Farmer-led adoption of ox weeding in Machakos District, Kenya

by

Kate Wellard and Mike Mortimore

Overseas Development Institute, Portland House, Stag Place, London SW1E 5DP, UK

Abstract

Machakos District, Kenya, is hilly and dry, but a large population means much land is cultivated. Animal traction is widely used for plowing and weeding. In 1978, 90% of cultivated lowland was inter-row weeded with oxen, using mouldboard plows. Factors contributing to the high adoption rate of ox cultivation included: a large, healthy cattle population as a result of traditional ownership; implement availability through private traders; extensive terracing allowing ox cultivation on all but the steepest slopes; credit availability; labour constraints; establishment of land ownership rights; a favourable environment for investment due to cash crops. Innovation by farmers and technology transfer between farmers have been more important than government extension services.

Introduction

Machakos District, located in southern Kenya between Nairobi and Mombasa, is classified as an arid/semi-arid area. Much of the topography is sloping. The district is peopled by the Akamba tribe. With population growing at over 3% per annum on a fragile land base, declining agricultural production per capita and environmental degradation might have been expected. However, livestock and crops have been integrated and production has kept up with population growth despite the spread of people into the more arid areas of the district. The environment is now in a better condition than in the 1930s, with almost all arable land protected by terraces. A continuing process of adoption and adaptation of new technologies from a variety of sources by small-scale Machakos farmers lies behind this 'success story'.

Researchers from the Overseas Development Institute and the University of Nairobi have traced the development of 80 productive technologies in the district from 1930 to 1990 (Tiffen, Mortimore and Gichuki, 1994).

History of ox cultivation and weeding

Cattle have always played an important part in the Kamba economic system. Originally they were repositories of investment funds, indicators of socioeconomic status and the dominant consumers of natural resources. With the development of other forms of saving and investment, and competing land use with arable crops, a major reason for owning cattle became the maintenance of a plow team (Mortimore and Wellard, 1991). By 1980, 78% of farmers in Mwala Location owned ox plows and 72% owned oxen (Rukandema, Mavua and Audi, 1981). Ownership in Makueni was 91 and 76%, respectively (Heyer, 1975). The rate of use of oxen and bullocks for plowing is even higher, with an active hire market and borrowing.

The use of oxen and bullocks for weeding was first recorded in the district in 1948 when men in Masii Location tried out a practice observed during wartime travel, mainly in India, Burma and Egypt (ODI interviews, 1990). During the 1950s, extension workers were promoting row-planting and inter-row weeding. However, in the early 1960s, few farmers in Masii (Heyer, 1967) and Embui (ODI interviews, 1990) Locations were found to be following the practice. Yet by the mid-1970s, much of the lowlands was ox weeded (in the first weeding), up to 86% of farmers in Makueni Location weeded with oxen (Heyer, 1975), and 90% of the cultivated area surveyed by Lynam (1978) was also weeded with oxen.

The first plows to be used in the district were very heavy, reportedly requiring up to 12 oxen for draft. In 1935, a smaller Hindustani plow introduced by the Department of Agriculture was said to be becoming popular. The lighter Victory mouldboard plow came into use in the 1940s, introduced by Indian traders. It used only one pair of oxen and was more easily managed, although farmers say it is less strong than the early plows. The mouldboard plow is compatible with reduced livestock holdings,

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smaller grazing areas and the less frequent need to break new ground as shifting cultivation patterns were stabilised. It would have been easier to manipulate on the terraces that became increasingly common from the 1950s, and on the small fields of the uplands. It is also compatible with increased participation of women in plowing work (Mortimore and Wellard, 1991).

Official reaction to the mouldboard plow, however, was largely negative. In particular, it was judged to be unsuitable for dry plowing and planting before the rains begin (de Wilde et al, 1967; Johnston and Muchiri, 1975); it failed to produce a cloddy structure for infiltration and to control weeds; and the same 20 cm furrow was used for primary cultivation, seedbed preparation and weeding (Alexander, 1975).

Various attempts have been made to introduce 'improved' traction equipment. Experiments with a single toolbar showed that weeding requires 5% of the labour hours per hectare required in hoe weeding (Muchiri, 1980). On the basis of this work, the Machakos Integrated Development Programme (MIDP) introduced, in 1979, a multipurpose toolbar which it hoped would be able to break the hard ground prior to the rains and serve for land preparation, planting and weeding. However, uptake was slow, several hundred units were unsold, and most users preferred their old plows, finding the MIDP equipment too heavy for their draft oxen (ODI, 1982). An evaluation report concluded that the problems of the mouldboard plow had been overstated. The mouldboard plow, slightly modified and available in different sizes, is the one principally used for plowing, planting and weeding in Machakos today (Mortimore and Wellard, 1991).

Factors affecting the adoption of ox weeding technology

The existing traction technology is imperfect, but this has not hindered very widespread adoption. Other factors influencing the adoption of the technology include crop husbandry, livestock ownership and management and socioeconomic factors.

As land holding sizes and grazing land have diminished, increasingly marginal areas have been brought under cultivation and cropping is now practised on a continuous basis throughout the district. An intensification of land use has accompanied this transformation. The protection of land by terraces, primarily to check soil and water erosion, created a necessary precondition for the use of oxen in the hill locations.

The advantages of timely weeding in conserving moisture by limiting weed competition, reducing run-off and increasing infiltration are recognised fully in some Akamba ox weeded systems (see, for example, Neunhauser et al, 1983).

The replacement of broadcast sowing with row planting (mainly for maize, the staple crop in all except the driest parts of the district) after about 1960 has facilitated the adoption of inter-row weeding (Lynam, 1978). The practice was promoted by extension workers from the 1950s, although women farmers interviewed in Embui did not learn it until after 1960 (ODI interviews, 1990).

The availability of suitable animals for traction has been critical to the uptake of plowing and weeding technologies. A tradition of cattle ownership, supported by improvements in animal health, nutrition and cross-breeding, has enabled the district to support a productive cattle production throughout the 1930–1990 period. Ownership of draft animals is directly related to the area of land a farmer can cultivate and, presumably, weed. For example, in Nzaui Location, the majority of farmers owned a pair of draft oxen or bulls, but one-third owned no draft animals and were found to be cultivating a smaller area than the average (Rukandema, Mavua and Audi, 1981). Farmers owning oxen or bulls were generally able to carry out their agricultural operations on time, but other farmers, who might borrow or hire a team or plow and weed by hand, were unable to do so. Ownership is also related to ecology and size of farms. Thus, in the lowland locations of Masii and Ngwata, most farmers are said to own a plowing team, but in the hills of Mbooni, where holdings are small and intricately terraced, many farmers are obliged to cultivate by hand (ODI interviews, 1990).

Ox weeding as practised in Machakos was estimated to reduce labour requirements at peak times from 17 to 11 days per hectare (Lynam, 1978). This was an advantage especially where farmers had extended their cultivated land in the drier, land surplus areas. Even where holding sizes are small (less than 1 ha), high-school enrolment rates and temporary

migration of young people to work in urban centres can create seasonal labour bottlenecks.

The institutionalisation of individual tenure that begun under colonial rule in the 1930s is now virtually complete. By the 1980s there was no unclaimed land in Machakos, although not all land had been registered. This has had a marked effect on land development and adoption of technologies (Tiffen, 1992). As one farmer in Makueni argued: "you cannot effectively develop a piece of land unless you know it belongs to you" (ODI interviews, 1990). The link between clarity of ownership or permanency of rights and the establishment of soil structures and trees is evident, but the wider effects on adoption of productivity enhancing technologies may also be felt.

Other developments in the district have also played a part in the uptake of animal traction technologies. In the 1950s, general agricultural prosperity and a high level of employment outside the district made investment funds available. Credit was provided by Asian traders, and much of the government's supervised credit was used for plows and ox carts. Coffee (after 1950) and cotton (from 1960) brought in cash (Mortimore and Wellard, 1991).

Conclusions

The adoption of animal power for weeding in Machakos has been contemporaneous with a number of developments in the district. Most important of these have been:

- the availability of implements, mainly through private traders
- a population of sufficiently healthy animals
- the construction of terraces on sloping areas
- some labour constraints
- the availability of capital
- a favourable environment for investment.

The source of innovation has been individual farmers who had travelled abroad, and traders. Its spread has been due less to the efforts of government extension services than to farmer to farmer exchange.

Despite negative official reactions, mouldboard plows ('Victory'-style) are widely used by farmers for plowing and weeding. MIDP's attempts to introduce 'improved' technology have been largely unsuccessful. An imperfect technology in the hands of skilful farmers is better than a poorly tested innovation, whose adoption calls for a major, risky investment.

References

Alexander E N, 1975. Increasing the efficiency of the traditional systems of ox cultivation. In: Westley S B and Johnston B F(eds), *Proceedings of a workshop on farm equipment innovations for agricultural development and rural industrialisation*. Occasional Paper 16. Institute of Development Studies, University of Nairobi, Kenya.

Heyer J, 1967. *The economics of small-scale farming in Lowland Machakos*. Occasional Paper 1. Social Studies Division, Institute of Development Studies, University of Nairobi, Kenya.

Heyer J, 1975. Preliminary report on farm surveys: tractor and ox cultivation in Makueni and Bungoma. In: Westley S B and Johnston B F (eds), *Proceedings of a workshop on farm equipment innovations for agricultural development and rural industrialisation.* Occasional Paper 16. Institute of Development Studies, University of Nairobi, Kenya.

Johnston B F and Muchiri G, 1975. Equipment and tillage innovations for Kenya's medium potential (semi-arid) farming regions. In: Westley S B and Johnston B F (eds), *Proceedings of a workshop on farm equipment innovations for agricultural development and rural industrialisation*. Occasional Paper 16. Institute of Development Studies, University of Nairobi, Kenya.

Lynam J, 1978. *An analysis of population growth, technical change and risk in peasant, semi-arid farming systems: a case study of Machakos District, Kenya*. PhD Dissertation, Stanford University, USA.

Mortimore M and Wellard K, 1991. *Environmental change and dryland management in Machakos District, Kenya, 1930–1990: profile of technological change.* Overseas Development Institute (ODI) Working Paper 62. ODI, London, UK.

Muchiri G, 1980. Production and use of agricultural machinery in Kenya. *Industry and Development* No 9.

Neunheuser P, Bayreuther H, Engel A, Friesenegger M, Magelassa A, Neves A, Renneke V and Salzer W, 1983. *Appropriate land use systems for smallholder farms: a survey of ecological and agroecological conditions in the Machakos District, Kenya*. Centre for Advanced Training in Agricultural Development, Technical University of Berlin, Germany. pp. 32–33.

ODI, 1982. *Machakos Integrated Development Programme: Phase 1 Evaluation*. Overseas Development Institute (ODI), London, UK.

Rukandema M, Mavua J K and Audi P O, 1981. *The farming system of Lowland Machakos, Kenya: farm survey results from Mwala*. Farming Systems Economic Research Programme Technical Report (Kenya) 1. Ministry of Agriculture, Nairobi, Kenya.

Tiffen M (ed), 1992. *Environmental change and dryland management in Machakos District, Kenya, 1930–1990: institutional profile*. Overseas Development Institute (ODI) Working Paper 62. ODI, London, UK.

Tiffen M, Mortimore M and Gichuki F, 1994. *More people, less erosion: environmental recovery in Kenya.* African Centre for Technology Studies Press, Nairobi, Kenya. 311p. ISBN 9966-41-082-1

de Wilde, J C et al, 1967. *Experiences with agricultural development in tropical Africa. Vol 2. The case studies.* Johns Hopkins Press, Baltimore, MD, USA.

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