Constraints to the adoption of animal-powered weeding technology in Tanzania

by

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Abstract

The adoption of animal traction technology in Tanzania is still low, and is increasing only very slowly. Very few animal-drawn weeders are in use. This paper examines various constraints that affect the adoption of animal-drawn weeders: farmers' financial limitations, socio-cultural constraints, small farm sizes, institutional inadequacies and farming practices. Alleviating such bottlenecks might might increase farmers' adoption of animal-powered weeding technology.

Introduction

The adoption of animal traction technology in sub-Saharan Africa is very low. No more than 8% of African farmers use animal power for agricultural production (Giles, 1975), and only 5% of those farmers who use animal traction for plowing use animal-drawn weeders in row crops (Starkey, 1986, 1988a). However, the adoption of animal-powered weeding technology varies widely in the region, from practically zero in Botswana to 40% in South Africa and Zimbabwe (Loewen-Rudgers et al, 1990; 2000). In most cases, the use of ox plows has led to extensification of the land which, in turn, has created considerable demand for labour for weeding.

In many parts of sub-Saharan Africa, timeliness in weeding and availability of labour for weeding are factors that have a major impact on crop yields, especially of grains. Poor weeding, or lack of weeding, are the biggest constraints to maize production in Tanzania. From their work in southern Tanzania, Croon, Deutsch and Temu (1984) suggest that timeliness of weeding is more important than the weed control method used, be it use of improved varieties, fertilisers, insecticides or timely planting.

In many countries of Africa, weeding is done manually by women. Women, however, have the biggest workload in the households, so there are clear benefits accruing to the adoption of animal-powered weeding, not only in terms of relieving women of the drudgery of manual weeding, but also in improving timeliness.

This paper briefly discusses some constraints to the adoption of the animal-powered weeding technology in Tanzania. First the spread of animal traction in Africa in general and Tanzania in particular is outlined. Then obstacles to the adoption of animal-powered weeding are discussed, and some policy options to improve the situation are presented.

Animal traction in sub-Saharan Africa: a brief history

There is now an extensive literature on the history of animal traction in Africa (for example, Munzinger, 1982; Kjærby, 1983; Starkey, 1988b, 1990; Sosovele, 1991; Starkey and Mutagubya, 1992; Birch-Thomsen, 1993). In much of sub-Saharan Africa, systematic programmes to introduce animal traction started between 1905 and 1945; missionaries, traders, colonising agents and settlers who came to Africa during that period brought draft animal technology with them. Generally, animal-drawn carts came first and were used around the trading ports. These were followed by plows, which were introduced into sub-Saharan Africa to help increase the production of cotton and groundnuts (Iliffe, 1979; Kinsey, 1984; Pingali, Bigot and Binswanger, 1987).

By 1945, animal traction was a familiar technology in many southern African countries. However, as most African countries were still under European colonialism, changes in European agriculture and a shift to tractorisation influenced the development and spread of animal traction in Africa. Between 1950 and the 1970s many attempts were made to introduce tractorisation schemes in Africa. Colonial governments, international agencies,

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some African elites and 'progressive farmers' supported tractorisation programmes.

By the 1970s, however, most tractorisation programmes in Africa recorded massive failures (Ruthenberg, 1964; Pingali, Bigot and Binswanger, 1987; Sosovele, 1991). Lack of technical know-how on how to look after tractors, the fuel crisis of the 1970s and chronic foreign exchange problems that limited importation of spare-parts, all contributed to the collapse of the tractorisation programmes. These problems influenced changes in policy emphasis from tractors to animal traction so that by 1986, almost all African governments were encouraging animal traction (Starkey, 1985, 1988a; Starkey and Goe, 1985).

Animal traction was not developed fully because during the tractorisation period only patchy and uncoordinated programmes of animal traction were implemented. This seriously restricted the development of animal traction in many African countries.

It is estimated that about 17 million draft animals are employed in Africa and that about 90% of this animal power is used for soil cultivation. Less than 5% of farmers who use plows with animals use weeding tines. Many reports suggest that the adoption of animal-drawn weeders by farmers using animal traction for plowing is low (eg, Barret et al, 1982; Kjærby, 1983; Anderson, 1985; Francis, 1986, 1988; ILO, 1987a, 1987b).

In parts of Africa, ridging plows are sometimes used for weeding between ridges. However, this requires well-trained oxen and proper handling of the implements. Many farmers are not able to meet these conditions, so very few can use ridgers for weeding.

In southern Africa, weeders are available which are fitted with levers to adjust row width, but although they have been used by farmers for many years, overall adoption rates are low (Starkey, 1986, 1988b).

Development of animal traction in Tanzania since the 1970s

In Tanzania, the late 1970s marked the turning point in policy options and brought some government support for animal traction technology. This turn of emphasis was reinforced by the collapse of the tractorisation programmes. The government, through its 'Kilimo' departments, embarked on oxenisation programmes in the regions. However, very little support was provided. Dissemination of knowledge about animal traction has largely been through informal farmer-to-farmer contacts. This method has greatly influenced the adoption of the technology which, inevitably, had to be based on what the farmers already knew about, namely the use of the plows (Sosovele, 1991). The adoption of the plow for land preparation has therefore shifted labour bottlenecks to weeding. This is reflected in the increasing use of hired labour for weeding (Birch-Thomsen, 1990), low timeliness, and the increasing involvement of women's labour in weeding (Sosovele, 1991). Labour shortage, especially in the peak season, can lead to low productivity.

More programmes to expand the use of animal traction were started through various multilateral and bilateral cooperation initiatives. For example, in 1977, an oxenisation project was started in Iringa with support from the EEC. Its objective was to increase the use of animal traction in agriculture by providing education facilities. At least two ox-training centres and several ox-training units were established in each district, and a range of implements (plows, ridgers, seeders, weeders, harrows and carts) was provided to these bodies for training. Also farmers were encouraged to buy implements through a credit (revolving fund) system (Sosovele, 1986, 1991). Although this was one of the early attempts to encourage the adoption of a comprehensive animal traction technology, its impact on the adoption of animal-powered weeding was minimal. Many farmers adopted the plows, but continued to weed manually.

In the 1980s several attempts to influence the adoption of animal-powered weeding were facilitated by donor-assisted special projects. For example, in 1987, the Mbeya Oxenization Project (MOP) was started with support from the Canadian Government. The primary purpose of the MOP was to encourage the use and adoption of ox-drawn weeding and transport equipment, with the view to combating both weeding and transport bottlenecks in food production in Mbeya Region. Equipment was imported from India, West Africa, Zimbabwe and Mozambique and was also produced locally (for example, the *Mkombozi* toolbar and an over-the-row weeder). Results of field tests indicated that some equipment had technical shortcomings. For example, the over-the-row weeder was

effective for early weeding, but unsuitable for late cultivation, and was also considered difficult to manoeuvre (Starkey and Mutagubya, 1992). Some of the constraints to the adoption of animal-powered weeding in the Mbeya Region were discussed by Loewen-Rudgers et al (1990; 2000) and Shetto et al (2000).

Another project, with similar objectives, was started in Iringa rural district in 1988, supported by CONCERN, an international non-governmental organisation. Initially, the project covered nine villages in Ismani Division, and aimed to enhance the ability of farmers to perform early cultivation, planting, weeding and transport using animal-drawn equipment. By 1990, about 60% of the farmers in two villages (Mangawe and Kihorogota) were carrying out inter-row weeding using animal-powered technology (Sosovele, 1991). Also, it was observed that time requirements for weeding had improved from 48 h/ha with hand hoes to 30 h/ha with animal-drawn weeders (Sosovele, 1991).

Other recent projects concerned with animal traction in Tanzania include the Tanga Draft Animal Project, the Usangu Village Irrigation Project, Rukwa Development Project, Kibondo Integrated Rural Development Project, Tanzania/Netherlands Farming Systems Research Project, Mixed Farming Project in Mwanga District, and Iringa Soil and Water Conservation Project.

Reasons for low adoption of animal-powered weeding in Tanzania

Problems with manufacturing, supply and marketing of equipment

Two factories produce animal-drawn equipment in Tanzania, the Ubungo Farm Implement (UFI) and Zana Za Kilimo (ZZK) in Mbeya. Some small-scale enterprises also produce implements in low numbers.

The Tanzanian Bureau of Statistics (URT, 1992) estimated that about 371 000 plows were owned by rural farming communities in 1990. The same report indicated that the ZZK factory produced 1764 plows in 1983, but by 1990 the factory produced only 42 plows. UFI, on the other hand, produced about 5000 plows in 1975 and about 76 000 in 1984; production declined to 24 000 in 1990. UFI has also been manufacturing animal-drawn weeders and importing some from abroad.

Similarly, through special oxenisation projects, animal-drawn weeders have been produced or imported into the country to be used by the targeted groups of farmers. Such equipment is inadequate and very few farmers will be reached during the period when donors are still funding the project. Overall, the supply of animal-drawn implements (including weeders) in Tanzania is poor (ILO, 1987b; Kjærby, 1983; Croon, Deutsch and Temu, 1984; Sosovele, 1991). Inadequate supply can be an effect of low production due to inadequate raw materials, deterioration of the industries and poor marketing systems.

In many rural areas, farmers using animal-drawn plows are still unaware of the existence of the various animal-drawn weeder technologies. For many years, the Government of Tanzania was responsible for production, distribution and marketing of farm implements. However, due to increasing economic difficulties, the government has been failing to meet its obligations. Attempts to use the cooperative societies to procure farm implements for the farmers have also not been very successful. Most cooperative societies in Tanzania are facing financial and administrative problems, and many do not know the size of the demand of farmers for animal-drawn weeders and how that demand can be met.

Through liberalisation of trade in Tanzania, the government has allowed private businesses to invest in production and marketing of farm implements. So far, there has been little private-sector investment and the production and distribution infrastructure (factories, transport and marketing) are underdeveloped or near collapse. For example, factories and other farm implement production units depend to a great extent on external supply for capital and raw materials; these are not always forthcoming, and often the factories produce below capacity. These factors, tend to discourage private investment.

Poor quality of the equipment

The quality of some animal-drawn cultivators is poor. Apart from a few locally-produced animal-drawn weeders, most of the cultivators available in Tanzania come from India, Zimbabwe or Zambia. Neither locally-produced nor imported cultivators have performed well in some areas in Tanzania because of their inferior quality (Kjærby, 1984). This problem is compounded by lack of repair services in rural

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areas. In many areas in Tanzania where animal traction is practised, there are no village artisans. Most of the farmers therefore abandon their equipment for lack of repair services. These problems tend to discourage farmers, and thus limit even further the adoption of animal-drawn weeders.

Inadequate extension

There has been little extension of animal-powered weeding technology in Tanzania. This may have resulted from two unrelated factors.

On the one hand, poor transfer of animal traction technology which has focused on male farmers as 'contact farmers' has compounded the female farmers' ignorance regarding animal-drawn weeders. Women, especially in rural areas, are rarely involved or consulted in the transfer of technology. Male farmers formed the contact groups because it has always been perceived that most households are led by males. This attitude influenced a great deal of the extension strategy of donors and development agents. Initially, the main labour bottleneck identified was primary cultivation. Cultivation is often done by men and women or in some rare cases by men alone. Because men are usually contacted in the transfer of animal traction technology, equipment that helps to overcome their labour burden gets the first priority. This situation has resulted in having more plows than animal-drawn weeders. In Tanzania, weeding is usually done by women.

On the other hand, where attempts were initiated to introduce animal-powered weeder technology via special projects, lack of competent extension personnel has limited the spread of the technology. Most extension staff are not adequately trained to handle complex issues related to animal-powered weeding. Attempts to use some progressive farmers as 'contact farmers' to spread the idea of animal-powered weeding were made in Iringa in the 1970s, but they failed because the farmers did not want to leave their villages to attend sessions in oxen-training centres (Loewen-Rudgers et al, 1990; 2000). Another reason why these attempts failed was because the donors withdrew their support.

As well as inadequate extension, there is also the problem of poor training of oxen, especially in row-crop weeding. Some oxenisation projects have attempted to reduce the number of people involved to two, and to use nose rings or halters with a rope connection back to an operator (Loewen-Rudgers et al, 1990; 2000). However, there are still some disagreements between researchers with regard to the most effective extension approach to deal with weeding activities. Main issues centre around the type of the equipment to be used (whether for over-the-row or inter-row cultivation) and the yoking system. More information on these issues is required in order to assist farmers to adopt the technology faster.

Extension also involves the dissemination of information on livestock husbandry and treatment of animal diseases. However, veterinary services are glaringly inadequate. This affects not only the adoption of weeder technology, but animal traction technology as a whole and the entire livestock economy. Indeed it might be interesting to find out whether/how increasing animal disease affects single farm operations such as weeding.

Incompatible farming practices

The rate of the adoption of animal-powered weeding technology is largely influenced by existing farming practices. Many farmers in Tanzania, especially in grain producing areas, used to practise mixed cropping that included traditional and 'introduced' agroforestry techniques and cultivation of termite mounds. Through a number of campaigns by the government and extension agents, attempts were being made to change this practice and encourage monocropping and row planting, all in the name of *ukulima wa kisasa* (modern farming).

Monocropping was stressed with the view that fertilisers would be made available to the farmers at subsidised prices. However, following the implementation of the structural adjustment programmes, fertilisers have been desubsidised and many farmers cannot afford them. This has compelled some to return to mixed cropping practices which might not be compatible with existing animal-powered weeding technology.

The shift to mixed cropping is also being encouraged by campaigns for agroforestry practices by the government and outside donors as part of the response to environmental degradation in rural areas in Tanzania. It is likely that these changes might influence the adoption of animal-powered weeder technology as more farmers abandon monocropping.

Although many farmers in Tanzania managed to adopt monocropping, few have been able to follow the practice of row planting and equal spacing. The introduction of the animal-drawn weeders requires farmers to plant in rows that are almost parallel. In the absence of animal-drawn seeders, row planting cannot be accurately carried out, and it is time-consuming if done manually. Campaigns to use animal-powered weeder technology are not likely to make headway if the rows are not completely parallel because farmers greatly fear crop damage.

There were also attempts to introduce multi-row weeding technologies in Tanzania, but they did not succeed. Initial experiments on research stations proved that the equipment is effective, yet its adoption by farmers has been minimal due to problems of manoeuvrability and crop damage (Starkey, 1989).

Crop damage is basically a result of farming systems which do not permit row and parallel planting to be practised. Roosenberg (1987) argued that damage to crops could be reduced by the use of single-line over-the-row weeders that weed either side of the single row, weeding half of the two adjacent inter-rows. Technically, though, Starkey (1989) maintains that a design that is both efficient and affordable has yet to be produced.

Financial constraints

Lack of capital is one of the main bottlenecks to the adoption of animal-powered weeding technology for most of the farmers in Tanzania. A study carried out in Iringa rural district (Sosovele, 1991) showed that some farmers who use animal-drawn plows were unable to use animal-drawn weeders because the price of weeders was too high. The factory price for a cultivator manufactured by UFI in 1989 was Tsh 2090 (at the time, US$ 1 = Tsh 192). The official retail price was Tsh 6210, but farmers were paying about Tsh 8310. Most farmers considered this price too high compared to hired labour (which cost only Tsh 400–1200/ha in 1989).

Binswanger (1986) makes this point very clear: "farmer adoption of a technological innovation will depend on the degree to which the innovation reduces the unit cost of inputs used in the production process". Animal-drawn weeders are intended to reduce the cost of labour for weeding, but where the cost of hired labour is negligible compared to that of the animal-powered weeder equipment, farmers will be reluctant to adopt weeders, as evidenced in many areas in Tanzania.

Most smallholder farms in rural Tanzania are very small (averaging about 1.5 ha), a fact which might influence a farmer's decision on the need to invest so much money in animal-drawn weeder technology. The small size of the farms, coupled with the high prices of the animal-drawn weeders (if available) and the relative cheapness of hired labour, might have influenced the rate of the adoption of animal-powered weeder technology. However, it must be emphasised that few farmers can afford hired labour, and not all villages have surplus labour. Rural–urban migration is increasing so fast that in some villages hired labour is not available or is obtained from other villages, thus raising its price to levels that most farmers cannot afford.

The inability of most farmers to pay for animal-drawn weeders is exacerbated by the on-going structural adjustment policies. Among other measures, the adjustment policies have involved devaluation of domestic currency, liberalisation of domestic product markets bringing domestic prices in line with world prices, trade and exchange liberalisation and reforms in financial institutions. Opinion is still divided as to the impact of the policies on the economy in general, but there is growing awareness that the policies will have a wide range of economic and social consequences for the people.

Some of the issues involved include the increasing rate of poverty and widening gap in income distribution. These are not the intention of such policies, but their byproduct. Through devaluation, the price of animal-drawn weeders (presumably other implements too) is too high for most farmers. Also through market reforms, farmers (often with big farms) who produce more stand to benefit more than those who produce less. Reform in the operation of the financial institutions has necessitated removal of subsidies on farm equipment. Due to strict lending regulations, many farmers are unable to obtain credit for animal-drawn weeders and other equipment (Kjærby 1983; Sosovele, 1991, 1993). These changes have increased the price of farm equipment even further.

Social issues

Numerous studies have indicated certain socio-cultural aspects that might limit the

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adoption of animal traction technologies (Starkey and Ndiamé, 1988; Starkey, 1990; Sosovele, 1991, 1994; Sylwander, 1994). Socio-cultural issues cited include unequal access (between men and women) to capital goods (eg, oxen, land and money) within the households; cultures and ethics that prevent certain ethnic groups from using animals for working; certain norms and cultural practices that limit women's access to sources of knowledge on animal traction; and traditional gender roles and changes in the drudgery connected with work. There are specific historical, socio-cultural, economic and institutional reasons that have generated and/or maintained these conditions (Boserup, 1970, 1976; Tobisson, 1980; Rwezaura, 1985). The socio-cultural issues mentioned above have also affected the adoption of animal-powered weeder technologies in Tanzania.

Conclusions and recommendations

Most of the issues raised above can be overcome provided there is sufficient commitment to the development of animal traction in Tanzania. To overcome problems of manufacturing, supply and marketing it is proposed that the government should create a more conducive atmosphere for private investors to participate in production, supply and marketing of the equipment. The new investment policy allows this to take place, but the poor state of the existing infrastructure (transport network, information systems, storage, markets) tends to discourage many possible investors. The government will have to take the upper hand in improving and developing the infrastructure as it is unlikely that private investors will be interested.

Improvement in manufacturing may lead to production of equipment that is of superior quality and at the same time affordable. This should be done through coordinated research and development activities that involve farmers themselves. Extension problems can be overcome first by changing priorities with regard to transfer of technology. Instead of a complete animal traction package, efforts should be made to transfer only the technology that is needed to overcome labour bottlenecks, such as cultivation, weeding and transport. The The focus should be on both male and female farmers. This can be made a condition even to donor-funded oxenisation projects.

As the use of extension services may not be feasible in Tanzania, the government can explore the possibility of allowing farmers' cooperative unions to have their own extension personnel. In Zimbabwe and many developed countries, big farmers and agribusiness companies managed to develop their own research and development stations and have their own extension services. This will possibly not be the case for Tanzania where most farmers are smallholders. Thus it will be necessary for the government to continue to support the extension services, and also to encourage farmers to pay for some services, as they do now for dipping services, for example.

Farming practices will continue to pose a challenge to the developers of animal-drawn weeder prototypes as more farmers abandon monocropping and practise mixed cropping. The shift to mixed cropping is stimulated by problems in the availability of fertilisers and the ongoing campaigns for agroforestry. Although not all farmers who abandon monocropping are shifting to mixed cropping, it will be necessary to encourage farmers to use organic manure, and also to encourage inventors of equipment to design prototypes that can be used in mixed cropping situations.

In order to reduce financial limitations to the farmers who would wish to acquire animal-drawn weeders, manufacturing, supply and marketing institutions should be encouraged to operate on competitive terms.

Unnecessary overhead costs (eg, a larger bureaucracy) should be avoided. The farmer's ability to pay could be raised by increasing producer prices. Special credit schemes (eg, group credits with longer periods of payment and subsidised interest rates) can be introduced as incentives to farmers.

Most of the often cited socio-cultural constraints are likely to change once the technology adopted proves to be profitable socially and economically. If animal-drawn weeders can enhance the status of the farmers after adoption, improve gender roles, and effect changes in the drudgery connected with work, there will be little talk of socio-cultural constraints; this was proved the case in Zaire (Starkey, 1984) and Tarime, Tanzania (Sosovele, 1991).

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Smallholder adoption of farming technology is necessary to speed the transition to CSA. Here, we assessed the determinants of adoption of five technologies that can help achieve some of the CSA outcomes in smallholder farms in Tanzania. They included crop and livestock diversity, irrigation, application of chemical fertilizers, and agroforestry.Â Adoption of Climate-Smart Agriculture Technologies in Tanzania. Barnabas K. Kurgat 1 * , Christine Lamanna 2 , Anthony Kimaro 3 , Nictor Namoi 2 , Lucas Manda 2 and Todd S. Rosenstock 4,5. 1 Department of Earth Sciences, School of Science and Applied Technology, Laikipia University, Nyahururu, Kenya.Â Differences in rates of diffusion suggests unique constraints to the uptake of each technology. Environmental influences on the adoption of animal traction 60. Michel Havard and GÃ©rard Le Thiec. Environmental impact of animal traction in Rukwa Region, Tanzania 68. A M Kilemwa. Animal traction and sustainable soil productivity in Kenya 72.Â The challenges of animal traction in Tanzania 252. H Sosovele. Animal traction in Mozambique: results from a survey of small-scale farmers 258. Alfredo de Toro and Alfredo B Nhantumbo. The challenges of reintroducing animal traction in post-war Mozambique 264. Alix von Keyserlingk.Â Animal traction therefore remains a suitable technology if it can be developed alongside the indigenous soil conservation techniques to alleviate labour drudgery. Indigenous soil and water conservation techniques. Vegetative strips. However, farmers wanting to adopt new varieties did not adopt due to seed access constraints and under-developed seed delivery systems. Adoption of new varieties is therefore analyzed using an augmented double hurdle model that allows estimating variety adoption conditional on seed access thresholds accounting for the additional information on sample separation. The study identifies the crucial role of seed access (local supply), extension, education, participatory decision making, capital, and household assets in determining adoption. The social economic benefits of the technology and policie