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Animal traction and market conditions: a case study from south-western Tanzania and northern Zambia

by

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Abstract

Historically the adoption pattern of animal traction in Rukwa, Tanzania, and Northern Province, Zambia, has been closely linked to the history of maize cultivation. In particular the introduction of improved maize varieties along with government subsidised fertilisers and pesticides in the mid-1970s increased the comparative advantage of animal traction, especially for plowing. Permanent cultivation became possible without decreasing yields. The removal of input subsidies and the national pricing system, as part of the structural adjustment programmes implemented in the late 1980s and early 1990s, affected the adoption pattern of animal traction. Studies were undertaken in two villages between 1990 and 1993, and found that the effect varied depending on the degree of animal traction adopted prior to the structural adjustment programme. Factors such as intensity of cultivation, population density and degree of market integration are shown to be of great importance.

Introduction

Like most of sub-Saharan Africa the agricultural systems represented in the south-west of Tanzania and northern Zambia have experienced major changes within the last five decades. There have been many different forces causing the changes and their effects have been many, and have varied in time and place. Typically, the process of change within the agricultural systems in response to changed production conditions includes an intensification, in terms of increased frequency of cultivation, and adoption of innovations like new cultivars, cultivation techniques and/or new implements (Boserup, 1965; Ruthenberg, 1980; Pingali, Bigot and Binswanger, 1987). In trying to explain the process of change, some writers have based their analysis on theories relating production to household needs and wants (usually population driven) under conditions of 'subsistence' (Chayanov, 1966; Boserup, 1965, 1981). Others have based their analysis on theories that relate production to demands from the market (Hayami and Ruttan, 1985). The main impetus for change in both types of theory derives from the pressure of increasing scarcity, particularly land availability.

In accordance with recent works by other writers (Goldman 1993; Tiffen and Mortimore, 1994), the point of view in this paper is that intensification and adoption of innovations are not merely driven by scarcities and constraints, but equally by opportunities and advantages. The latter is often as significant as constraints where good market access exists, through a cash crop infrastructure to facilitate both supply of inputs and outlets of products, leading to an expansion of economic opportunities.

Although perhaps simplifying the diversity within sub-Saharan agricultural systems, a scenario of change is given in Figure 1, and the possible implications for resource management are listed in the boxes. One of the important factors restricting the generality of the scenario is the variation in agro-climate, especially in relation to the adoption af animal traction (McIntire, 1992). Furthermore, to reduce the complexity, no specific comments are made on the importance of animal transport, but, as stressed by Starkey (1994), it can be crucial for the profitability of animal traction.

An important distinction between forces causing the process of change and intensification, in relation to the adoption of animal traction in the present case study, relates to what Lele and Stone (1990) refer to as "autonomous intensification" and "policy-led intensification". The former refers to the Boserupian process of intensification and adoption of innovations: changes evolve over a realtively long period of time in response to increasing population pressure through experimentation, adaptation and adoption of new techniques within the indigenous traditional

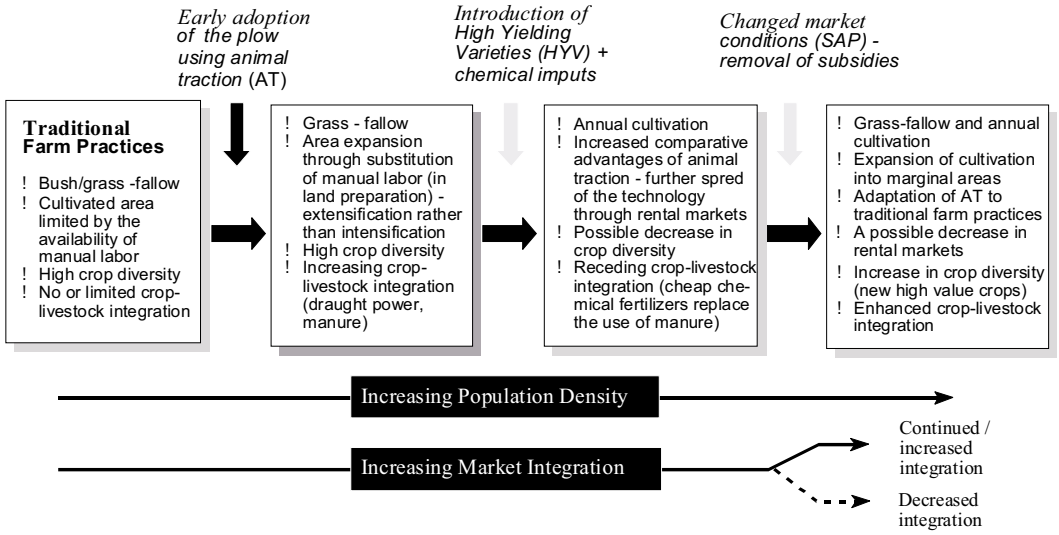

Figure 1: A possible scenario of changes within agricultural systems in sub-Saharan Africa

knowledge system (Swift, 1979). The latter refers to the effect of government policies which may either act by widening or restricting the farmer's sphere of activity: widened where opportunities are created, for example through subsidies and/or improved infrastructure; restricted due to factor scarcity, for example through changes in land laws or tenure. Changes as a result of alterations in national policies may occur more or less 'over-night'.

The objective of this paper is to illustrate how the adoption pattern of animal traction, especially related to field operations, may vary according to the significance of the different forces driving the process of change. Furthermore, I aim to portray the impact of recent alterations in government policies, in this case the effect of changing marketing conditions as a consequence of the Structural Adjustment Programme on the use and dissemination of animal traction.

Field data and study area

The paper is based on three periods of fieldwork between 1990–93 in the south-western part of Tanzania, Rukwa Region, and north-eastern Zambia, Northern Province. Firstly, a household survey was carried out in Ulinji Village, Sumbawanga District, Tanzania, and David Chikoti Village, Mbala District, Zambia in 1990. It involved 31 and 30 households, respectively. Secondly, both villages were revisited in 1991 (Birch-Thomsen, 1993). Thirdly, minor fieldwork was carried out in Ulinji Village in 1993.

Ulinji Village is located on the Fipa Plateau in Sumbawanga District, on the main road approximately 15 km south-east of the district and regional centre, Sumbawanga. The mean annual rainfall is between 803–960 mm and the natural vegetation is dominated by grassland with scattered trees and bushes. David Chikoti Village is located on the Mambwe-Mwenzo Dissected Plain directly south of Ulinji across the border to Zambia. During the dry season the district centre, Mbala, can be reached by car along the gravel road in approximately 1.5–2 hours. No public transportation service is available. The average annual rainfall is between 1000–1100 mm, and the vegetation varies from grass/bush fallow close to the settlement area to dense *miombo* woodland in remoter areas.

In addition to the difference in location, the two villages vary in several important respects (Table 1). First of all, bearing the difference in location in mind, it is not surprising that the highest population density is found in Ulinji, but the difference becomes even more pronounced when calculated on the basis of the actual land area possessed by farmers. Part of the explanation is that large parts (36%) of the village area in

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Table 1: Population and cultivation differences between Ulinji and David Chikoti villages based on surveys of 31 and 30 households, respectively

Study site	*Population density (people/km²)*		*Intensity of cultivation (R-value)*[1]	*% area planted with maize*	*Maize sales as % of total production*	*% farmers using animal traction for plowing*	*% of cultivated area plowed with oxen*
	Per total area	*Per cultivable area*					
Ulinji	47	310	86	61	39	87	86
Chikoti	28	61	53	43	87	53	51

*1) R-value = cultivated area/(cultivated + fallow area)*100*

Ulinji are non-cultivable due to rock outcrops and steep slopes. Furthermore, supporting the assumptions made by Boserup, the intensity of cultivation (measured by the R-value; Ruthenberg, 1980) reflects the difference in population density, with permanent cultivation in Ulinji and a fallow system in David Chikoti. However, this broad calculation conceals variations within the villages in crops grown, techniques used in land preparation, and the location of the fields both on the topo-sequence and distance from homestead. This variation is by far most evident in David Chikoti where the majority of farmers follow a dual-farming strategy closely related to specific crops: permanent cultivation of maize close to the homesteads, and a fallow rotation system (a grass-mound-system; Stromgaard, 1988) of finger millet, beans and cassava on more distant fields. For a further discussion on the measures of density and intensification, see Kates et al (1993). In terms of area cultivated, maize was the dominant crop in both villages in 1990. But, whereas in Ulinji maize was both a cash and food crop, it was almost entirely a cash crop in David Chikoti. Finally, the general assumption about changes in cultivation techniques with changing intensity of rotation (Ruthenberg, 1980; Pingali, Bigot and Binswanger, 1987) seems to be supported by this study. However, an important point to emphasise is that the percentages of upland area plowed using oxen (86% in Ulinji and 51% in David Chikoti) conceal a variation in the pattern of use of animal traction in each village. This variation is to some extent linked to the discussion on intensity mentioned above. While 85% of the farmers using animal traction for plowing in Ulinji plowed all their fields, only one farmer did so in David Chikoti. Moreover, half of the farmers in David Chikoti plowing with animals cultivated between 20–85% of their holdings using manual labour–typically in the traditional grass-mound-system. The dual strategy of farming was both crop and technology related.

Factors affecting the adoption pattern of animal traction in 1990

In order to understand the dissemination and adoption pattern of animal traction in the study area, it is necessary to look at the changes which have occurred in the past four decades. For that purpose, a brief description of the transformation, its major causes, and its effects on cultivation techniques and cropping pattern, will be given with reference to Figure 2.

In the 1950s and early 60s, agriculture in the two study villages was dominated by the traditional farming systems prevailing among the Fipa in southern Tanzania and the Aisa Mambwe in northern Zambia. The grass-mound-system was practised both in Ulinji and David Chikoti, but, in addition, farmers in David Chikoti practised the slash-and-burn system called *chitemene* (Pottier, 1988; Stromgaard, 1989). During this period the first introduction of animal traction took place in both villages, and in both cases it was introduced by a single farmer. The process of change during the early adoption of animal traction refers to the autonomous intensification described earlier in this paper. Given the relatively low population density,

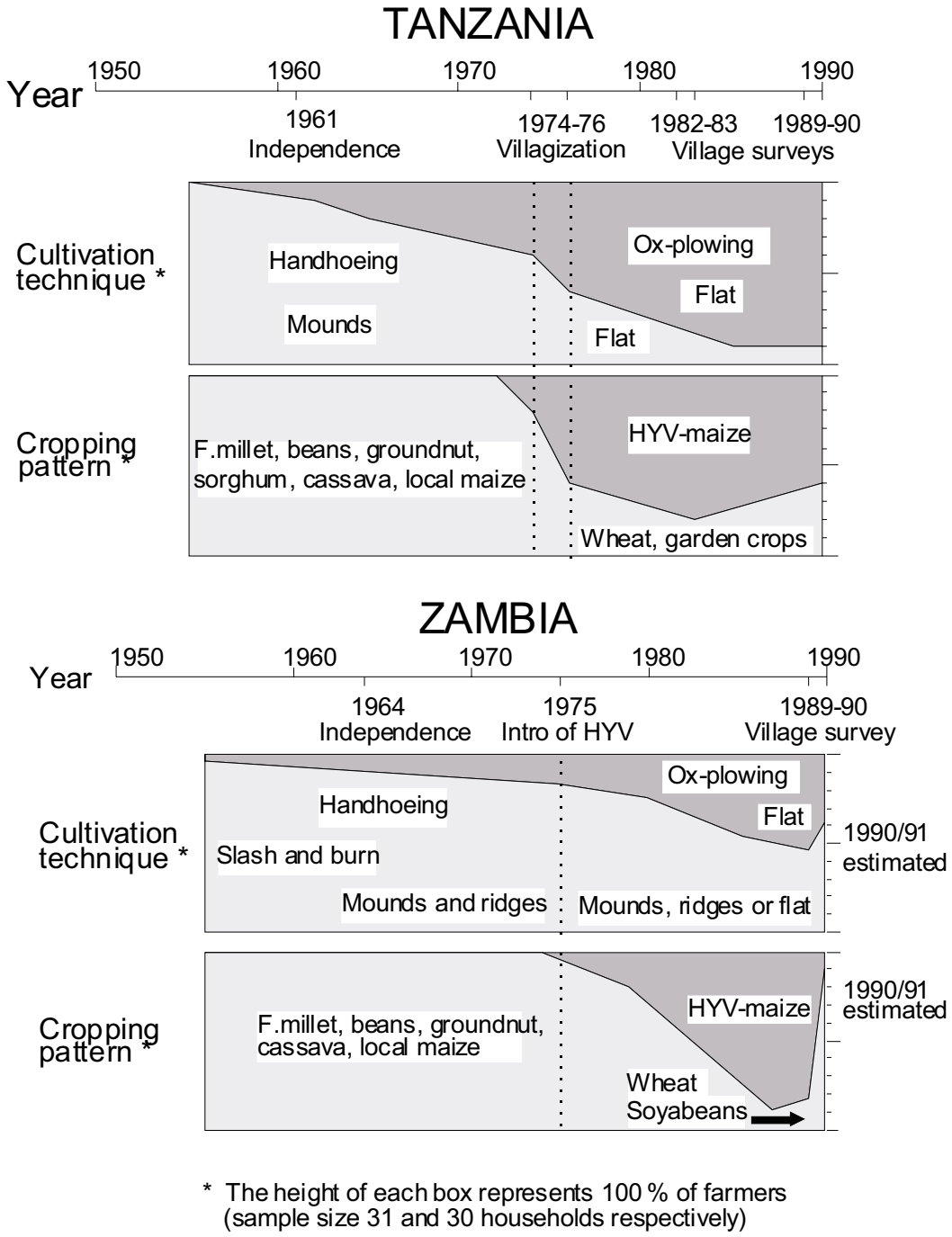

Figure 2: Changes in cultivation techniques and cropping patterns in the two villages

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the substitution of manual labour by animals enabled farmers adopting this new technology to expand their land under cultivation. The dissemination of ox-plowing in the two villages within this period reflects the general difference in population density and intensity of rotation. By the mid 1970s approximately 40% of the farmers in Ulinji and 20% in David Chikoti were using animal traction for plowing, with little effect on the general cropping pattern.

Between 1974 and 1976 a major change in land use and tenure occurred in the Tanzanian village as a consequence of the national re-settlement programme. People were moved into a nucleated settlement pattern, and the traditional tenure system was abolished. During this period the adoption of animal traction accelerated, and by 1976 approximately 60% of the farmers used the technology when plowing their fields. The technology continued to spread during the late 1970s and early 1980s, not just in terms of farmers owning plows and trained oxen but also induced by the emerging rental market (used by 26% of the farmers). As observed elsewhere in Tanzania (Kjærby, 1989) this increase occurred despite the government policy supporting tractorisation. Restrictive policies on land tenure and labour (reallocation of land, communal fields and work) increased the factor scarcity and added to the effect of the general population increase. This is believed to be part of the explanation for the increased adoption of animal traction. In addition, the change towards a more intensive land use pattern, caused by villagisation, was enhanced through the National Maize Project which started in 1974–75 and included the introduction of subsidised hybrid maize seeds, fertilisers and pesticides. With the use of these inputs, permanent cultivation with high outputs became possible. While reducing the importance of the previous traditional practice of fallow, it increased the comparative advantage of ox-plowing. Furnished with the heavily subsidised input prices and the national pricing system, the production of maize for the national market became economically feasible even in remote regions such as Rukwa (Raikes, 1988). Despite the problem of irregular deliveries of inputs, market integration increased rapidly during the 1980s.

The picture is somewhat different in David Chikoti. Despite the early introduction of animal traction in the mid-1950s, the dissemination evolved at a slower speed than in Ulinji. Two main explanations are evident. Firstly, the dominance of extensive farm practices, which left stumps of trees in fields, acted as a constraint to mechanisation. Secondly, the introduction of HYV-maize and the establishment of a marketing system did not become efficient until 1982 (Sano, 1989). As a result of the government subsidies related to maize production, and the deliveries of seeds and fertilisers, as well as collection of harvest through the Northern Cooperative Union, permanent cultivation became possible. Farmers started to clear large fields close to the village. Because of the labour-saving capability of ox-plowing in land preparation, the dissemination of the technology increased in close relation to the adoption of the permanent cultivation of maize. Maize and ox-plowing became a new way of cultivating fields in parallel to the traditional farming system.

In their conclusions Pingali, Bigot and Binswanger (1987) state that high yielding varieties and fertilisers are not a precondition for mechanisation, nor is mechanisation a precondition for the adoption of high yielding varieties and fertilisers. Whereas the latter has been found valid in the case from David Chikoti, these findings indicate a positive relation between the income-generating maize cultivation and ox-plowing in both villages. Bearing this in mind, the outcome of adopting animal traction in the 1980s was an intensification as well as an expansion of the area cultivated. In Ulinji, with an increasing scarcity of cultivable land, only a very moderate expansion took place. On the other hand, farmers adopting the new technology in David Chikoti were able both to expand and intensify their cultivation. On average, farmers using oxen cultivated twice as much land as hoe-cultivators - an average of 7 ha compared to 3.6 ha. The same trend was evident when comparing the size of the individual fields. Furthermore, although extensification rather than intensification is the norm when animal traction technology is new (Starkey, 1992), the close relation between maize cultivation, including the use of fertilisers, and animal traction in David Chikoti led to an intensification.

To sum up the changes prior to 1990, the transformation of the agricultural systems in Ulinji was brought about by an increasing factor scarcity. In addition, farmers responded to the new opportunities related to the market conditions. On the other hand, despite the lower population density in David Chikoti the intensification and adoption of animal traction took place in response to the 'artificially' improved access to the market, with farmers expanding the areas given to the marketed crop, maize. The high dependency on the government policies, in terms of marketing, increased the vulnerability of farming in David Chikoti.

Changed market conditions in the 1990s and the effect on animal traction

By the late 1980s and early 1990s farmers in both villages were facing major changes in market conditions. In Tanzania the period of structural adjustment was started by the agreement between the government and the World Bank on the Economic Recovery Programme of 1986–89. But it was not until the implementation of the Economic and Social Action Programme (1990–93) that the liberalisation within agriculture really took off. The removal of the national pricing system, a general abolition of subsidies, and legalisation of the negotiation of prices between private dealers and farmers are some of the main changes that affected farmers, especially in a remote region such as Rukwa. In the case of Northern Province, the failure of the Northern Cooperative Union to collect the harvest from the crop-season 1989/90 and to pay farmers and deliver seeds and fertilisers caused a breakdown in the marketing system. Large amounts of the uncollected maize had been burned by the time of the second field work in 1991. Furthermore, farmers experienced a declining maize economy because of the removal of subsidies.

As illustrated by the data from the second visits to Ulinji (1993) and David Chikoti (1991), farmers reacted rapidly to these policy-induced changes, causing an immense impact on land use, cropping patterns, and the use and dissemination of animal traction in both locations.

Ulinji

During the fieldwork in July 1993, major changes in land use were observed. Firstly, cultivation had expanded into an area not previously identified as part of the village area. In addition, a number of new fields had been opened for cultivation in an area previously reserved for grazing (Birch-Thomsen & Fog, 1996). The virgin grassland had been tilled at the end of the rainy season (April–May) preparing it for cultivation in November/December. The previously common technique of making mounds was observed, but most of the new fields were plowed using animal traction – an adoption of the 'new', and labour-saving, technology into the traditional practice of farming widely used prior to the villagisation process. During a group meeting it was explained that some farmers had shifted their cultivation to the old grazing area and left the fields close to their homesteads for fallow. These fallow fields were either used for grazing or planted with eucalyptus trees – the availability of firewood and building poles had decreased dramatically. Second, there had been a change in the cropping pattern within the village. Wheat had been introduced as a new cash crop at the expense of maize, though the latter continued to be an important staple food crop. In addition, farmers stated that the area cultivated with beans, sunflower and finger millet had increased. In the case of finger millet, this was especially true on the newly opened fields. Thirdly, garden cultivation along small streams and depressions had been expanded further.

David Chikoti

The dramatic drop in maize marketing observed during the fieldwork in 1991 forced farmers to increase the cultivation of more distant areas. Farmers who had been marginally involved in HYV-maize production returned to the cultivation of the traditional crops finger millet and beans. The regrowth of vegetation in these parts of the village area favoured the traditional grass-mound-system and even lopping of branches (*chitemene*). Farmers previously hiring other farmers to plow their permanent fields (44% of farmers using animal traction) stopped using this practice. On the other hand, some farmers owning one or more ox-teams were actually observed to use ox-plowing in the traditional system. After approximately 15 years of experience with ox-plowing, these farmers were reluctant to give up the labour-saving technology. They adopted

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animal traction into the traditional system by substituting the previous hoed mounds with winter plowing in between trees and bushes. In David Chikoti, the survey revealed a reversal in the development of the farming systems, contrary to general theories on the evolution of farming systems. Because the conditions affecting maize cultivation have been breaking down, with diminishing economic returns to farmers and insufficient supply systems, farmers are returning to more extensive cultivation practices.

Acknowledgments

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