The relevance of animal traction to the humid zone

by

L. Reynolds *

International Livestock Centre for Africa, Humid Zone Programme, PMB 5320, Ibadan, Nigeria

Introduction

Animal power for cultivation and transport is probably used in every African country. Why is it therefore necessary to question the relevance of animal traction in the humid zone? A literature search quickly reveals that the majority of reported draft schemes occur in semi-arid conditions, less often in sub-humid areas and very few in the humid zone. Within the humid zone the lowland forest region has remained particularly unattractive to proponents of animal traction.

The humid zone can be defined as that area receiving over 1500mm annual rainfall, with a growing season in excess of 270 days. The coastal strip of West Africa, much of central Africa, eastern Madagascar and a small part of Mozambique, giving a total area of 4.1 million sq km (18.5% of tropical Africa), fall within this zone. Only 6% of the cattle and 9% of the human population of tropical Africa are included in the zone (Jahnke, 1982). A typical small farm comprises 6-8 individuals, cultivating 2-4 ha and owning 2-4 small ruminants. Major food crops are maize, yam and cassava; the tree crops cocoa and oil palm are important in some areas.

The lowland forest zone contains farmland under cultivation and bush fallow. Coarse grasses invade these areas and natural clearings, but grass cover is sparse or absent under the tree cover. A derived savannah belt is found adjacent to, and north of, the lowland forest. This area is subject to regular fires and many tall trees have been destroyed leaving low trees, shrubs and bushes. Coarse grasses cover fallow areas, but a reduction in the frequency of burning on uncultivated land allows an invasion of woody species and reversion to forest (Crowder and Chheda, 1977). Rattray (1960) has identified *Pennisetum spp.* as typical of the grasses of this zone.

Major factors

General

The requirements for successful introduction of animal traction into an area have previously been discussed by various authors (Goe and McDowell, 1980; Sargent, Lichte, Matlon and Bloom, 1981; Munzinger, 1982a; Starkey, 1985). Many factors overlap so that consideration of one involves interaction with others. This paper concentrates on those aspects of particular relevance to the humid zone, bearing in mind that the focus of discussion is resources available within a small farmer community.

Animals

The primary requirement must be animals, which need feeding and keeping alive. We have already seen that cattle are relatively scarce, generally explained by the presence of tsetse flies and the parasitic disease trypanosomiasis which infests 90% of the humid zone. Some

** As Dr. Reynolds was unable to attend the networkshop in person, many ideas contained in this paper were presented by his ILCA colleague, Dr. S. Adeoye.*

breeds, such as N'Dama and West African Shorthorns, can tolerate trypanosomes and exist where non-trypanotolerant humped zebu breeds succumb. The humid zone has an extremely unsuitable climate for exotic breeds. However the concentration of tsetse flies varies from area to area, and a recent survey in southern Nigeria indicated the presence of 0.3 million cattle, compared with 12.0 million cattle in the country as a whole (Akinwumi and Ikpi, 1985; Jahnke, 1982). Zebu outnumbered trypanotolerant cattle by 3 to 1, with the numbers of all bovines declining towards the coastline.

In the forest region very few cattle are found but they are present in larger numbers in the derived savannah where dense rainforest has been cleared. A number of observations, outside the scope of this paper, suggest that the tsetse challenge in southern Nigeria has decreased in recent years, allowing permanent settlement of cattle owners in the derived savannah. It is not known whether other countries have experienced similar changes. Some cattle are therefore immediately available, but are they suitable for animal traction? Elsewhere zebu cattle are widely used, and N'Dama are worked in Sierra Leone (Starkey, 1982). Suitability depends upon what work is to be performed, and the power required. Work output is related to body size and a small breed would be more limited in its usefulness where heavy soils, requiring more effort for land preparation, are found (Goe and McDowell, 1980).

Before a plow can satisfactorily be used, it is necessary to destump the land. In the forest zone fields are cultivated for around three years before reversion to bush fallow. Destumping could only be justified if the means were available to maintain soil fertility levels and thereby allow extended periods of cultivation.

Farmers can overcome the lower power capacity of small animals by increasing the numbers in a team. There is, however, evidence that stress, which can arise from work, poor nutrition, other concurrent diseases, pregnancy and lactation, increases susceptibility to trypanosomiasis (MacLennan, 1970). These factors have not been quantified but they will constitute an additional constraint on the use of draft power in a tsetse-infested zone. Prevention and control of disease will be influenced by the standards of husbandry, but exogenous veterinary inputs are also required which are outside the control of individual farmers.

As regards feeding, the humid tropics have the advantage of a lengthy growing season and high rainfall producing lush vegetation so that fodder is available throughout the year. However the nutritional value of grasses falls rapidly as plants mature, and become unpalatable, but browse maintains its feeding value over a long period and is therefore a valuable supplement to grass. Leguminous browse in particular has the potential to provide high quality feed at low cost throughout the year. If a farmer in the humid zone requires a team of 4 small trypanotolerant cattle to provide sufficient draft power for land preparation he will need a large quantity of fodder. A team of 4 N'Dama cattle, each weighing 300 kg, would need around 11 tonnes dry matter (DM) per year, obtainable from 0.55 ha of *Pannicum maximum* pasture (Doppler, 1980). It is unlikely that such an area would be available close to a village even if the farmer was willing and able to plant pasture.

A steady supply of mature animals would be needed for any successful animal traction scheme. Butterworth (1985) pointed out that a herd of 12 young and breeding animals is required to provide replacements for 2 oxen. In the humid zone self-sufficiency is unlikely to extend to the provision of draft animal replacements, and small farmers would be forced to purchase stock.

Forage and fodder crops in West Africa have been reviewed by Crowder and Chheda (1977). Dry matter yields of natural pasture range from 2 to 6 tonnes/ha, but planted pasture can

frequently produce 20 tonnes DM/ha. Animal production from planted pasture on the derived savannah of Nigeria has been recorded as 4 times that from natural rough grazing (Ogor and Hedrick, 1963). Continuous grazing in humid areas permits a build-up of ticks and internal parasites in cattle, and possibly nematode infestation in the soil. Grazing young stock together with older animals causes heavy helminth burdens in the former and retards growth. Rotational grazing of planted pasture is therefore necessary requiring additional fencing (Crowder and Chheda, 1977).

Annual biomass production on fallow land in an established forest environment would be around 10 tonnes DM/ha, compared with 8 tonnes DM/ha in a savannah region (Nye and Greenland, 1960). However a lower proportion of the regrowth on forest fallow is palatable to livestock, and the practicality of allowing cattle to graze on small scattered fields within rainforest is questionable. Regular burning of accumulated and dead plant material following shifting cultivation on savannah land encourages *Imperata cylindrica*, a grass that is fairly nutritious when young but which rapidly becomes lignified and unpalatable.

Crop residues are a valuable feed resource to alleviate any deficit in the dry season. Residues can be grazed *in situ*, but some crops, such as cassava, remain in the fields after others have been harvested and the problem of access to scattered forest fields arises again. Residues can also be collected and fed to penned animals, but labour may be a constraint for collection of residues from the first season crops, when planting a second season crop is in progress. There will be less demand for farm labour during the dry season after a second crop has been harvested, and animals should also be free for transporting residues back to the household.

During the rainy season fodder production is likely to be in excess of requirements. Conservation of this surplus could provide additional material for dry season feed, but competition for labour, difficulties in drying hay, and technical problems for small farmers making silage reduce the likelihood of either process significantly contributing to small-scale farming.

A more serious obstacle than the provision of feed *per se* is the integration of cattle into a farming system where at present livestock are outsiders. Small ruminants exist but in reality they look after themselves. If farmers are to own draft cattle drastic changes to the present farming systems are inevitable. Each individual component of the change may be small but in total they are practically and psychologically immense.

Maintenance of draft animals in good health is only partly dependent on husbandry and hygiene. Prophylaxis against diseases such as rinderpest, trypanosomiasis, and contagious bovine pleuropneumonia requires medication from an external source. In most countries within the humid zone veterinary services are over-stretched attempting to meet existing obligations. The additional burden of valuable draft animals would require the attachment of staff to a project, and as such this would be outside the control of smallholders.

Farmers unaccustomed to dealing with cattle could find it difficult to recognize health problems at a sufficiently early stage to allow simple remedies to be effective. A natural step would be for a farmer to turn to a more experienced neighbour for advice, but to whom does he turn when cattle owning is new to a district? Accessible and well-trained extension staff would be necessary to provide advice.

Finance

A considerable investment is required for a smallholder to purchase draft animals, and as indicated earlier, few farmers in the humid zone are likely to own a large enough herd to produce their own stock. In addition the animals are of limited use without, at the very least, equipment for land preparation. Weeding, a very labour-intensive operation, can also

be performed with draft, but requires further equipment. Access to adequate credits on favourable terms is a prerequisite for the adoption of animal traction (Munzinger, 1982b). Thus the involvement of a credit agency is essential.

Selective promotion of market crops is necessary unless existing cropping structures can support repayment schedules for the credit scheme (Munzinger, 1982b). Delgado and McIntire (1982) have shown that profits generated from the staple millet-sorghum cereal system in the Sahel are too low, although production of groundnuts and cotton improved the viability of a traction scheme. Upland rice in Sierra Leone is also of limited profitability (Starkey, 1982).

Studies outside the humid zone indicate that farmers with oxen plant a larger area than those without draft power, but a shortage of labour often prevents adequate weeding on the expanded area. Crop yields per hectare tend to be lower although the total yield rises, reflecting the increased area under cultivation (Zalla, 1976; Sargent *et al.*, 1981; Faye, 1985; P.A. Francis, personal communication).

In the early years animal traction is likely to have a negative effect on farm profitability, because of the repayment of credits (Starkey, 1984, 1985; Doppler, 1978, quoted in Munzinger, 1982b; Sargent *et al.*, 1981). Barratt (1985) reported in Burkina Faso that the cash costs of animal traction were so high and farm cash revenues so low that non-farm revenues were needed to support the cost of animal traction, particularly the purchase of equipment.

If, in the planning stage, the existing cropping system is found to be incapable of generating sufficient income for animal traction to be profitable an alternative market crop would be needed. The simultaneous introduction of a new crop and livestock is inadvisable. If a cash crop must be introduced it is better to allow farmers time to assimilate the cropping skills before introducing a second and fundamentally more drastic change, in the form of draft power.

Social factors

Animal traction projects have frequently been dominated by factual analysis of agricultural engineering and economics, so that recording and analysis of social factors remained rudimentary (Kalb, 1982). Specific ethnic or cultural identities may be linked to animal traction so that a particular tribal group may not be adopters because animal traction is not part of their culture. A resource-demanding intervention may be targeted at wealthy or elite farmers, whose activities may be of no interest to non-progressive farmers who find it impossible to identify with this elite (Schonherr, 1975, quoted in Kalb, 1982). Women play important roles in African agriculture but often innovations are directed solely at the male farmer. Access to land, to allow the expected increase in area under cultivation to take place, is important. In many places population increase has raised the demand for arable land, resulting in a shortening of fallow periods. This may cause a decrease in soil fertility, that could be exacerbated by the introduction of animal traction and subsequent additional demand for land. Production strategies are often oriented towards ensuring sufficient food for home consumption, so that increases in total production, expected by project staff, fail to materialize (Kalb, 1982).

Rogers and Shoemaker (1971) have emphasized that what really matters in the adoption of any innovation is the way the project is perceived by potential adopters. Five criteria should be fulfilled: observability, trialability, complexity, relative advantage and compatibility. Thus target farmers should be able to observe animal traction in operation over a period of time, and be able to try it out for themselves. Where complex new techniques are involved intensive training will be required and the project may appear less attractive to

the target group. Thus, rather than offering a complete package of new techniques, a stepwise approach is recommended. Relative advantage of an innovation to development planners might be primarily economic but small farmers, at a subsistence level, may place more importance on social prestige, social approval, and relief from drudgery relegating economic factors to a secondary level. Finally the innovation must not only be compatible with sociocultural values and previous experiences of the target group but must also meet the felt needs of the group.

Starkey (1984) quotes an example from Zaire where a complicated matrilineal inheritance system meant that a farmer's assets, such as ox, plow and cart pass to his nephew on his wife's side rather than his son. This naturally restricted the interest of the son in working with his father on the project. Jealousy was also a strong factor in the project area, with reports of reprisals being taken against individuals who appeared to be flourishing, which acted against the adoption of animal traction with its high cost and status implications.

The inclusion of cattle for the first time in a farming system requires radical changes. Any such development project would have to take a long-term view with a funding horizon extending for at least eight years. Demonstration units would be needed, and pioneer farmers would have to be identified, trained and provided with necessary animals and equipment so that others could see the innovation and relate it to their own circumstances. Barratt, Lassiter, Wilcock, Baker and Crawford (1982) have shown that the learning curve for animal traction extends up to four years. In the early stages mistakes are made and benefits are not maximized. Premature extension of the project could lead to disenchantment and disillusionment, to the detriment of longer-term objectives.

Summary and conclusions

None of the difficulties of introducing animal traction to the humid zone are insurmountable. Problems would be fewer where farmers already are familiar with handling cattle, in the derived savannah rather than the forest zone, where additional land is available, and where infrastructure is in place to market a cash crop and provide necessary inputs.

Given that funds for development are not unlimited it is necessary to select projects with the best chance of success. Animal traction is never an easy target because of its many interacting facets and the complexity of the infrastructure required. As a guide it should be simpler to establish animal traction in lower rainfall areas than the humid zone, and in highland rather than lowland areas. Exceptions can be found to any general rule and individual countries will have different priorities within their development plans. However in the opinion of this author the general development of animal traction within the humid zone should be deferred until softer targets have been tackled. When more of the necessary preconditions have been achieved through the adaption of existing farming systems, animal traction could eventually be viewed as a natural addition, instead of a "big bang" change.

A final word of warning from Eicher and Baker (1982). Africa's history over the last 50 years is littered with discontinued animal traction schemes sponsored by missionaries, colonial governments, and more recently foreign aid programmes. "Waves" of animal traction have appeared, only to disappear or recede during periods of drought, changes in government policy and the failure to provide veterinary support services. Sponsors of any scheme, foreign and domestic, must be prepared for a long-term commitment, without which a potentially sound project may flounder through lack of resources before it has reached maturity.

References

Akinwumi, J. A. and Ikpi, A. E. 1985. Trypanotolerant cattle production in Southern Nigeria. ILCA Research Report, Ibadan, Nigeria.

Barratt, V., Lassiter G., Wilcock, D., Baker, D. and Crawford, E. 1982. Animal traction in Eastern Upper Volta: a technical, economic and institutional analysis. International Development Paper 4. Department of Agricultural Economics, Michigan State University, East Lansing, Michigan, USA. 118p. (E,F).

Barrett, V. 1985. Animal Traction in Burkina Faso. pp. 39-41 in: S. V. Poats, J. Lichte, J. Oxley, S. L. Russo and P. H. Starkey (Editors) Animal Traction in a Farming Systems Perspective. Network Report No. 1, Farming Systems Support Project (FSSP), University of Florida, Gainesville, Florida, USA. 187p. (E,F).

Butterworth, M. H. 1985. Beef cattle nutrition and tropical pastures. Longman, England. 500p. (E).

Crowder, L. V. and Chheda, H. R. 1977. Forage and Fodder Crops. pp. 127-159 in: C. L. A. Leakey and J. B. Willis (Editors). Food crops of the lowland tropics. Oxford University Press, U.K. (E).

Delgado, C. L. and McIntire, J. 1982. Constraints on oxen cultivation in the Sahel. American J. Agric. Economics 63: 188-196. (E).

Doppler, W. 1978. Einführung in die Projektplanung und Beurteilung. Stuttgart, Hohenheim, Germany. (G).

Doppler, W. 1980. The economics of pasture improvement and beef production in semi-humid West Africa. GTZ, Eschborn, Germany. 195p. (E).

Eicher, C. K. and Baker, D. 1982. Research on agricultural development in sub-Saharan Africa: a critical survey. MSU International Development Paper No. 1. Department of Agricultural Economics, Michigan State University, East Lansing, USA. 335p. (E).

Faye, A. 1985. Project experiences in Senegal. pp.43-45 in: S. V. Poats, J. Lichte, J. Oxley, S. L. Russo and P. H. Starkey (Editors) Animal Traction in a Farming Systems Perspective. Network Report No. 1, Farming Systems Support Project (FSSP), University of Florida, Gainesville, Florida, USA. 187p. (E,F).

Goe, M. R. and McDowell, R. E. 1980. Animal traction: guidelines for utilisation. International Agricultural Development Monograph 81. Cornell University, Ithaca, NY, USA. 84p. (E).

Jahnke, H. E. 1982. Livestock production systems and livestock development in Tropical Africa. Kieler Wissenschaftsverlag Vauk, Kiel, Germany. 253p. (E).

Kalb, D. 1982. Sociological aspects of the use of draught animals on African smallholdings. In: P. Munzinger (Editor). Animal traction in Africa. GTZ, Eschborn, Germany. 490p. (E,F,G).

MacLennan, K. J. R. 1970. The epizootiology of trypanosomiasis in livestock in West Africa. pp.751-765 in: H. W. Moulding (Editor). The African trypanosomiases. Allen and Unwin, London. (E).

Munzinger, P. 1982a. Development and situation of animal traction in Africa and conditions limiting further promotion. pp. 13-61 in: P. Munzinger (Editor). Animal traction in Africa. GTZ, Eschborn, Germany. 490p. (E,F,G).

Munzinger P. 1982b. Economic aspects of using draught animals. pp. 269-337 in: P. Munzinger (Editor). Animal traction in Africa. GTZ, Eschborn, Germany. 490p. (E,F,G).

Nye, P. H. and Greenland, D. J. 1960. The soil under shifting agriculture. Technical Communication No. 51. Commonwealth Bureau of Soils, C.A.B., Farnham Royal, Bucks, England. (E).

Ogor, E. and Hedrick, D. W. 1963. Management of natural pasture (range grazing) in West Africa. Journal of the West African Science Association 7: 145-153. (E).

Owen, S. 1985. Animal traction experiences in the Gambia. pp. 37-38 in: S. V. Poats, J. Lichte, J. Oxley, S. L. Russo and P. H. Starkey (Editors) Animal Traction in a Farming Systems Perspective. Network Report No. 1, Farming Systems Support Project (FSSP), University of Florida, Gainesville, Florida, USA. 187p. (E,F).

Rattray, J. M. 1960. The grass cover of Africa. Agricultural Studies No. 49. Food and Agricultural Organization, Rome, Italy. 168p. (E).

Rogers, E. M. and Shoemaker, F. F. 1971. Communication of innovations: a cross-cultural approach. New York, USA. (E).

Sargent, M. W., Lichte, J. A., Matlon, P. J. and Bloom, R. 1981. An assessment of animal traction in francophone West Africa. Working Paper 34. Department of Agricultural Economics, Michigan State University, East Lansing, USA. 101p. (E,F).

Schonherr, S. 1975. Neue Extensionsmethoden zu beschleunigter Verbreitung agrarischer Innovationen. In: G. Wurzbacher (Editor). Störfaktoren der Entwicklungspolitik Empirische Materialien zur Entwicklungsländerforschung. Stuttgart, Germany. (G).

Starkey, P. H. 1982. N'dama cattle as draught animals in Sierra Leone. World Animal Review 42: 19-26. (E,F,S).

Starkey, P. H. 1984. The use of draught animal power in the Kasai occidental and Kasai oriental regions of Zaire. Report to the British Overseas Development Administration, London, U.K. (unpublished). 41p. (E,F).

Starkey, P. H. 1985. Preconditions for successful animal traction adoption. pp.67-75 in: S. V. Poats, J. Lichte, J. Oxley, S. L. Russo and P. H. Starkey (Editors). Animal Traction in a Farming Systems Perspective. Network Report No. 1, Farming Systems Support Project (FSSP), University of Florida, Gainesville, Florida, USA. 187p. (E,F).

Zalla, T. 1976. A proposed structure for the medium term credit program in the Eastern O.R.D. of Upper Volta. African Rural Economy Program Working Paper No. 10. Department of Agricultural Economics, Michigan State University, East Lancing, USA. (E).