

Improving animal-powered tillage systems in Tanzania

by

A K Kayumbo

Agricultural Officer (Mechanisation), Ministry of Agriculture, PO Box 9071, Dar es Salaam, Tanzania

Abstract

In many developing countries agriculture is still largely based on hand tool technologies, with animal traction and tractors playing minor roles. Agriculture could be made more efficient and successful if this situation were reversed, with animal traction being the major source of farm power, supplemented by hand tools and engine-powered technologies where required.

Unfortunately animal traction is still regarded as no more than the use of ox plows on the farm. Ox plows are important in any tillage system as a means of relieving the farmer from the drudgery of hand tool cultivation, but unless other animal-powered implements, for example for harrowing, planting, weeding and even harvesting, are used in conjunction with plows, the full benefits of using ox plows may not be realised. Indeed, exclusive use of ox plows without such other implements could put an additional workload on the farmer.

This paper discusses the use of a wide range of animal-powered agricultural implements that could be used to improve the efficiency of agriculture in Tanzania.

Background

A major benefit of using ox plows is that a given area of land can be cultivated in a much shorter time than it can using hand hoes. But this increased efficiency can also have its drawbacks. For example, weeds can be growing over an entire field within a few days, and if the household relies only on hand tools for weeding, and if hired labour is not available, this can cause a serious labour bottleneck. If weeding is excessively delayed, there is a risk that the farmer may even lose a portion of the crop. If the farmer capitalises on the use of ox plows by increasing the area under cultivation, while still relying on hand tool technologies for other agricultural operations, the labour constraints become even more serious.

A solution to this dilemma is to complement the use of ox plows with more efficient methods and implements for other farm activities—harrowing, planting, weeding and even harvesting—also using animals as the source of power. Unfortunately, many farmers lack the technical know-how to use animals for these other agricultural tasks, largely because suitable effective and durable implements are not available.

This paper describes some animal-powered implements that could be used to increase agricultural efficiency in Tanzania.

Plows

In many countries, including Tanzania, the most commonly used plows are the 25 cm mouldboard types on short steel beams (Photo 1). Several other types of plow, are available, for example:

- ripping plows including the Ethiopian *maresha* and the ripper tine
- 15 cm single mouldboard plows on wooden or steel beams which can be short or long
- 25 cm reversible plows
- 25 cm single mouldboard plows on steel and wooden beams or toolbars and toolcarriers
- 25 cm double mouldboard plows on steel frames or toolcarriers.

A potential hazard with the extensive use of ox plows is the possibility of accelerated soil erosion, particularly in areas where farmers do not observe soil conservation measures. Thus while the plow may be introduced to improve primary and secondary tillage operations the overall benefits may be negative if soil degradation occurs over the plowed land in subsequent years (Elwell, 1990).

The plow should therefore be used in conjunction with proper tillage systems such as contour plowing using appropriate plowing patterns, reversible plowing, plowing between contour grass strips and trash bunds, plowing between terraces, etc.

Photo 1: Mouldboard plow commonly used in Tanzania



Photo: A K Kayumbo

The plow steel beam can also function as a simple toolbar: various attachments for weeding, furrow opening for planting purposes, ripping and earthing-up can be fixed to it with a bracket (Starkey, 1988).

Harrows

Farmers in upland farming systems rarely harrow after plowing, mainly because harrowing with hand tools is such a tedious operation. Farmers in these areas generally carry out a second plowing to kill weeds immediately before planting, but harrowing would be a quicker and much more efficient way to prepare a fine seedbed free from weeds, if a suitable and effective implement were available.

Many of the harrows currently available on the market are too light to be effective in breaking up soil clumps and killing weeds (Figure 1).

Five-tine cultivators can be used as harrows in a two-stage process. First, the cultivator is fitted with two reversible teeth in the front and three 20 cm sweeps (or one 70 cm sweep) on the hind tines, to cut the weed roots just below ground level. Second, reversible teeth are fitted on all five tines of the cultivator (Photo 2) to disintegrate the soil, thus shaking the soil from the weed roots to expose them to the sun for desiccation. Alternatively the two operations can be combined in one by fitting a 70 cm sweep in the rear and four reversible teeth in the front.

Planters

Planting is also a very tedious and time-consuming operation, particularly when the inter-row and within-row spacings are small. Many farmers tend either to broadcast the seeds or to plant them in hills with two or more seeds per hill.

Row planting is equally difficult to achieve with hand planting methods and most farmers prefer to plant behind the first or second plowing operation, dropping seed every two or three furrow slices behind the plow (Kjærby, 1983).

Figure 1: Zig zag harrow

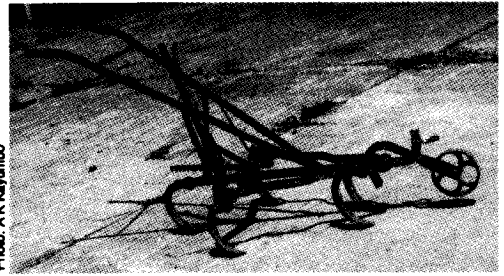
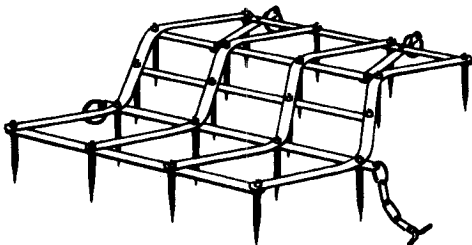


Photo: A K Kayumbo

Photo 2: Cultivator fitted with five reversible tines for harrowing

The main problem with using planters is the need to use graded seed. The seed must be graded both in size and shape and appropriate seed plates used (Kayumbo, 1987). Vertical seed metering devices tend to be more effective than horizontal seed plates.

Most animal-powered planters on the market are single row planters. Donkeys are best used to pull such single row planters as planting can be cumbersome with two oxen. The use of multiple row planters may have potential. Initially very simple ox-drawn multiple row seeders should be introduced. Such seeders are basically to be provided with furrow openers with which to open shallow furrows along which seed and fertiliser can be dropped and covered.

Having this idea in mind it is possible to adapt and convert some implements for seeders. A simple tine can be attached to the beam of a mouldboard plow to make a simple furrow opener (Photo 3). The five tine cultivator can be converted to operate as a simple ox-drawn multiple row hand seeder by fitting furrow openers, seed tubes and simple fertiliser and seed hoppers. A seed covering device and a row marker can be added but seed and fertiliser can be dropped or metered by hand behind the implement.

Alternatively, a farmer can opt to open half ridges using a hiller and then drop seed along the top and fertiliser along the bottom of the half ridge by hand; these are covered as the ridge is completed on the return pass. The hiller can be fitted on the rear tine of a five-tine cultivator or on the steel beam of the plow and ridge.

Ridge cultivation systems

It is interesting to see a farmer constructing a 90 cm ridge using a hoe. The farmer first cuts a half ridge piling three slices of soil at a time with the first slice neatly turned under to bury the weeds as the half ridge is formed. Similarly, when completing the ridge the farmer does the same, ending with a well-formed and weed-free ridge.

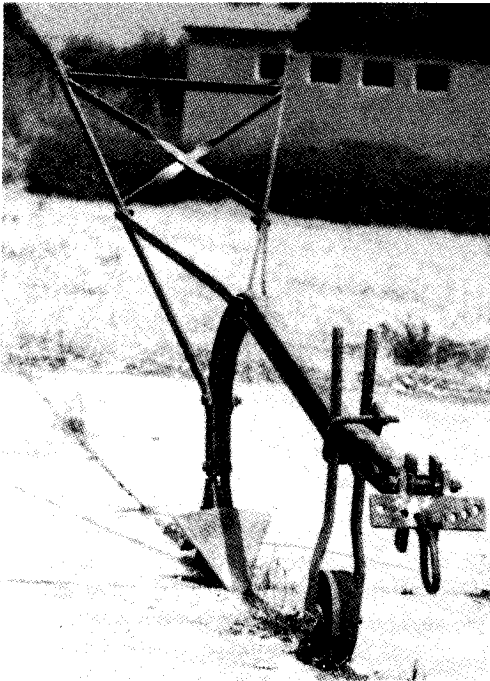


Photo: A K Kayumbo

Photo 3: Furrow opener for planting

In order to form a good, weed-free ridge using the ox ridger the farmer has to observe the following:

- ideally, the land is plowed and the first weed population allowed to germinate before ridging
- young weeds are best killed using effective weeding implements leaving unweeded strips along which the ridges are built. By following this procedure ridges will be well formed and free from weeds
- in light soils, such as sandy loams, it may be possible to split old ridges with the ox ridger without plowing by allowing the first generation of weeds to germinate and then cleaning the ridges of all weeds before constructing new ridges
- to clean the weeds on the old ridges using oxen, a tie ridger/weeder blade fitted on the plow or ridger steel beams or fitted on the hind tine of the cultivator can be used. The blade is used in the tilted position if necessary
- when the plow is used to construct new ridges, old ridges are best cleaned of weeds using the tie ridger/weeder
- the tie ridger/weeder blade is also a suitable implement for weeding between 70–90 cm ridges and tying them in one pass to conserve soil and water.

Minimum tillage

In semi-arid areas, shifting cultivation is still a common practice. Shifting cultivation consists of slashing bush followed by burning and direct seeding in the first year. In subsequent years, however, the farmer has to clean the field of all crop residues before burning and planting. Here the farmer may plant the seed after the first showers of rain or dry plant just before the rains start. This means the weeds germinate ahead of the crop, or together with the crop, and the farmer must start hand weeding immediately the weeds start germinating or just after planting if the field was already infested with weeds at the time of planting.

If herbicides are not available, this system of cultivation can be improved through the use of the ripper tine in combination with sweeps as follows:

- the first generation of weeds is allowed to germinate for three days after the onset of the rains
- the young weeds are killed using sweeps
- the ripper tine is used to break the soil in rows at the recommended inter-row spacing
- the seed can then be planted immediately along the loosened row, preferably using a jab planter.

Subsequent weeding operations are possible using sweeps and hillers.

Alternatively the ripper tine can be used just before the onset of the rains, but planting is then delayed until the first young population of weeds has germinated and been killed using sweeps.

Irrigation farming

Although animals are rarely used in irrigation farming in Tanzania, here are several interesting possibilities for the use of various ox-powered implements and farm equipment (Starkey, 1989):

- furrowers can be used in collaboration with plows to construct irrigation furrows
- wooden bund formers (Figure 2) can be made locally and used for the basin irrigation system
- single row ditchers can easily be made from local materials (including timber) and used to construct water transport canals
- scraper type implements (including the buckscraper) can be used for levelling work (Hopfen, 1981)
- dam scoops made from oil drums (200 litres) can be used to construct dam walls.
- rotating puddlers can be used in conjunction with suitable harrows for puddling paddy fields.

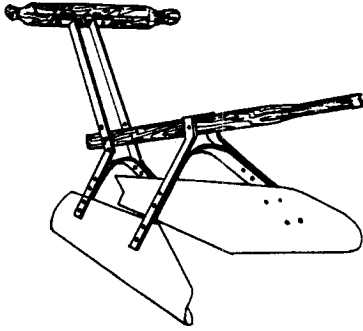


Figure 2: Wooden bund former

Terraced cultivation systems

As mentioned above, the farmer has to use the ox plow together with proper soil conservation measures, particularly the use of terraces.

Although little is known in Tanzania about animal-powered implements that can be used for the construction of terraces, the following possibilities exist:

- different types of plows and ripper tines can be used to loosen the soil so that earth-moving implements can be used
- dam scoops can be used to move the loosened soil and level the terrace
- similarly, scraper blades can be used with the dam scoop for better levelling and quicker results.

References

- Elwell H A, 1990. *A review of current erosion research at the Institute of Agricultural Engineering (IAE), Harare, Zimbabwe*. Institute of Agricultural Engineering, Harare, Zimbabwe.
- Hopfen H J, 1981. *Farm implements for arid and tropical regions*. (Revised edition). FAO Agricultural Development Paper 91. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. 159p.
- Kjærby F, 1983. *Problems and contradictions in the development of ox-cultivation in Tanzania*. Research Report 66. Scandinavian Institute of African Studies, Uppsala, Sweden. 164p.
- Kayumbo A K, 1987. Constraints to the wider use of farm equipment in the rural areas. pp. 35–39 in: *In quest of agricultural mechanisation policy and strategies in the United Republic of Tanzania*. Proceedings of national workshop on farm tools and equipment technology: basic needs and employment, held 8–10 October 1985, Dar es Salaam, Tanzania. International Labour Organisation (ILO), Geneva, Switzerland. 69p.
- Starkey P, 1988. *Perfected yet rejected: animal-drawn wheeled toolcarriers*. Vieweg for German Appropriate Technology Exchange, GTZ, Eschborn, Germany. 161p.
- Starkey P, 1989. *Harnessing and implements for animal traction*. Vieweg for German Appropriate Technology Exchange, GTZ, Eschborn, Germany. 244p.