultural production potential. The present human population is estimated to be about 23 million; 65% of the population is concentrated in areas of higher agricultural production potential, and so some good agricultural areas are net food importers.

Agriculture is mainly rainfed and the agro-ecological classification is based on rainfall probability, evaporation and the physical relief. The areas of medium agricultural production potential occur in small pockets in boundary regions between high rainfall and semi-arid areas.

These areas of medium agricultural potential experience bimodal rainfall patterns with a long rainy season between March and May and a short rainy season in October and November. The distribution of the available rain over two seasons reduces the effectiveness of the total rainfall for crop production and the drought occurring between the seasons causes soil moisture stress that inhibits crop development and reduces potential biomass production. Thus the only crops that can be grown successfully are short season ones with low biomass yields.

Crop production in Kenya is mainly done by smallholder peasant farmers using hand tools. Information on farm mechanisation has been generally available for more than 40 years. However, data from district surveys indicate that only about 20% of the farmlands (about 600 000 ha) are fully mechanised (tractorised); of the remainder, about 200 000 ha are farmed with animal-drawn implements and about 1.8 million ha are farmed manually.

Industrial farm equipment and implements are very expensive in Kenya and are becoming more so. Maintenance and servicing of farm equipment are also very expensive, and repair facilities are often not within easy reach: vital work days may therefore be lost when the equipment is unserviceable.

## Manual tillage systems

Most of the smallholder farmers in Kenya are mixed farmers. Many of them have migrated from areas of higher to areas of lower agricultural production potential, but they continue to apply farming practices which have been handed down through the generations, even though they may not be appropriate in the new settlements. The result is many operational problems and poor crop yields.

In general, crop farming is underdeveloped. Initial bush clearance and land preparation are often done using low-work-output hand tools: the main implements for bush clearance are still the axe and the *panga* slashing knife. In the high tropical surface air temperatures manual workers get tired quickly and can only work effectively for a few hours each day. Initial land clearance work therefore requires many labour-days per hectare. The reduction of effective working labour-hours inflates the real costs of land preparation and tillage. In many instances labour costs may be beyond the reach of poor peasant farmers, who are then forced to use destructive methods of land preparation such as bush burning, which leave the surface layer baked by heat and prone to severe wind and water erosion.

Poor peasant farmers have very few financial resources for investing in good agricultural practices. Even where "improved" tools are

available such farmers continue to use the low performance hand tools, notably the *jembe* and *forked jembe* hoes and the *panga*, which are available in different sizes and shapes in the local markets at prices which the farmers can afford. As long as smallholder farmers' crop production margins remain very low they will continue to use these inefficient tools.

The physical characteristics of the soils force the farmer to delay land preparation until after the onset of the rains. This practice reduces the length of the crop growing season and, because the rainy seasons are short for cereal production, any reduction of the growing season leads to severely reduced yields.

The time available for land tillage is often critical and sets the farmers in a state of panic. Labour is scarce at this time and the cost of daily labour increases, severely affecting the crop production costs. In this working environment where labour is in short supply, the quality of land tillage is reduced, resulting in substandard seedbed preparation and early infestations of noxious weeds while the crop seedlings are still at the critical juvenile growth stage.

On old land the *jembe* achieves very good weed control, the only limitation being the rate of work output. However, tillage with the *jembe* is generally shallow, so that in places and soil types where deep cutting is desirable in order to increase the level of rainwater infiltration, the *jembe* is not suitable; its use will lead to a low level of soil water storage and the soils will quickly dry out to the extent that the plant extractable soil moisture will be below the rooting zone. In this case the crop will not achieve its yield potential.

### Tillage using draft animals

Some farmers do achieve a higher level of farming income and are able to hire or own draft animals and animal-drawn implements.

The most important aspect of any power unit is its source of energy. The energy of a draft animal comes from its feed. Therefore the feeding and management of the draft animal is very important in order to efficiently tap the animal's power. The animal's energy is in high demand when the heavy duty operations are at the peak; this normally occurs during the dry season when fodder and pasture are in short supply. Management of the draft animal therefore requires the provision of storage facilities for animal feed for dry season feeding and for water.

In Kenya, the widely used animal-drawn tillage equipment is the Victory mouldboard plow. It is

generally manufactured locally and when made from good quality steel it is light and popular with farmers. It is used for land preparation, ridging, furrow opening for seed planting, inter-row weeding, soil spreading and harrowing. The implement requires high draft power, particularly when the soils are dry and hard. Thus the farmer may be forced to use as many as three pairs of working oxen which may make the tillage operations expensive and uneconomical for the low value food crop production.

With the conventional mouldboard plow, animal energy is used in turning over the soil: ripper tines require less energy for turning and shifting soil and can therefore cut deeper into the hard soil crusts in order to facilitate better rainwater infiltration. In the hot temperatures of the tropics overturning the soil layers exposes the moist soil layer to increased, faster drying, thus worsening the plant seed growth environment. Exposure of lower soil layers to high surface temperatures also speeds up volatilisation of plant nutrients from the soil. The soils become degraded and corrective measures are often needed after successful cropping. In the higher plateaux where temperatures are cooler and the rainy season is longer, overturning the soil layers and burying the young weeds is still considered an effective means of weed control.

Research and development programmes have continued to acquire "improved" animal-drawn implements suitable for tillage both in the high rainfall mountain ranges and low rainfall savannah. The Bukara toolbar was recently designed to operate with a single pair of working oxen. The equipment is light and sturdy and the design allows easy adjustments. The toolframe can be fitted with a one- or two-furrow plow, cultivator tines, furrow openers, two-furrow ridger, seed planter and blade cultivators. The equipment and tools are still undergoing field experiments and evaluation.

### Reduced tillage and herbicides

A large part (over 50%) of farm inputs is associated with tillage operations. Reducing the level of tillage without significantly reducing crop production could play a major role in increasing profitability.

Although reduced tillage is practised in the high rainfall areas, it is rare in medium potential areas as the majority of smallholder farmers lack the appropriate technical knowledge.

However, in a few scattered river basins, where irrigation schemes allow high value crops such as fruits, onions and flowers to be grown, limited integrated weed control is commonly practised.

Herbicides are applied using small pressure knapsack sprayers before transplanting the seedlings. Later the plots are weeded using hand tools to control the second generation of weeds.

Financial resources are major constraints limiting the adoption of any expensive farming technology. In Kenya herbicides are quite expensive, which contributes to the low rate of adoption. Herbicides also require large amounts of water for dilution before spraying. Fetching water, and transporting it to the fields where all the operation are carried out manually, requires a lot of labour and may also contribute to the low rate of adoption.

Many of the weeds found in the farms produce large quantities of seed with varying degrees of dormancy. When a flush of newly germinated weeds is controlled with a herbicide a new generation of weeds later emerges from a reservoir of dormant seeds and could easily reduce the effectiveness of the initial herbicide application. Several of the weeds are hardy and difficult to eradicate using the

available herbicides. As a result farmers often combine chemical weeding with mechanical weeding and often cannot quantify the role played by each practice.

Most smallholder farmers are poorly educated. This may pose problems of understanding the recommended quantities and methods of applying the herbicides. Reduced tillage systems will depend on extensive farmer orientation and product information transfer through the agricultural extension services and the chemical firms' technical field officers.

## Conclusion

Draft animal power is expected to continue to occupy a significant place in tillage practices in the medium potential areas of Kenya. Its development and improvement in all aspects including animal production for draft animal provision and animal-drawn implements will continue to be priority areas for applied agricultural research.

*Photograph opposite*  
Stockpile of plows at the Lenco factory, Zambia