Constraints to the adoption of animal traction weeding technology in Mbeya Region, Tanzania

by

L Loewen-Rudgers*, E Rempel, J Harder and K Klassen Harder

Mbeya Oxenization Project, PO Box 2904, Mbeya, Tanzania and
Mennonite Economic Development Associates (MEDA)
402-280 Smith Street, Winnipeg MB R3C 1K2, Canada

Abstract

Mbeya Region of Tanzania is relatively fertile and makes an important contribution to the national production of maize, the major food crop. Inadequate weeding is the cause of low maize yields. Animal-drawn weeders could do much to alleviate this, but only 15% of the 200 000 smallholder farmers in the region own cattle, and most of these do not use draft animals for weeding. One objective of the Mbeya Oxenisation Project is to increase the use of animal weeding by farmers already plowing with cattle.

Following a literature review, baseline survey and discussion with farmers, nine key constraints to the adoption of animal traction weeding were identified. In descending order of importance these are:

- *non-availability of implements*
- *poor implement quality*
- *inadequate repair services at village level*
- *previous emphasis on inter-row rather than over-the-row cultivators*
- *poor extension*
- *lack of communication between manufacturers and farmers*
- *poor timeliness of operations*
- *inadequate training of animals*
- *fear of crop damage by animals and implements.*

Because the specific target group comprises ox-using farmers, four other possible constraints–limited capital, overriding risk avoidance, gender division of labour and too-complicated technical packages–are less important. They could, however, be major constraints to farmers adopting animal traction for the first time.

The project hopes to overcome problems relating to implement supply, design and quality by working with local manufacturers. The repair problems may be solved by supporting and training village artisans. Solutions to the constraints relating to on-farm practices are probably known by some progressive farmers; working in villages with 'contact farmers' should identify appropriate solutions, and may stimulate the interest of other farmers. This extension approach, based on innovative farmers and inter-farmer information flows, should be effective and sustainable.

* Subsequent addresses: L Loewen-Rudgers
Mennonite Central Committee
PO Box 14894, Nairobi, Kenya

Background

The population of Mbeya Region is 1.1 million, about 5% of Tanzania's population of 22 million. The region's land area is six million hectares, or 7% of Tanzania's land area of 89 million hectares. Approximately 200 000 predominantly smallholder farm families cultivate 385 000 ha out of the total 2.8 million arable hectares. Corresponding figures for Tanzania as a whole are 2.25 million farm families cultivating 6.2 million hectares out of the total of 39.5 million arable hectares (Croon, 1982; EIU, 1987).

Soils in the region vary considerably. There is a high proportion, perhaps one-third, of *Inceptisols* (USDA) containing recent volcanic ash (in the FAO system of classification they are known as *Cambisols* and *Andosols*). These have higher fertility, water-holding capacity and alkalinity than the more typical 'tropical soils' such as *Oxisols* (*Ferrasols*) which occupy perhaps one-third of the land area. About one-third of the area has sandy *Entisols* (*Arensols* and *Regosols*). Average annual rainfall in the region is quite high (1300 mm) but varies considerably (600–3600 mm). The average elevation is 1300 m above sea level,

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with a range of 500–2800 m (Rombulow-Pearse and Kamasho, 1982).

Because of the variation in precipitation, elevation and soil type, a wide variety of food and cash crops, including maize, beans, bananas, coffee, tea, rice, groundnuts, cotton and wheat, can be grown in the region (Rain, 1984a). The relatively high precipitation and better soils enable the Mbeya Region to export food to other regions in Tanzania and occasionally to other countries (Croon, Deutsch and Temu, 1984). Tanzania is frequently self-sufficient in maize, the major food crop, and sometimes exports it, as in 1987 (EIU, 1987) when the Mbeya Region, with only 5% of Tanzania's population, produced 324 000 tonnes of maize—14% of Tanzania's total production. Smallholder farmers grow most of their maize in rows with little intercropping.

Animal traction status

Ox-drawn mouldboard plows were introduced into Mbeya Region during the 1930s (Kjærby, 1983). Although there have been few animal traction development programmes in the region (or in the rest of Tanzania), conditions seem favourable. There are many cattle, surplus land for area expansion and relatively high production levels of cash crops, both food and non-food. Nevertheless, only 10–20% of farming households own oxen, the most common draft animals (MRIDEP, 1987). This is a figure similar to that for all of Tanzania (Kjærby, 1983; ILO, 1987a; Starkey, 1988a). The proportion of farming households owning work cattle varies greatly within the Mbeya Region from none in areas producing no cash crops to 66% in areas producing cash crops. Overall use of draft animals (including those households which borrow or rent cattle) varies from none to 93%.

Weeding with draft animals

Starkey (1986, 1988a) reported that although animal-drawn weeders are available in most African countries, only 5% of those farmers using animal traction for plowing use animal-drawn weeders in row crops. Figures cited varied from around 0% in Botswana, Mozambique, Uganda and Zambia, to between 10 and 20% in Cameroon and Mali, and to as much as 20–40% in South Africa and Zimbabwe. Numerous other references have reported low adoption of animal traction weeding in Africa by farmers utilising animal traction for plowing (Barrett et al, 1982; Smid, 1982; Kjærby, 1983; EFSAIP, 1984; Jaeger, 1984; Anderson, 1985; Francis, 1986, 1988; ILO, 1987b).

It has been reported that very few farmers in the Mbeya Region used animals for both plowing and crop weeding (Croon, Deutsch and Temu, 1984; Rain, 1984a). This appeared to be true of the situation in Tanzania as a whole (Kjærby, 1983; ILO, 1987a).

Acland (1971) and Terry (1984) reported that maize in East Africa should be kept free of weeds for the first month after emergence and then weeded three times, when plants are 5–10, 45 and 90 cm high. They also said that if maize growth is checked by weeds shortly after emergence, it *never* recovers fully.

In five experiments in the Southern Highlands of Tanzania, Croon, Deutsch and Temu (1984) found that one weeding of maize at 10 cm resulted in an average yield of 4.2 t/ha compared to 2.3 t/ha when maize was not weeded at all. They also reported that poor weeding of maize was the biggest constraint to maize production in southern Tanzania. They suggested that timely weeding was itself more important than use of improved varieties, fertilisers, insecticides or timely planting.

In a survey of 320 farmers in 20 villages in the Mbeya Region, more than 50 constraints to crop production were listed, the four most important being insufficient credit, lack of hand hoes, damage by wild animals and late weeding. Lack of good animal-drawn weeders was listed as the main constraint to crop production by those farmers who plowed with animals (Rain, 1984b).

Several researchers have reported that introduction of animal traction plowing without animal traction weeding increases labour productivity through expansion of area planted. However, it decreases yield per hectare because there is insufficient labour for the timely weeding of the larger crop area. The same researchers have reported that animal plowing without animal weeding limits the effectiveness of animal traction farming and slows the overall rate of adoption of animal traction technology (Starkey, 1981; Smid, 1982; Kjærby, 1983; Jaeger, 1984; Rain, 1984a; Anderson, 1985; Francis, 1986; Kemp, 1987).

Considering the apparent benefits of timely weeding through use of animal traction, particularly by those farmers plowing with animals, it is difficult to understand the low level of adoption of animal traction weeding technology.

Sources of information

In the following sections, nine of the most crucial current constraints to the adoption of animal weeding technology in the Mbeya Region of Tanzania are reviewed, and ways in which those constraints might be lessened are discussed. There have been three main sources of information for this analysis.

First, a review was made of the available literature on animal traction in Africa.

Second, use was made of the results of a highly structured survey of 511 smallholder farmers in areas of the Mbeya Region having the highest use of animal traction. This survey collected baseline data to guide the implementation of the Mbeya Oxenization Project (MOP). This project has been designed to increase smallholder use of animal traction. It is supported by the Government of Tanzania, the Canadian International Development Agency (CIDA) and the Mennonite Economic Development Associates (MEDA).

Third, information has come from the informal questioning of 300 farmers during 18 visits to 11 villages for the preliminary on-farm testing of prototype animal-drawn implements.

Possible limitations and dangers

Three important factors may limit the accuracy and applicability of the prioritised list of constraints.

Non-typical farmers

The data were collected during the first four-year phase of the MOP project (1987–91). MOP was specifically attempting to increase the use of animal-drawn equipment by those farmers who were already using animal traction for plowing. Emphasis was placed on maize weeders and carts. The MOP was therefore working with farmers already using animal traction and with the existing public and private infrastructure. MOP was facilitating the manufacture and marketing of implements that have minimal imported components, and hoped to extend animal traction technology to more farmers. However, since farmers participating in the initial survey and in the preliminary testing of implements were likely to be wealthier than typical smallholder farmers, they may not have been subject to the same constraints as average farmers. For example, the cost of implements and the availability of credit may have been less crucial to them.

Farmer courtesy

The true intentions and feelings of smallholder farmers are reflected far more in their actions than in their words. When demonstrating a new implement or discussing whether a new practice will be adopted, the development worker, whether a national or an expatriate, is usually surrounded by friendly enthusiasm, cooperation, courtesy and affirmation, and receives the answers he or she wants to hear. These may actually be the exact opposite of the farmers' true intentions or feelings. This may hinder the development worker from assessing accurately constraints to the adoption of a technology. Moreover, it may become a constraint in itself if it leads to the introduction of inappropriate methods. Starkey (1988b) pointed out that although animal-drawn wheeled toolcarriers functioned well and were nearly always well-received when demonstrated to farmers, very few of the hundreds given or sold to farmers in Africa in recent years were still in use.

Realistic time scales

An early assessment of constraints to adoption of animal traction weeding technology is necessary so that the more appropriate methods for alleviating the constraints can be introduced at the outset of the programme. However, early assessment is probably not as accurate as later assessment. Unfortunately, it may take five years to discover whether animal-drawn weeders are being purchased in large numbers, and ten years to see whether those weeders are still being used. The current methods for transferring animal traction weeding technology will certainly have to be judged in the long term. Nevertheless, decisions have to be taken now which will influence the success of the technology transfers envisaged.

Nine crucial constraints

The constraints to adoption of animal traction weeding technology in the past, and those anticipated in the future, are discussed below in descending order of severity. The subjective nature of much of the information, and the relatively small differences in the severity of some of the constraints, means that the ranking

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is only qualitative and tentative. The discussion focuses on animal-drawn tine cultivators for maize. However, other implements may also be relevant for weeding and soil conservation, particularly in the hillier areas of the region. Ridgers, instead of tine cultivators, are used by some farmers for the second or third weeding of maize at 60–90 cm. They simultaneously weed and cover the second application of nitrogen fertiliser. Implements for making tied ridges may also have potential in hillier areas for simultaneous weeding and water and soil conservation at the time of the cultivation (at 90 cm). However, the following constraints refer primarily to the potential for the adoption of tine cultivators.

Equipment availability

Weeding implements have not been distributed to stores close to farmers. In the literature consulted, there is little evidence to suggest that availability of implements at village level is a problem elsewhere in Africa. Starkey (1986) stated that weeders were available in most countries. However, during prototype testing in villages in Mbeya Region, many farmers said that they had never seen weeders, and did not know where to buy them.

In the highly structured survey of 511 farmers in Mbeya Region, the most popular place for purchasing animal-drawn implements (usually plows) was the regional capital Mbeya, often more than 50 km, and sometimes more than 100 km, away. Farmers may be willing to travel such distances for the essential, and more familiar, plow, but not for the unfamiliar weeder. Informal questioning of farmers indicates that they would be more inclined to adopt animal traction weeding technology if weeders were available in village stores. Greater demand at the village level would then encourage the distribution of weeders from larger centres, which then might in turn encourage increased supply through local manufacture or importation.

The poor supply of animal-drawn implements in Tanzania is referred to several times in the literature (Kjærby, 1983; Croon, Deutsch and Temu, 1984; Rain, 1984b; ILO, 1987a). However, this may be primarily a problem of local distribution rather than national supply. For the past 20 years, the Government of Tanzania has been largely responsible for the marketing of animal-drawn implements. The distribution of weeders might be improved by helping the private sector manufacturers and retailers. This may be more possible now than it would have been a few years ago, because the government now has a more liberal attitude towards free enterprise (EIU, 1987).

Equipment quality

The quality of the available cultivators is poor. Most cultivators available in Tanzania are of the Cossul model from India or a similar model from Zambia. Several reports indicate that if such cultivators are used on stony or stumpy land, cast iron parts break and soft steel components bend (Kjærby, 1984; ILO, 1987a). This has been seen with several cultivators during village visits by the MOP. About half of the 300 Cossul cultivators provided by the EEC in the early 1980s for purchase by farmers at 14 ox-training centres in the neighbouring Iringa Region remain unsold. This is partly because farmers soon became aware of the poor quality of the cultivators (Massunga, 1988).

The introduction of higher quality cultivators would seem the most logical way to alleviate this constraint, but these are likely to be more expensive. Other approaches might include educating farmers not to use the cultivators on stony or stumpy land, facilitating establishment of village repair services (blacksmiths) and/or making spare parts available in villages. Few, if any, such repair services exist in the villages and spare parts can be obtained only by cannibalising unsold cultivators.

Repair services deficiency

There are very few, if any, village-level repair services and spare parts in Mbeya Region. Several literature references suggest that the adoption of animal traction technology in Africa depends to a large degree on village artisans who can repair and even manufacture implements (Haug and Gerner-Haug, 1982; Anderson, 1985; ILO, 1987b; Pingali, Bigot and Binswanger, 1987). Such craftsmen working with smallholder farmers could become enthusiastic research and development teams. They would be more in touch with the needs and wants of the farmers than could any parastatal manufacturer, government research institution, extension organisation or donor-sponsored development project. There would be a need for development projects to facilitate the establishment of village craftsmen–farmer teams through the provision of credit and technical knowledge. This type of development is what Bunch (1982) refers to as 'participatory' rather than the more typical 'paternalistic' (giving all and doing all) development. This latter has seldom resulted in a sustainable transfer of technology.

It is interesting to note that in Europe and North America farmers themselves, in conjunction with local craftsmen, used to manufacture hand tools and animal-drawn implements. Even after some local craftsmen developed larger factories for animal-drawn (and later tractor-drawn) implements, farmers went to local blacksmiths who made spare parts and repaired implements. Only within the past 30 years have most local blacksmiths disappeared. Only recently have large implement *manufacturers*, together with local implement *dealers*, provided most new implements, spare parts and repair services. It should also be noted that most of the 'development' in European and North American agriculture occurred within the private sector. Governments provided increasing levels of assistance in terms of research, extension and transportation infrastructure, but they seldom became involved in implement manufacture or marketing.

Emphasis on inter-row cultivation

Emphasis has been placed on inter-row as opposed to over-the-row cultivation. Inter-row cultivators, as introduced by many animal traction development programmes in Africa, are somewhat difficult to operate and often do not kill all weeds within the crop row. Thus weeding with a hand hoe is necessary after animal cultivation. Difficulties in operation arise from the wide weeding yoke, which prevents the animals from working as a team and makes steering them difficult. Successful operation of the inter-row cultivator also requires planting in parallel rows which necessitates either the use of relatively expensive animal-drawn planters or time-consuming systems of accurate spacing during hand planting. Even when rows are parallel, steering is difficult because the operator must look at two crop rows simultaneously. Finally, to avoid crop injury, particularly when rows are not exactly parallel, the cultivator is often kept too narrow to throw soil on top of small weeds growing within the crop rows.

Roosenberg (1987) suggests that over-the-row cultivators might be adopted more quickly by farmers because they are easier to operate and throw enough soil into the crop rows so that later weeding by hand is seldom necessary. Over-the-row cultivators are easier to steer because the same narrow yoke can be used as for plowing or carting. The operator only has to look at one row at a time. Further, costly or time-consuming planting of crops in exactly parallel rows is not necessary. Nevertheless, it is more difficult to design an affordable over-the-row cultivator because they generally require wheels and a heavier construction.

Poor extension

Extension of animal traction weeding technology has been almost non-existent in Mbeya Region. A few small local and donor-assisted development programmes have attempted to extend animal traction plowing and transport technology to local farmers, but efforts to extend animal weeding technology have been minimal. Lack of such extension efforts may have resulted from the great expense of traditional extension methods which require the training of numerous extension workers to go into villages to train farmers. The immensity of the task of transferring the difficult-to-learn technology of inter-row cultivation may also have contributed to the lack of extension in this field.

During preliminary testing of prototype over-the-row cultivators, reaction was more favourable in villages where one or more progressive farmers were successfully using inter-row cultivators. Farmers were less enthusiastic about weeding with oxen in the villages where they had never seen a cultivator in use. This not only demonstrated the need for good extension, but also that progressive farmers themselves may be the most effective extension personnel. The most desirable extension approach might be one in which animal traction weeding technology is transferred as inexpensively and as quickly as possible to a few progressive 'contact farmers' in each village, who in turn could extend the technology to other farmers with little further involvement of expensive projects or government extension personnel.

Attempts to transfer animal traction technology to contact farmers at 14 ox-training centres in the neighbouring Iringa Region are failing because progressive contact farmers do not want to leave their villages to attend the centres. These training sessions must, by necessity, be held during the very times when

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farmers need to be on the farm to plow, plant and weed. Another problem is that the oxen-training centre buildings and personnel cannot be maintained now that the donor agency has withdrawn support (Massunga, 1988). A less ambitious ox-training centre approach in the Mbeya Region is also failing.

It would seem that animal traction weeding technology could be transferred more effectively by externally supported development programmes if less money were spent on building institutions such as ox-training centres. Instead, more money should be spent on frequent village visits by expatriate development workers and their national counterparts from established extension institutions. They should endeavour to train contact farmers on their own farms. In this way, the contact farmers should be able to continue extension efforts with some help from Tanzanian extension personnel after the end of the expatriate-assisted development project.

Marketing difficulties

The failure of farmers to express disquiet may result in the marketing of unwanted cultivators. To take an example, the animal-drawn wheeled toolcarrier was engineered well and farmers said they liked it. However, they obviously did not really like it, because despite being distributed to farmers, few were ever used for any length of time (Starkey, 1988b). The Tanzanian smallholder farmer is reluctant even to express displeasure when a Tanzanian extension worker attempts to introduce a new practice or piece of machinery the farmer does not like. The farmer is even more courteous when foreign development workers do so.

A good implement may function well, increase the farmers' productivity and fulfil their needs. Nevertheless, it would be unwise to invest time and money in manufacturing and marketing large numbers of such an implement if the farmers do not like the implement well enough to use it. To avoid this mistake with new weeding implements, it might be advisable to demonstrate and test each implement several times in each of 10 to 20 villages. If this appears successful each implement could be test-marketed in small numbers (100). Finally, it would be important to return to the villages to see if farmers are actually using the implement before the production and marketing of large numbers is contemplated. Although the main object of this exercise would be to determine farmers' true demands, occasionally it might be possible to change farmers' wants (extend a more appropriate technology) so that their wants are more compatible with their needs.

The MOP should be prepared to facilitate the production and marketing of a 'less desirable' implement (an inter-row cultivator) as opposed to a 'more desirable' one (an over-the-row cultivator) if farmers do not like the 'more desirable' option. The adoption of 'less desirable' cultivators would seem better than total rejection of animal traction weeding technology.

Poor timing in cultivation practices

Farmers seem to weed late, so animal-drawn cultivators do not function well and potential yield increases are not realised. For example, from the informal questioning of 300 farmers in 11 villages in Mbeya Region it was concluded that only 10% of farmers begin weeding maize by hand-hoe when the crop is 15 cm tall (just slightly after the recommended time). About 60% begin weeding when the crop is 30 cm, and the remaining 30% begin when the crop is 45 cm or taller. Only a few farmers felt it necessary to begin weeding earlier.

About half indicated they would purchase a cultivator, if available and affordable, but primarily to relieve labour constraints rather than to begin weeding earlier. In fact, some farmers indicated they would not buy the inter-row or over-the-row cultivators being demonstrated because those cultivators would not remove weeds that were 30 cm high.

It is likely that if animal weeding technology were introduced to farmers without emphasising the importance of early weeding, the technology would be rejected in the long run. This is because few cultivators function well when weeds are 30 cm high, and overall yields would be no higher than those resulting from the usual untimely hand weeding. Relieving labour constraints without increasing yields would justify only a low level of adoption of animal weeding technology.

It is evident that to facilitate adoption of an acceptable level of animal-drawn weeders, timely weeding will have to be an important component of the 'contact farmer' extension approach. In demonstration plots on their own fields, farmers will have to be shown that cultivators function better when weeding begins early. It will also have to be demonstrated that timely weeding, with or without cultivators, results in higher yields than weeding at the usual time (30–45 cm).

The problem of animal training

The difficulty of training oxen to follow crop rows may limit adoption of animal-drawn weeders. There has been considerable disagreement as to the best approach to use in training and guiding oxen, particularly for use in row crop cultivation. Farmers in Tanzania who plow with oxen use one person to control a yoked pair using voice commands initially taught through varying degrees of whipping and encouragement. Several oxenisation programmes have attempted to improve upon this, particularly for row crop cultivation, by using nose rings or halters with some kind of rope connection back to an operator. Initially, an additional person may have to lead the animals in front, particularly for row crop cultivation. This approach is being advocated by the Uyole Agricultural Centre near Mbeya and is taught at the various ox-training centres in the Iringa and Mbeya Regions (Massunga, 1988; Shetto, 1988).

From the informal questioning of farmers in 11 villages it was found that those farmers who were unenthusiastic about animal traction cultivation felt that it would be difficult to train oxen to follow crop rows. In contrast, those who wanted to buy cultivators felt that oxen could be trained to follow crop rows in several days using the voice command system. The views of Conroy (1988) agree with those of farmers in Mbeya Region who are enthusiastic about ox row crop cultivation. Conroy (1988) reported that the use of nose rings, ropes, halters and bridles was unnecessarily complicated and that the most effective approach was to use a simple yoke, voice commands and a goading stick. Unfortunately, he did not mention whether this method was suitable for row crop cultivation.

Obviously, a successful animal weeding technology extension package must include one or more effective methods for training animals to follow crop rows. Because it is not clear just what those effective methods might be, it may be best to go to the animal traction farmers themselves for the answers. By observing how the ‘contact farmers’ who are testing prototype cultivators presently train their oxen to follow crop rows, it is hoped that a successful guidance system will be found. This could be incorporated into the animal weeding extension package. It is to be hoped that farmers will want over-the-row cultivators because animals pulling these should be able to learn more easily to follow crop rows. It is possible, however, that this constraint will turn out to be far more severe than is now envisaged.

Fear of crop damage

The great reluctance of farmers to tolerate *visible* damage to their crops caused by animals may limit the adoption of animal-drawn weeders. Farmers do not seem to appreciate the extent to which weeds can cause *invisible* crop damage.

Farmers are extremely fearful that animals will eat and trample crops during cultivation, or that the cultivator may uproot crop plants or cover them with soil. Many of these fears can be decreased to an acceptable level through teaching farmers to place muzzle baskets over the mouths of animals and ensuring that animals are properly guided to follow crop rows. However, great extension efforts will be required to convince farmers that although over-the-row cultivators may cover a few crop plants, the increased yield and/or the decreased need for hand weeding resulting from covering weeds should more than compensate for the visible crop damage.

It would seem that the extreme fear of crop damage rules out the possibility of introducing the use of harrows to remove small weeds just after crop emergence. This was a common weed control method in maize and beans in North America prior to the use of herbicides.

Less immediate constraints

Several constraints to the adoption of animal traction weeding technology commonly discussed in other situations are not considered to be crucial constraints within MOP in its initial phase. This is because MOP has specifically planned to transfer the technology to moderately wealthy smallholder farmers who already use animals for plowing.

However, although the following four constraints may seem unimportant to the present target group, they may become critical when attempts are made to transfer animal-drawn weeding technology to farmers who are adopting draft animals for the first time.

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Capital and credit

Numerous papers list expensive implements or inadequate credit as important constraints (Barrett et al, 1982; Kjærby, 1983; Jaeger, 1984; Anderson, 1985; ILO, 1987a). This should not be a major constraint for MOP as the cultivators being considered are inexpensive and the current target farmers are comparatively wealthy. However, credit assistance may be necessary for establishment of small private workshops and repair services.

Risk avoidance

Several sources suggest that improved technology is very difficult to transfer to typical smallholder farmers because they operate mainly in a non-market economy. In such cases, maximising the security of mediocre yields is most important. Risking the possibility of little or no yield because of some innovation which might result in a high profit is seldom considered (Lappe and Collins, 1977; Hyden, 1980). However, most farmers using animals for plowing in Mbeya Region are operating very much within the market economy and should be willing to take risks such as adopting animal weeding in order to increase profits by decreasing their labour costs and/or increasing their crop yields.

Gender issues

Several literature references suggest that animal weeding technology might not be adopted for maize because although it is a ‘men’s crop’, hand weeding is ‘women’s work’ and driving oxen is ‘men’s work’ (Kalb, 1982; EFSAIP, 1984; ILO, 1987b). Certainly among farmers using animals for plowing in Mbeya Region, driving oxen is ‘men’s work’. However, results from the highly structured survey of 511 farmers in 18 villages suggested that nearly 50% of the work force for hand hoeing maize is male. It would therefore seem that men would want to adopt animal traction weeding technology, if for no other reason than to decrease their own labour burdens.

Complicated packages

Many oxenisation programmes have attempted to introduce ‘complete packages’ all at once. These packages have included the animals, the training of animals, the training of farmers, all soil-moving implements (often complicated multipurpose implements) and animal-drawn carts. It is often argued that adoption of complete packages is necessary in order to realise the full potential benefits of animal traction technology. This may be true, but simultaneous introduction of all components of a complicated package seems too expensive and too complex for easy adoption by smallholder farmers.

In such complicated projects, the adoption of any one component, such as weeding technology, might not be achieved simply because it ‘gets lost in the shuffle’. Croon, Deutsch and Temu (1984), in their description of what has become a very successful maize improvement programme in Mbeya Region, point out that farmers do not and cannot adopt complete improvement packages at one time. Instead, the components of the package must be prioritised and then introduced step by step.

Starkey (1986, 1988b) indicated that, in designing animal traction development programmes, the most limiting factor should be tackled first, and introduction of complicated multipurpose implements should be minimised. This approach is being used in the Mbeya Oxenization Project. Farmers using ox plows have identified inadequate weeding as the key limiting factor in the production of maize and some other crops. The animal-drawn cultivators being introduced are single-purpose implements mainly because the target farmers already have single-purpose plows.

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Editors' note. This contribution is based on a paper initially prepared for the West Africa Animal Traction Network (Loewen-Rudgers et al, 1990). The authors' review and analysis provide valuable background to the subsequent work undertaken in Mbeya (and elsewhere in Tanzania), as described elsewhere in this book.