On-farm participatory research on ox-powered weeding technology in Sukumaland, Tanzania

by

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Abstract

Sukumaland in north-west Tanzania makes an important contribution to the national production of cotton and maize. The use of animal traction for plowing is common. Inadequate weeding is considered the major factor limiting crop production. Ox-drawn weeders (inter-row cultivators) could do much to alleviate the problem. Following the farming systems diagnostic survey, ox-drawn weeders were tested in different villages. Three models of weeders (Cossul, Agro-Alfa and Mkombozi) were tested by farmers in different types of soils.

Farmers emphasised the importance of early weeding. On average ox-weeded maize yielded 4782 kg/ha and hand-weeded plots only 2649 kg/ha. Ox-weeded cotton fields yielded an average of 575 kg seed cotton/ha compared to 475 kg seed cotton/ha for hand-weeded plots. Economic analysis showed that ox weeding took less than one-quarter of the time of hand weeding (39 and 173 working hours/ha, respectively). The quality of the equipment differed, but the choice of which model to buy depended on the price and soil type.

Introduction

Sukumaland, comprising Mwanza and Shinyanga Regions, has a cattle population of about 3 million, or one quarter of the national livestock herd. Some 15–30% of the cattle are oxen and these are used to plow more than 50% of the land (Wella, Babu and Roeleveld, 1993; Ngendello, 1995). Animal traction was introduced to Sukumaland as early as 1923 (Oloufa, 1982), but it was used mainly for primary tillage and transport. Starkey (1985, 1988) found that although animal-drawn weeders are available in most African countries, only 5% of those farmers using animal traction for plowing practise animal-powered weeding.

Diagnostic surveys in Mwanza and Shinyanga Regions confirmed that weeding was a major limiting factor in crop production in ox-cultivated areas (Bantje, 1989; Wella, Babu and Roeleveld, 1993; Bunyecha et al, 1994). Different alternatives to solve the weeding problem were discussed with farmers.

The first attempt to alleviate the problem was made in 1989/90 when different types of herbicides were tested in Maswa and Meatu District, Shinyanga Region. Within one season the technology had failed completely, as it did not fit the existing farming system; a particular problem was access to water supplies.

The second attempt was made in 1991 when ox-drawn inter-row cultivators were tested in two villages. The main objectives were to determine the technical, social and economic aspects of ox weeding compared to hand weeding. Results appeared very promising.

In 1992, the testing was transferred to Kwimba District, Mwanza Region. The research approach also changed from individual contact farmers to the group approach. Farmer Research Groups were formed and proved very valuable (Wella and Roeleveld, 2000). Farmers first tested the *Cossul* weeder and initial reactions of male and female farmers were very positive (Wella and Roeleveld, 2000).

After three seasons of intensive testing involving three types of ox-drawn weeder, farmers began to buy the weeders of their choice. Some of the farmers involved in the programme have also trained other farmers (even some from outside the district) on animal-powered weeding.

This paper discusses the methodology, success, potentials and problems encountered or likely to be encountered in the introduction and dissemination of ox-weeding technology.

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Table 1: Mean yields of maize and cotton from ox-weeded and hand-weeded plots

	Mean yield (kg/ha)				
Crop	*Ox-weeded*	*Hand-weeded*	*t-value*	*Probability*	*Number of plots*
Maize	4782	2649	2.138	0.040	18
Cotton	575	475	1.854	0.106	8

Methodology

The trial was conducted for three years. Three villages were selected (Kishili, Mwakilyambiti and Mwampulu) and in each village three types of ox weeder (*Cossul, Agro-Alfa* and *Mkombozi*) were tested.

The number of farmers per village varied between 10 and 20 and on average one ox weeder was available for three households. Most farmers had both an ox-weeded plot and a hand-weeded plot; plot sizes varied, but the minimum plot was 0.5 ha (randomised block design).

In the third year some maize fields were intercropped (randomised complete block design) with cowpeas in both hand-weeded and ox-weeded plots (as requested by female farmers) to observe the effect on ox weeding. Weeding started in November/December and continued until January/February.

Farmers recorded data on time spent, labour distribution per activity and the people involved. Data on yield were collected by researchers in a 4 x 5 m area. Technical data were analysed and followed by a farmer assessment.

Results and discussion

Crop yields

Shetto (1988) reported that relieving labour constraints without increasing yields would justify only a low level of adoption of animal weeding technology. This was not the case in Kwimba District, as labour productivity became the main criterion for acceptability and adoption of ox-powered weeding technology.

General analysis of yield data for maize showed a significant difference between ox-weeded and hand-weeded plots (t-test at 5% significance). Analysis per village showed significant differences in only villages. For cotton, no significant differences were observed. Results are summarised in Tables 1 and 2.

Time, labour productivity and labour arrangements

Table 3 compares the outputs from ox-weeded and hand-weeded fields in Kishili and Mwakilyambiti villages, showing that ox weeding takes less than one-quarter of the time of hand weeding. This implies that productivity of labour during weeding can be increased by using animal traction.

Table 2: Comparison of mean yields of maize and cotton from ox-weeded and hand-weeded plots, by village

	Mean yield (kg/ha)				
Village	*Ox-weeded*	*Hand-weeded*	*t-value*	*Probability*	*N*[a]
Maize					
Kishili	5225	4606	0.880	0.412	7
Mwakilyambiti	5421	2143	2.357	0.023	7
Mwampulu	3700	1200	4.192	0.032	3
Cotton					
Kishili	700	600	1.750	0.140	6
Mwakilyambiti	450	350	1.000	0.055	2

[a] *Data for one farmer for maize are omitted because of dubious quality*

Table 3: Performance of maize cropping in ox-weeded and hand-weeded plots, Kwimba District, 1994/95

	Weeding time (h/ha)		*Yield (kg/ha)*		*Output (kg/h)*	
Village	*Ox-weeded*	*Hand-weeded*	*Ox-weeded*	*Hand-weeded*	*Ox-weeded*	*Hand-weeded*
Kishili	40	178	5425	4606	136	26
Mwakilyambiti	38	169	5421	2143	143	13

An economic analysis of hand and ox weeding, presented in Table 4, shows that ox weeding is highly profitable. Therefore, ox-weeding technology is both technically and economically superior to hand weeding.

Women and young children did most of the interplant weeding. In circumstances where only a husband and his wife are in the field, women tend to lead the ox team.

Technical assessment of the ox weeders

Farmers used different models of ox weeders in different types of soils. The technical assessment of each type in relation to soil was quite clear. They all agreed that all types are appropriate depending on the type of soil intended for use. The *Agro-Alfa* and *Mkombozi* were ranked higher than *Cossul* in terms of strength and durability of parts, and hence were considered suitable for heavy soils *('Mbuga')*. However, the *Cossul* model was mostly liked by farmers due to its lightness (suitable in light soils like *'Luseni'* and *'Itogolo'*), price and good handling qualities. It was noted that the efficiency in weeding for all models depended on the soil type on one hand and experience of both oxen and the user on the other hand. The proportion of different soil types varied markedly between villages.

Equipment quality

The inter-row cultivators tested performed well provided that the fields were well prepared, and that weeding was done at the optimum time. Using the *Cossul* on stony or stumpy land can lead to breakage of cast iron parts and bending of soft steel components (Loewen-Rudgers et al, 1990; 2000), but these problems did not occur in Kwimba District, and only a few implements suffered damage in three years of use. The majority of farmers bought a cheap *Cossul* cultivator for the 1995 season.

Efficiency in eradicating weeds

Some weeds caused major problems, especially when weeding was delayed or seedbed preparation had been poor. There is positive correlation between weed type and soil; plant species with a stronger deep root system and quick vegetative growth (such as *'migundululu'*) are common in heavy soils. In light soils the most troublesome weed is *'tiza'* (*Commelina* spp), which tends to collect along the duckfeet of the weeder, lifting the tines and leaving unweeded patches.

In general it was noted that ox weeding was more effective than hand weeding in eradicating weeds because of deeper penetration which destroys the rooting system. In addition, ox weeding clears weeds off the field, so there is no chance of regrowth.

Farmer assessment

Many farmers still weeded late and few farmers (about 20%) did a second ox weeding (recommended weeding time is two weeks after sowing). Only 10% of farmers did ox weeding within two weeks after planting, 67% between two to four weeks and 23% after four weeks. Reasons for late weeding included the shortage

Table 4: Economic analysis of hand and ox weeding, Kwimba District, 1994/95

	Cost of hiring labour (Tsh/ha)	*Average weeding time*[a] *(h/ha)*	*Cost of weeding (Tsh/ha)*	*Value of output*[b] *(Tsh/h)*	*Benefit:cost ratio*
Hand weeding	7000	173.5	40	887	22.0
Ox weeding	3500	39.0	90	6401	71.3

[a] *Averages for the two villages (see Table 3)*

[b] *Based on output averages for the two villages (see Table 3) and market price of Tsh 46/kg for maize during harvesting (US$1=Tsh 500 at time of study)*

of weeders when the trial was carried out, flooded fields and unexpected family problems.

Discussion with farmers in Kwimba showed that ox weeders would not remove weeds that were about 30 cm high. It was also noted that earlier weeding can facilitate good eradication of weeds between plants, as soils can easily be thrown on top of small weeds, and subsequent hand hoe weeding is not necessary. Farmers noted that if ox-weeding technology was introduced to farmers without emphasising the importance of early weeding, the technology would be rejected in the long run.

In the cowpea intercropped trial, farmers indicated clearly that the spreading variety of cowpea can impair a second ox weeding.

References

Bantje H, 1989. *Farming system diagnostic survey in Maswa and Meatu Districts, Shinyanga Region*. Working Paper 4. Tanzania/Netherlands Farming Systems Research Project, Lake Zone Agricultural Research and Training Institute, Ukiriguru, Mwanza, Tanzania.

Bunyecha K, Bagarama F, Babu A, Bulderman A, Enserink H, Kileo R, Makundi P J, Roeleveld A C W, Tamminga K J and Wella E B, 1994. *Farming system informal survey in Kwimba District, Mwanza*. Working Paper 9. Tanzania/Netherlands Farming Systems Research Project, Lake Zone Agricultural Research and Training Institute, Ukiriguru, Mwanza, Tanzania.

Loewen-Rudgers L, Rempel E, Harder J and Klassen Harder K, 1990. Constraints to the adoption of animal traction weeding technology in the Mbeya region of Tanzania. pp 460–471 in: Starkey P and Faye A (eds), *Animal traction for agricultural development.* Proceedings of the Third Regional Workshop of the West Africa Animal Traction Network, held 7-12 July 1988, Saly, Senegal. Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. 475p. ISBN 92-9081-046-7

Loewen-Rudgers L, Rempel E, Harder J and Klassen Harder K, 2000. Constraints to the adoption of animal traction weeding technology in Mbeya Region, Tanzania. In: Starkey P and Simalenga T (eds), *Animal power for weed control*. Animal Traction Network for Eastern and Southern Africa (ATNESA) and Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. ISBN 92-9081-136-6

Ngendello A, 1995. *Animal husbandry in two contrasting cropping systems, Kwimba District: diagnostic survey report. Part II. Luseni and Mbuga dominated system*. Working Paper 12. Agricultural Research and Training Institute-Ukiriguru, Mwanza, Tanzania. 65p.

Oloufa M, 1982. *Sell that tractor while still running*. Expert consultation on appropriate use of animal energy in agriculture in Africa and Asia, 15–19 November 1982, Rome, Italy.

Shetto R, 1988. *Preliminary observation on the introduction of animal drawn weeding technology in Mbeya Region*. Mbeya Oxenization Project, Mbeya, Tanzania.

Starkey P, 1985. *Animal power utilisation in Malawi*. Report of AGA consultancy mission 7–21 September 1985. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

Starkey P H, 1988. *Perfect yet rejected. Animal-drawn wheeled tool carriers*. Vieweg for German Appropriate Technology Exchange, GTZ, Eschborn, Germany. 161p. ISBN 3-528-02053-9

Wella E, Babu A and Roeleveld A C W, 1993. *Livestock diagnostic survey in Kwimba District. Part I. Itogolo dominated system*. Working Paper 12. Agricultural Research and Training Institute-Ukiriguru, Mwanza, Tanzania. 84p.

Wella E and Roeleveld A C W, 2000. Participatory research on oxen-drawn weeders in Lake Zone, Tanzania. In: Starkey P and Simalenga T (eds), *Animal power for weed control*. Animal Traction Network for Eastern and Southern Africa (ATNESA) and Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. ISBN 92-9081-136-6

