Overcoming constraints to animal traction through a collaborative research network

by

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Abstract

This paper briefly reviews the introduction of animal traction in sub-Saharan Africa and presents an overview of the geographical distribution of draft animals. Overcoming present constraints to animal traction in Africa will require expertise from many disciplines and input from National Agricultural Research Systems (NARS), international agricultural research centres, universities and other organizations within and outside of Africa.

The aim of ILCA's Animal Traction Thrust is to increase and improve the use of draft animal power at the smallholder level. This should raise farm production and income, increase labour efficiency and promote integrated crop/livestock farming systems that will allow sustained agricultural production without ecological degradation. This aim is to be met by: identifying constraints, improving the nutrition of draft animals, designing low-cost animal-powered implements, and developing draft animal technologies.

Research will involve collaboration with NARS in sub-Saharan Africa, primarily through a network approach. A network could offer assistance in the planning, implementing and monitoring animal traction research on common problems. The network would: facilitate exchange and awareness of information, improve liaison and co-operation, increase the level of technical knowledge, encourage evaluation of non-conventional technologies and strengthen animal traction research. The network should lead to dissemination of information, co-ordination of animal traction research efforts, extension of proven technologies and the strengthening of national animal traction research teams. Following initiatives by several agencies, a West African Animal Traction Network (WAATN) has been formed.

* Position at the time of the 1988 workshop. A subsequent address may be found in the workshop participant address list.

Introduction

Human labour and draft animals continue to supply nearly all the power for agricultural production at the smallholder level in sub-Saharan Africa. It is estimated that only 15-20% of all arable land in the continent is cultivated using animal traction, although there are large regional variations (ILCA, 1981). In the Ethiopian highlands, for example, almost all cultivation is done using draft animals.

The high cost of imported machinery, the foreign exchange burden of fossil fuels and the disappointing experience with tractorization schemes have motivated many African countries to redirect their agricultural policies to include draft animal components. National governments and international aid agencies are promoting the use of animal traction as a development strategy for increasing food production and labour efficiency at the traditional level, in some instances devoting large amounts of capital and human resources to establish animal traction programmes.

Draft animals (cattle, equines and camels) can utilise crop residues to provide energy for agricultural production, transport and other operations. Use of draft animals integrates crop and livestock production systems, with widespread benefits often occurring through the resultant use of manure as fertiliser and generally improved animal husbandry. Using

animal power for crop production, post-harvest operations, transport, and land and water management can increase the efficiency of human labour and reduce human drudgery.

At present, draft animals are mainly used for plowing. They are largely unused for secondary cultivation (planting, weeding and harvesting) and non-conventional uses (construction of ponds and terraces, logging, water-lifting and operating gear-driven equipment). Expanded and more efficient use of animal power offers substantial opportunities for smallholders to intensify and diversify their farming methods, thus increasing food production and income using renewable rural resources.

However, successful expansion or intensification of the use of draft animals depends on several factors, including availability of animals, proper animal husbandry and management, adoption of suitable cropping techniques, and the supply and maintenance of appropriate equipment. Research is often required to ensure that technologies are adapted to the combination of animals, soils, crops, feed resources, and the economic and social conditions that characterise a particular farming system. Thus, there is a need to consolidate and apply previous animal traction research and orient future programmes so that the full potential of draft animal power in Africa can be realised. Greater emphasis must be placed on integrating and co-ordinating research efforts at both the national and international levels.

This paper briefly reviews the introduction of animal traction in sub-Saharan Africa, presents an overview of the geographical distribution of draft animals and outlines how an animal traction network can facilitate the implementation of collaborative research to overcome constraints to the use of draft animal power.

Animal traction in Africa

The introduction of animal traction into sub-Saharan Africa and its various stages of development have been documented by several authors, including FAO (1972), ILCA (1981), Sargent, Lichte, Matlon and Bloom (1981), Munzinger (1982) and Pingali, Bigot and Binswanger (1987). A brief overview partially drawing on these reports is provided as a background to the present discussion.

Traditionally, draft animals have played a major role in the integrated crop/livestock production system in Ethiopia, with the use of paired oxen for plowing beginning around 2000 B.C. Ethiopia's extensive association with animal traction is atypical of other sub-Saharan African countries where the use of animals for primary and secondary cultivation, and wheeled transport was introduced only during the latter part of the nineteenth and beginning of the twentieth centuries by settlers, missionaries and different colonial administrations in an attempt to expand cash crop production.

The use of oxen for plowing on any substantial level began during the late 1800s, initially in Madagascar and shortly afterwards in Botswana and Mozambique. Favourable economic conditions, cleared land and the availability of draft animals and equipment resulted in draft animal cultivation becoming widespread in these countries by the beginning of the twentieth century. Over the next 40 years, especially during the 1930s, concerted efforts were made by the colonial administrations and private companies to promote the use of animal traction in both anglophone and francophone countries for the production of cash crops: groundnuts in Burkina Faso, Ghana, Mali, northern Nigeria, Senegal and The Gambia; rice in Guinea, Mali and Sierra Leone; and cotton in Benin, Chad, Côte d'Ivoire, Kenya, Niger, Tanzania and Uganda. The success or failure of such schemes was generally dependent on whether there was enough cleared land available to effectively

utilise animal-drawn equipment. The farming intensity had to be such that it became profitable to switch from hand labour to animal power.

However, smallholder adoption of animal traction for the production of cash or subsistence crops throughout this same period was minimal due to several factors. The shift from hoe agriculture to a technology which incorporated an animal traction component for power required an understanding of both animal husbandry and various improved agronomic practices. Since extension advice was often not readily available, many farmers had difficulties in realising a profit when implementing this technology. Inappropriate equipment, lack of spare parts, inadequate veterinary services, poor delivery and marketing systems, and policies discriminating against African farmers prior to independence, also hindered the expansion of animal traction.

Following World War II, during the 1950s and throughout the post-independence period, until the mid-1970s, attempts were made in many African countries to shift from the hand-hoe, or animal power, to tractors. However, large-scale tractorization projects never succeeded because of inappropriate equipment, maintenance and repair problems, and high operational costs. These became exacerbated by rising fuel prices and foreign exchange constraints. As a result, efforts were slowly redirected towards the use of animal traction and by the late 1970s and early 1980s it was being promoted as an appropriate technology for increasing agricultural production at the smallholder level (Mettrick, 1978; Shulman, 1979; Sargent *et al.*, 1981; Barrett, Lassiter, Wilcock, Baker and Crawford, 1982; Imboden, Starkey and Goe, 1983).

Geographical distribution and numbers

Data on the extent to which animal traction is used within most countries is based primarily on general estimates. Table 1 gives an indication of the current situation in sub-Saharan Africa.

The use of animal traction in West Africa is mainly concentrated between the 650 mm isohyet of the Sahelo-Sudanian zone and the 1500 mm isohyet of the Sudano-Guinean zone. In the arid Sahelian zone above this northern boundary donkeys, horses and camels are utilized for transport, packing and lifting water. Cultivation with draft animals is limited because of inadequate rainfall, although some seasonal cropping is carried out on the flood plains of the Niger and Senegal Rivers. In the Sahelo-Sudanian zone (northern Senegal and Nigeria, central Mali, Niger and Chad) teams of oxen, predominantly of Zebu cattle breeds, are used for cultivation. Equines are used for transport, packing and to a certain extent for cultivation, notably in Mali and Senegal.

From the 1000 mm isohyet southwards into the Sudan-Guinean and upper Guinean zone (southwestern Mali, Burkina Faso, southern Senegal, The Gambia, Sierra Leone, Guinea, Côte d'Ivoire, Ghana, Togo, Benin and central Nigeria) tsetse challenge becomes high (ILCA, 1979). The Zebu breeds of oxen used to the north are replaced with trypanotolerant taurines or Zebu-taurine crosses. Equines are used less in this zone, although in The Gambia they are the primary draft animals. The figures in Table 1 indicate that Mali, Senegal and Nigeria have the highest numbers of draft animals in West Africa.

Animal traction is employed in all countries in East Africa, although there are pronounced differences in total numbers of working animals within and between countries in the region. Next to Ethiopia, Kenya has the second largest number of draft animals, but variation within this country is extreme. For example, in the Muchakos District, east of Nairobi, about 80% of farmers use teams of paired bulls for cultivation. In other areas such as Massailand, animals are not used for cultivation, although donkeys are frequently used for packing (Starkey and Goe, 1984). Up to 90% of the farmers in eastern and northern Uganda use oxen for plowing, with a national average of

Table 1: Estimated numbers of draft animals in sub-Saharan Africa[1]

Region/Country	Type(s)	Numbers	Region/Country	Type(s)	Numbers
West Africa			**East Africa**		
Benin	cattle	30-40,000	Ethiopia	cattle	6,000,000
Burkina Faso	cattle	75-80,000	Kenya	cattle	700,000
	donkeys	50-60,000	Tanzania	cattle	600,000
	horses	3,000	Uganda	cattle	600,000
Chad	cattle	105-130,000			
Côte d'Ivoire	cattle	30-40,000	**Central Africa**		
The Gambia	cattle	18-20,000	Angola	cattle	300,000
	donkeys	25-30,000		donkeys	5,000
	horses	5-7,000	Cameroon	cattle	50-55,000
Ghana	cattle	20,000		donkeys	4,000
	donkeys	1,000	Central African Rep.	cattle	8-10,000
Guinea	cattle	100,000	Zaïre	cattle	1,000
Guinea-Bissau	cattle	4,000			
Mali	cattle	200-320,000	**Southern Africa**		
	donkeys	150,000	Botswana	cattle	350-360,000
	horses	30,000		donkeys	140,000
Niger	cattle	16-20,000		horses	24,000
	donkeys	10,000	Lesotho	cattle	180,000
Nigeria	cattle	100-200,000	Madagascar	cattle	260-330,000
Senegal	cattle	130-140,000	Malawi	cattle	50-70,000
	donkeys	140-180,000		donkeys	1,700
	horses	200,000	Mozambique	cattle	100,000
Sierra Leone	cattle	1,000	Zambia	cattle	180-315,000
Togo	cattle	9-10,000	Zimbabwe	cattle	500-800,000

[1] *Excluding the use of camels and equines for packing and riding*
Sources: compiled from numerous references, including Starkey (1988)

40%. Oxen are used to plow about 12% of the cultivated land area in Tanzania (Starkey, 1988).

Tradition, climatic conditions and disease have limited the use of animal traction in central Africa. Draft animal use in Cameroon for cultivation and carting is concentrated in the northern cotton producing areas of the country where tsetse infestation is low. Use of oxen in high-risk zones where cropping conditions are favourable for rice production requires routine chemoprophylaxis (Neunhauser, 1977). Trypanosomiasis also restricts animal traction activities to the northern parts of the Central African Republic. Use of draft animals in the Congo, Equatorial Guinea and Gabon is mostly limited to a few mission stations (Munzinger, 1982). Less than 1% of the farmers in Zaïre use animal traction, although there is widespread interest among national authorities and donor organizations to increase its use (Starkey, 1984). About 40% of all farmers in Angola use oxen for plowing, while donkeys are relied on for packing and carting (Starkey, 1988).

Zimbabwe has the largest draft animal population in southern Africa (Table 1). Approximately 80% of the farmers in Botswana plow using either cattle or donkeys. Spans of 6-8 cattle of various ages and sexes are yoked in

pairs and connected in tandem by chains between the yokes (Starkey and Goe, 1984). In Malawi, 95% of the working oxen are concentrated in the northern part of the country where they are used for plowing, ridging, and to a small extent carting. Oxen are also used for small-scale logging operations (Starkey, 1985). Rice and cotton are cultivated using oxen in Madagascar, while donkeys are used in the southern areas for carting (Tran van Nhieu, 1982). Animal traction is of minimal importance in Burundi and Rwanda and it plays a minor role in Swaziland. Within certain regions of Lesotho, up to 40% of smallholders use animal traction. Animal traction is concentrated in the eastern and southern parts of Zambia and the tsetse free highlands of Mozambique (Munzinger, 1982).

Research areas identified

Animal traction has often been promoted without a clear understanding of the biological and socio-economic constraints facing farmers within a particular agricultural system (Goe, 1982; Starkey and Goe, 1984 and 1985). Preliminary appraisals to determine whether the use of such a technology might be profitable or identify those factors which might limit its adoption or expansion have frequently been absent. Multidisciplinary studies involving draft animals within crop/livestock systems have often been lacking. Sometimes they have reflected such an approach in name only, as scientists pursued their work separately or with only minimal interaction.

In September 1987, the International Livestock Centre for Africa (ILCA) held an Animal Traction Thrust Planning Conference at which scientists from National Agricultural Research Systems (NARS), international research institutes, donor organizations and universities met to discuss and identify research needs for animal traction in sub-Saharan Africa. The objective of ILCA's Animal Traction Thrust is to increase and improve the use of draft animal power at the smallholder level so as to raise production and income, increase labour efficiency and promote integrated crop/livestock farming systems that will allow sustained agricultural production without ecological degradation. This objective is to be met by:

- identifying constraints to the introduction and enhanced use of animal power and, if possible devising measures for overcoming these constraints;
- improving the nutrition of draft animals through better use of on-farm feed resources, thereby increasing animal working efficiency, especially at the onset of the cropping season;
- designing improved, low-cost animal-powered implements that will increase the efficiency of existing field operations, permit present areas to be more intensively cropped and allow more land to be brought under cultivation;
- developing draft animal technologies that allow diversified operations outside cultivation periods.

These research activities will be achieved collaboratively with NARS, primarily through a network approach. An animal traction research network will help strengthen the ability of NARS to develop appropriate technical solutions and carry out investigations in different areas of draft animal power, and assist international agricultural research centres (IARC's) and donor organizations in implementing and conducting the research by providing infrastructural and manpower inputs.

Animal traction research network

Recognised need

The need for establishing an animal traction research network was recognised by ILCA in 1981. It was apparent from experience gained during early work with its former Ethiopian Highlands Programme, and from communication with other individuals, national and international organizations involved in animal traction research in sub-Saharan Africa.

In 1983, the Animal Health and Production Division of the Food and Agriculture Organization (FAO) became interested in the formation of the network, indicating that its emphasis would be on development and training. Subsequently, ILCA and FAO conducted three missions to a total of 12 anglophone and francophone countries in eastern, western and southern Africa to assess interest in establishing an animal traction network. Individuals contacted during the missions supported the establishment of such a network.

The USAID-funded Farming Systems Support Project (FSSP), of the Univeristy of Florida, sponsored a workshop on animal traction in Togo in 1985, and facilitated another in Sierra Leone in 1986. This initiative led to the formation of the West African Animal Traction Network (WAATN). This open and informal network is coordinated by a steering committee comprising West African research and development specialists, a technical adviser and a representative of ILCA. The WAATN steering committee met in 1987 at ILCA's headquarters to plan for this current workshop in Senegal. One of the main objectives of this workshop will be to discuss the future structure, direction and operation of the WAATN.

ILCA submitted a revised proposal to the European Community (EEC) in December 1987 for the development of an animal traction research network. The research network will offer assistance to plan, implement and monitor animal traction research in sub-Saharan Africa. It will involve information exchange, technical co-operation, research collaboration and training. ILCA anticipates that it will act primarily as a resource organization, and it is prepared to assist network co-ordination. It is envisaged that the steering committee of scientists from national agricultural research systems (NARS) will be responsible for network planning and decisions.

Network goals

The overall goal of the network is to improve and extend the use of draft animal power in sub-Saharan African agriculture in order to increase agricultural production and raise rural incomes. The network will link organizations and individuals with research, development, and training interests in the field of draft animal power. Specifically, the network will:

- facilitate exchange and awareness of both existing and newly written information, including production and circulation of technical reports in English and French.
- improve liaison and co-operation;
- increase the level of technical knowledge and understanding of decision makers, researchers, extension personnel, and farmers about the potential of draft animal power;
- encourage more widespread field evaluation of non-conventional uses of animal traction that have been successful in some African countries, including water-lifting, milling, oil-seed pressing, land and water management, and forestry operations;
- strengthen animal traction research in NARS programmes through research collaboration, logistical support, and strategic technical training.

Network outputs

It is envisaged that the network should have the following outputs:

- establishment of a sub-Saharan animal traction research network with appropriate linkages with other networks in Africa;
- compilation, evaluation and dissemination of past and present documented experience relating to research on animal power;
- co-ordination of animal traction research efforts being carried out by NARS and international organizations and institutions in Africa;
- integration of NARS research activities and a change of emphasis from on-station component research to integrated on-farm research;

- extension of proven technologies using animal power for crop cultivation, post-harvest operations, transport, water-lifting, earth-moving, erosion control and forestry;
- establishment and strengthening of national animal traction research teams.

Conclusions

Overcoming the constraints to the use of animal traction in Africa will require expertise from many disciplines and input from NARS, IARCs, universities and other organizations within and outside of Africa if solid results are to be achieved.

Networking offers an operational structure for multidisciplinary intervention and progress, and can be used to encourage co-operation between institutions both within and among countries. It can provide training facilities, promote collaborative research, development and extension of appropriate research techniques, provide for joint planning and execution of research on an inter-country basis, and focus expertise and finance on particular fields.

Résumé

Cet article examine rapidement l'introduction de la traction animale en Afrique subsaharienne et présente une vue générale de la distribution géographique des animaux de trait. Le dépassement des contraintes à l'utilisation de la traction animale en Afrique devra mettre en oeuvre l'expérience de plusieurs disciplines et les efforts conjugués des universités, des services nationaux de recherche agricole (SNRA), centres de recherche agricoles internationaux, et autres organisations africaines et étrangères.

L'objectif du secteur de recherche en traction animale du Centre International pour l'Elevage en Afrique (CIPEA/ILCA) est d'augmenter et d'améliorer l'utilisation de la traction animale dans les petites exploitations pour accroître le niveau de production et les revenus, l'efficacité du labour et favoriser le développement d'une agriculture intégrant culture et élevage dans un système de production écologiquement équilibré. Un tel objectif nécessite d'identifier les contraintes, d'améliorer l'alimentation des animaux de trait, la conception des outils et réduire leur coûts, et introduire de nouveaux développements technologiques.

Les recherches seront menées en collaboration avec les SNRA, sur la base d'un réseau de travail. Le CIPEA et la FAO ont enquêtés sur 12 pays anglophones et francophones de l'Est, de l'Ouest et du Sud africains pour évaluer le potentiel de développement d'un réseau de culture attelée. Le Farming Systems Support Project (FSSP) soutenu par l'USAID a financé un séminaire consacré à la traction animale au Togo en 1984 et en Sierra Leone en 1986 qui a débouché sur la création du Réseau Ouest-africain de la Traction Animale (ROATA). Ce réseau soutiendra la planification, la réalisation et l'évaluation des recherches en culture attelée dans les domaines propres à l'Afrique subsaharienne. Il facilitera les échanges et la distribution des informations, la liaison et la coopération, l'élévation du niveau des connaissances techniques, l'évaluation sur place des travaux, et les recherches.

ROATA visera à établir un réseau de recherche sur la traction animale subsaharienne. Il évaluera et distribuera les résultats des expériences documentées (passées et présentes). Il assurera la coordination des efforts de recherche tout en intégrant les activités des SNRA. Ce réseau développera la vulgarisation des techniques de culture attelée éprouvées, et favorisera l'établissement et le développement d'équipes de recherche nationales.

References

Barrett V., Lassiter G., Wilcock D., Baker D. and Crawford E. 1982. Animal traction in Eastern Upper Volta: a technical, economic and institutional analysis. MSU International Development Paper No. 4. Department of Agricultural Economics, Michigan State University, East Lansing, Michigan, USA. (E).

FAO 1972. Employment of draft animals in agriculture. FAO, Rome, Italy. 249p. (E).

Goe M.R. 1982. Current status of research on animal traction. World Animal Review 42: 2-19. (E,F,S).

ILCA 1981. Animal traction in sub-Saharan Africa. ILCA Bulletin 14, International Livestock Centre for Africa, Addis Ababa, Ethiopia. 17p. (E,F).

Imboden, R., Starkey, P. H. and Goe, M. R. 1983. Rapport de la mission de consultation préliminaire à l'établissement d'un réseau de coopération technique dans les pays en voie de développement (TCDC) en matière de développement, recherche et formation pour l'utilisation de l'énergie animale. Organisation

des Nations Unies pour l'Alimentation et l'Agriculture (FAO), Rome, Italy. 115p. (E,F).

ILCA, 1979. Trypanotolerant livestock in Westand central Africa. Vol.1: General study. ILCA Monograph No.2. International Livestock Centre for Africa, Addis Ababa, Ethiopia. 148p. (E,F).

Mettrick, H. 1978. Oxenisation in The Gambia. Ministry of Overseas Development, London, UK. 68p. (E).

Munzinger P. 1982. Animal traction in Africa. GTZ, Eschborn, Federal Republic of Germany. 490p. (E,F,G).

Pingali P., Bigot Y. and Binswanger H. 1987. Agricultural mechanization and the evolution of farming systems in Sub-Saharan Africa. World Bank, Washington D.C., in association with Johns Hopkins Press, Baltimore, USA. (E).

Sargent M.W., Lichte J.A., Matlon P.J. and Bloom R. 1981. An assessment of animal traction in francophone West Africa. African Rural Economy Program working paper No. 34. Department of Agricultural Economics, Michigan State University, East Lansing, Michigan, USA. 101p. (E,F).

Shulman, R. 1979. Strategy for the advancement of animal traction in Mali. USAID, Bamako, Mali. 62p. (E,F).

Starkey, P. H. 1984. The use of draught animal power in the Kasai Occidental and Kasai Oriental regions of Zaire. Report of an advisory mission from Jan. 30 to Feb. 11 1984. British Overseas Development Administration, London and Sierra Leone Work Oxen Project, Freetown, Sierra Leone. 40p. (E,F).

Starkey, P. H. 1985. Animal power utilization in Malawi. Report of consultancy mission 7-21 September 1985. FAO, Rome, Italy. 26p. (E).

Starkey, P. H. 1988. Animal traction directory: Africa. Vieweg for German Appropriate Technology Exchange, GTZ, Eschborn, Federal Republic of Germany. 151p. (E).

Starkey, P. H. and Goe, M. R. 1984. Report of the preparatory FAO/ILCA mission for the establishment of a TCDC network for research training and development of draught animal power in Africa. FAO, Rome, Italy. 82p. (E,F).

Starkey, P. H. and Goe, M. R. 1985. Report of third joint FAO/ILCA mission to prepare for the establishment of a TCDC network for research training and development of draught animal power in Africa. FAO, Rome, Italy and ILCA, Addis Ababa, Ethiopia. 85p. (E,F).

Tran van Nhieu J. 1982. Animal traction in Madagascar. pp. 427-449 in: Munzinger, P. (ed), Animal Traction in Africa. GTZ, Eschborn, Federal Republic of Germany. 490p. (E,F,G).