

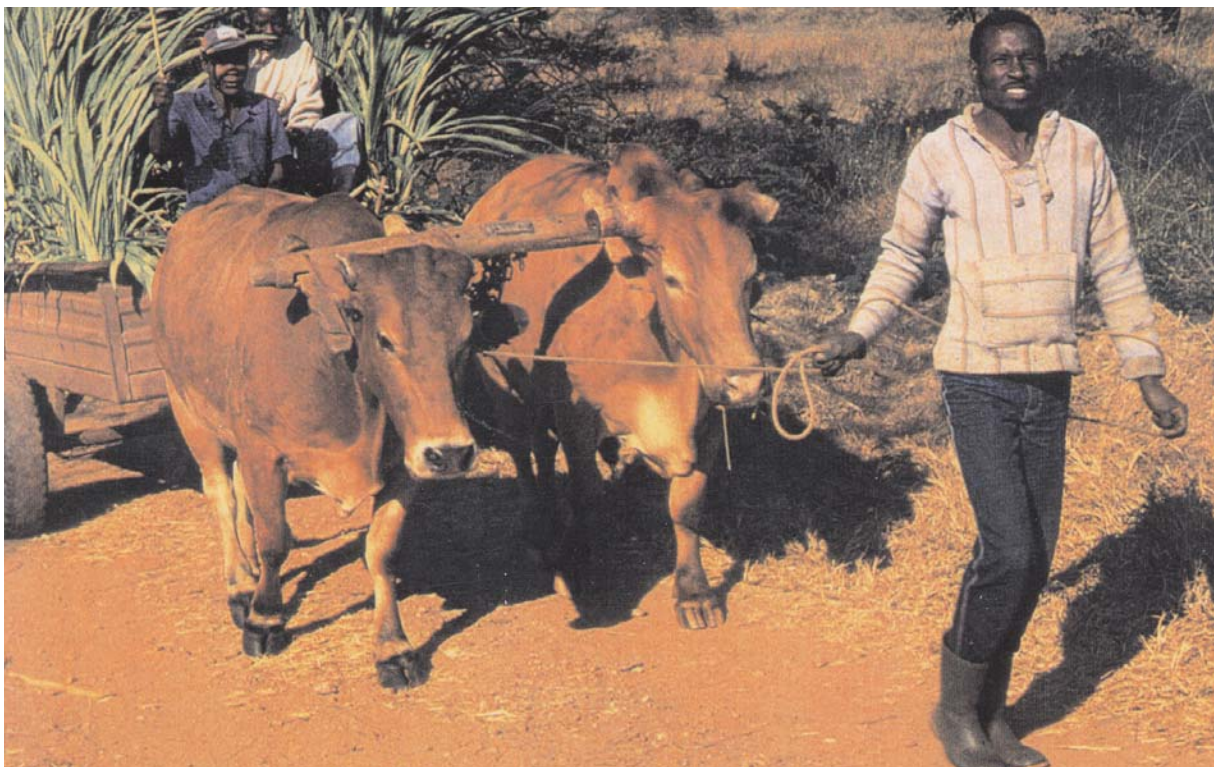
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Republic of Zambia

Ministry of Agriculture

Animal traction in Zambia: status, progress and trends 1991



Report prepared by

Paul Starkey, Henk Dibbits and Emmanuel Mwenya

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Paul Starkey, Animal Traction Development.*

Summary

Background

A five-year investment plan for animal traction in Zambia had been prepared in 1985. In 1990, it was decided to review the progress made since that plan, and obtain a new picture of animal traction in the country. To achieve this, a three person team visited all provinces during a four-week period in late 1990. The team comprised an international specialist in animal traction, the national Animal Draft Power Coordinator and his counterpart. They contacted over 200 people, including Ministry of Agriculture officials, staff of development projects and financial institutions, farmers and manufacturers. Site visits were made to farms, workshops and factories. Many published and unpublished documents were reviewed. Questionnaires were issued to all agricultural extension units (camps) through provincial and district offices to obtain estimates of draft animals and implements.

The initial findings of the mission were presented to a meeting in February 1991 attended by Ministry of Agriculture officials, staff of animal traction development projects and representatives of aid donors. Part 1 of this report presents an overview of animal traction in Zambia and discusses some key issues raised during the mission and the follow-up meetings. Part 2 of the report summarizes some of the key observations of the field visits, drawing heavily on the information supplied to the mission by people working in the provinces.

National animal traction status

About 240,000 draft animals are employed in Zambia, with 120,000 plows, 30,000 ridgers, 20,000 cultivators and 5,000 planters. About 60,000 sledges and 30,000 animal-drawn carts are also used. Nearly all work animals are oxen. Observations suggest that draft cows are increasingly being used, particularly within four-animal teams, but no data are available on the numbers of female animals employed in the different provinces. The national population of donkeys is low: only about 1500 donkeys are used for packing and carting. There is growing interest in the potential for employing donkeys.

The status of animal traction varies markedly between provinces and districts. The distribution of work animals is illustrated schematically in Map 1.

Animal traction in the north of Zambia

In Northern, Luapula, Copperbelt and North Western Provinces, where annual rainfall exceeds 1100 mm,

fewer than 10,000 draft animals are employed in total. Constraints include limited ownership of cattle, small numbers of steers, lack of knowledge of animal traction and extensive farming systems based on shifting cultivation. In some northern areas, trypanosomiasis severely restricts cattle keeping, but the spread of other diseases in the north of Zambia is often limited by the low population density of cattle.

In much of the north, animal traction is increasing steadily from its very low level, assisted by development projects and by farmer migration. As the technology is quite new, support services (including implement supply and repair) are poorly developed. Few animal-drawn carts are available, but farmers who have been assisted to obtain these have found them highly profitable. Farmers' ability to invest in animal traction is determined largely by credit availability and by marketing opportunities. Animal traction for cultivation and transport is likely to rise noticeably in these areas provided efficient crop marketing systems can be developed.

Animal traction in the west and south

In the west and south of the country, cattle are common in the tsetse-free zones, and animal traction has been used for many years. Areas exist where 90% of farmers employ draft animals for cultivation and transport. Not all farmers own work animals, and the proportion of farmers hiring or borrowing animals can be high. In these areas, traditional sledges are widely used, being more affordable than carts.

Overall, animal traction is increasing in the west and south as cattle populations continue to multiply and to expand their range. Cattle and work oxen can now survive and work in areas, such as Kaoma, that previously presented critical tsetse challenges. In these areas of introduction, training and support services may be needed. Elsewhere in the west and south, the main constraints appear economic, with the need for improved crop marketing opportunities to justify further investment in animal traction. Institutional credit is seldom available to assist farmers purchase draft animals and implements. There are also supply constraints, as present systems for the supply and distribution of implements and spares are only adequate along the line of rail.

Tsetse flies still restrict the keeping of cattle in many areas. In the Southern Province (and further north along the line of rail) the tick-borne "corridor disease" has been causing significant mortality within herds in the traditional sector. Corridor dis-

ease increases the risk involved in owning draft animals and also reduces the supply of steers. The disease may lead to a temporary fall in the number of working animals, and to an increase in the employment of work cows, as available females are used to replace lost work oxen.

Animal traction in central and eastern Zambia

The situation in central and eastern regions is mixed. There are areas of long-standing animal traction use, and others with little animal power. Constraints are mainly economic and associated with limited opportunities for profitable marketing of crops. In some areas where tsetse exist, few cattle are available and animal traction knowledge and support services are very limited.

Economic and social issues

Most recent adopters of animal traction have been supplementing available hand labour. In so doing, they have usually increased their total production by extending their total cultivated area. This has increased manual labour requirements for weeding, as few farmers weed with draft animals, particularly in the early years of adoption. Around provincial centres and along the line of rail, animals have sometimes replaced tractor ownership or tractor hire services that have become unavailable or unaffordable. On several commercial farms, animal power is used to complement tractor power, particularly for transportation.

The profitability of animal traction depends largely on the profitability of crop cultivation. Many farmers have had great difficulties marketing their produce and receiving timely payment. The problem has been greatest for maize, so farmers have tended to increase their cultivation of cash crops such as sunflower and soya. Improvements in purchasing arrangements for maize, rice and other commodities would almost certainly stimulate investment in animal traction. All farmers and development projects experience problems due to high inflation and interest rates.

Gender differences in the use of, and benefits from, animal traction generally reflect prevailing rural traditions. Most owners and users of work animals in Zambia are men. Boys are commonly expected to tend work animals. Although it is not very common for women to plow or help to control working animals, this may be increasing. In the Western Province, up to one third of households are headed by women, but if they own oxen these are generally looked after and worked by male relatives. Projects and training institutions in several areas of the country are increasingly trying to involve women in animal traction.

Implements and implement manufacture

Farmers appear generally satisfied with the common "Safim" designs of plow: about 12,000 - 15,000 are purchased each year. About half of these are made in Zambia by Northland and Gameco and half are imported from Zimbabwe. Farmers seem quite tolerant of manufacturing defects, such as those observed in past years in Northland plows. This may be partly attributable to the limited choice that farmers have had. Northland, which used to have a virtual monopoly, ascribed its problems to "jobbing" techniques, old equipment and subsidised competition. Zimbabwe plows have a good reputation, and appear to be the most popular plows available. A large consignment was imported in 1985, with EC assistance.

A Dutch-financed scheme was initiated in 1984 in which the government-backed firm "Lenco" assembled plows manufactured by the Dutch firm Rumpstad. The first plows were assembled in 1985, but the initial 4450 plows were widely judged by the farmers to be too heavy. Sales were very slow. Lenco subsequently assembled a lighter design of Rumpstad plow, using components imported with SIDA assistance. Sales remained low and Lenco resorted to selling them at below cost price. With further Dutch assistance, workshop machinery has recently been installed at Lenco to allow it to manufacture (as opposed to assemble) Rumpstad-designed plows and a range of other implements.

Several smaller manufacturing initiatives have been undertaken by firms and projects. A large consignment of lightweight Italian plows and ridgers was recently imported for use in the Southern Province. Initial test results and the reaction of farmers suggest that the plows may be too weak and of unsuitable design. One of the ridgers appears to have potential as a weeder.

Animal-drawn transport

Simple animal-drawn sledges are widely used in the west and the south. They are cheap, easy to maintain and can be dragged along sandy paths and roads. Sledges have limited carrying capacity and animal-drawn carts appear to offer greater social and economic benefits. In some areas they have proved effective and economically attractive for transporting maize and rice. Some provincial cooperative unions are actively encouraging ox carts for maize transport. In comparison with other countries in Africa, the number of ox carts owned in Zambia is low, and the animal-powered transport sector appears underdeveloped.

Most animal-drawn carts in the country are made from scrap vehicles. Various "appropriate technology" designs with wooden wheels and bearings have

been developed and promoted. Among the organizations involved have been University of Zambia Technology Development Advisory Unit (TDAU), Kasisi Mission (Lusaka Province), North Western IADP and Katopola Agricultural Engineering Centre (Eastern Province). Diffusion has been very limited and few such carts have been used by farmers for long.

A comprehensive series of on-farm tests of cart designs was recently carried out by Magoye. Carts based on steel axles, roller bearings and pneumatic tyres appeared most appropriate. This conclusion is supported by experiences of Muzama Crafts in North Western Province. When it introduced locally-made carts based on imported axles and tyres, adoption was rapid, and the use of animal-drawn transport increased rapidly in Kaoma and Zambezi Districts. Similar positive experiences, on a smaller scale, have been reported by Msokhocika Project, Eastern Province. Lenco, has been selling small numbers of technically good, but expensive carts. It has plans to market a cheaper ox cart, based on imported axles.

The bearing firm "SKF Zambia" recently attempted to meet the demand for locally-made steel ox cart axles. Its original hub design used ball bearings. About 2000 hub units have been sold, but various problems have been reported, and repairs are extremely difficult. SKF is therefore developing a new hub design, using roller bearings.

Research

Much recent research relating to animal traction has involved the testing and development of implements. The Regional Research Station at Magoye has been undertaking on-station and on-farm implement testing, with some replicated on-station trials. Several organizations have worked with ox carts, emphasizing practical development rather than objective research. Standardized methods for testing implements and carts have been developed at Magoye. They combine on-station testing with subsequent farmer evaluation. Such rigorous, objective testing should be valuable, particularly if carried out prior to product marketing. In practice, several recent donor-supported initiatives have imported and marketed implements without waiting for such testing.

Socioeconomic studies assessing the impact of animal traction on farming communities have been sponsored by projects in the Northern, North Western and Western provinces. Very few research findings relating to animal traction in Zambia have been published internationally or widely circulated within the country.

Training

Many provinces have small centres for training extension workers and/or farmers in animal traction. Artisanal training is particularly strong in the east. A national animal draft training centre has recently been established at Palabana. It will undertake in-service training and it is developing practical facilities, training methods and instruction materials. Several Zambians have benefited from training in animal traction in Zimbabwe, and a training manual for Zambia, based on Zimbabwe materials, has recently been financed by SIDA. The University of Zambia, the Natural Resources Development College and the Zambia College of Agriculture have been giving increasing attention to animal traction in their curricula, but all claim to lack good teaching materials.

Impact of research and extension

During recent years, the main impact of the extension services on animal traction has been in the areas of new introduction. In these areas, the long-standing extension messages on how to train draft animals and how to use basic implements appear to be useful to farmers unfamiliar with work animals. In other areas, where draft animals are widely used, there seem few, if any, recent examples of changes in animal traction technology attributable to the research and extension services. The range of implements used is still very limited, with most farmers using only a "Safim-type" plow, with its regulator removed. Although the research, extension and training services have various recommendations relating to animal management, yoking, implement use and diversified uses of animal power, there is little evidence of these being readily adopted by farmers already familiar with animal traction. A re-assessment of future animal traction research-extension needs in the light of farmer responses to existing recommendations appears necessary.

Liaison and information exchange

Information exchange between the various projects and agencies involved in animal traction varies considerably. Coordination and liaison at provincial and national levels is improving, but strategy formulation and information exchange would be assisted by the production of clear, candid and concise reports of research-extension findings and actual project experiences.

Outlook for animal traction

Draft animals are extremely important in Zambian farming systems and they already contribute significantly to crop production and marketing. It is likely that animal traction will continue to increase in most areas of the country, particularly if crop marketing

systems can be improved. While hoe farmers will continue to adopt animal traction, there is little chance that current animal-users will be able to adopt tractor power in the near future. At present, only a small proportion of farmers use animal power for weeding, although weeding is considered a bot-

tleneck. Further research-extension efforts in this area may identify the constraints and facilitate adoption. If suitable and affordable axles and wheels could be made more available, animal-drawn carts could increase significantly in Zambia, with many important social and economic benefits.

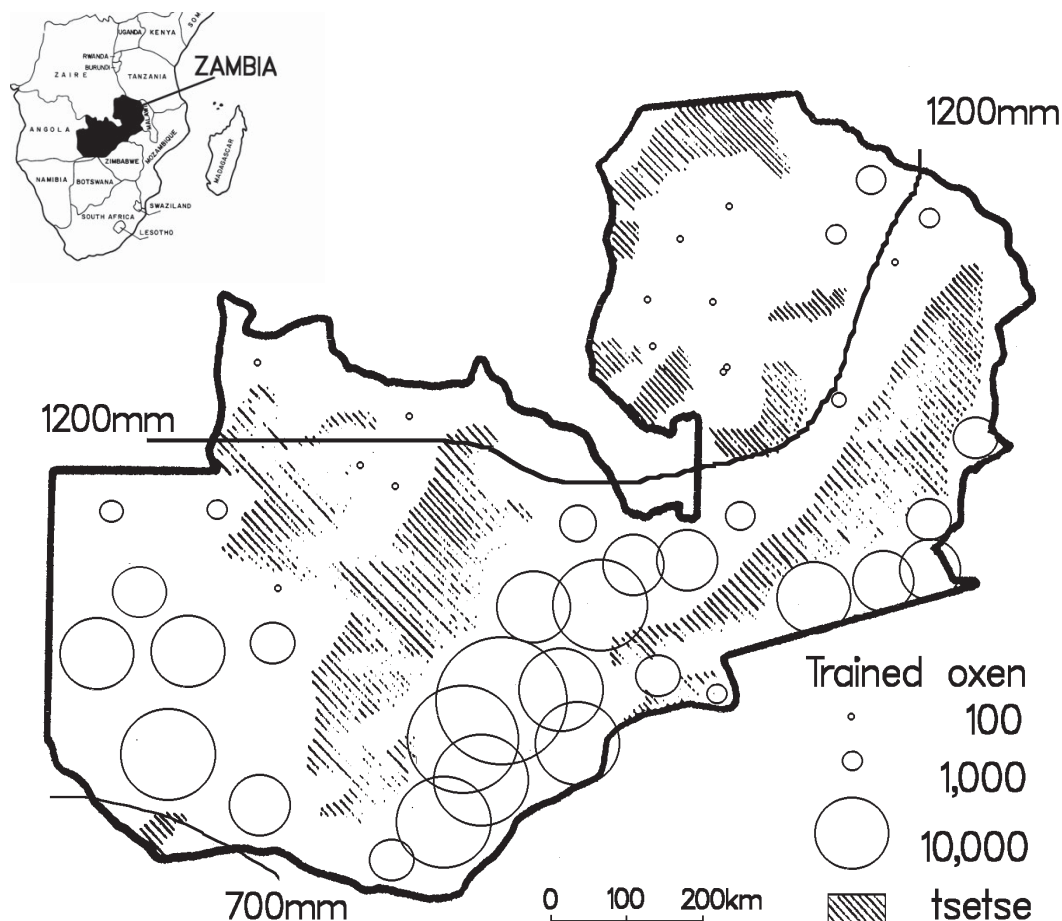
Map 1. Schematic presentation of the numbers and distribution of work oxen in Zambia.

The numbers of work oxen are represented by circles. The size of each circle is approximately proportional to the number of trained oxen in that district. The shaded areas on the map are considered to be of relatively high tsetse challenge. The map also indicates broad rainfall zones by giving the approximate position of the 1200 mm and 700 mm isohyets.

The inset shows the position of Zambia in Southern Africa.

Sources: Tsetse distribution after Müller (1986).

Work oxen population figures from Tables 1-9 of this report.



Preface and acknowledgements

Since the 1985 animal draft power investment plan (MoA, 1985) there has been no systematic attempt to review of the status of animal traction in Zambia. By commissioning this report, the Animal Draft Power Coordinator Project has attempted the daunting task of providing a detailed analysis of the animal traction situation in the country, highlighting areas of progress, apparent constraints and observed trends.

This report has been prepared over a period of several months, and contains information from many sources. Much information derives from personal discussions with many people currently working with animal traction in Zambia and from a wide-ranging literature review. This report also contains statistics obtained from questionnaires given to agricultural extension staff in all provinces. Personal observations derived from field visits are also included in the report.

Much of the information from the different provinces was collected during four weeks of extensive travel throughout Zambia in late 1990. During this time the team had discussions with policy makers, development workers and farmers in all nine provinces. The main findings of this mission were subsequently presented to a meeting of Ministry of Agriculture officials, staff of animal traction development projects and representatives of aid donors in February 1991. Following this meeting, a draft report was prepared and circulated for comments, observations and further detailed discussions. The team members also analysed the initial responses to the questionnaire survey, and revisited the provinces where the information seemed incomplete or needed verification.

This publication, which is the final report of the review exercise, attempts to summarize all aspects of the review in two parts. Part 1 contains the authors' overview of animal traction in Zambia and their analysis of certain key issues. Part 2 provides more details of the organizations contacted in each province and the observations of field visits. Within Part 2, ideas and information supplied to the mission are reported, whether or not the mission members agreed with the information. The authors hope that the views of the people concerned have been adequately presented.

The team is only too aware of the dangers of trying to provide a national review, when each of the nine provinces merits its own detailed analysis. In many ways it was unreasonable for such a review team to attempt to make a series of lightening visits to the provinces and then make pronouncements about the national situation, project achievements and the needs of farmers. The time was too short to appreciate and understand the complexity of the local farming systems in each of the provinces. It was also insufficient to comprehend all the internal and external pressures on the organizations involved in agricultural development. The team therefore wishes to apologize in advance, should anything they say appear to be inaccurate or unfounded. Clearly time was too short to obtain a comprehensive understanding of past events and present realities. The team is also aware of the danger of using the expertise of hindsight to be critical of past initiatives: any implied criticism is intended to be constructive.

The mission team wish to express their thanks to all who facilitated their work. The authors are greatly indebted to all ministry officials, project staff, development agents, farmers, researchers, manufacturers, artisans and others who gave up their time to provide information. The mission would not have been possible without the great assistance of the staff of the Ministry of Agriculture headquarters and Ministry staff in the provinces. All persons who provided information, and all who helped in completing and analysing the questionnaires are to be greatly thanked. Particular appreciation goes to Mr. Mantel Sindazi for information concerning implement manufacturing. Warm hospitality was received in all provinces, and the team is most grateful for this.

The mission was undertaken within the context of the National Animal Draft Power Coordinator Project of the Ministry of Agriculture. This project is supported by the Directorate General for International Cooperation (DGIS) of The Netherlands' Ministry of Foreign Affairs. The project is implemented by IMAG-DLO, the agricultural engineering institute of The Netherlands. The team wishes to thank IMAG-DLO for their assistance in arranging the services of the external consultant and in publishing this report.

Paul Starkey, Henk Dibbits, Emmanuel Mwenya
July 1991

Acronyms and abbreviations

ADP	Animal Draft Power (Animal Draught Power)
ADP-CP	National Animal Draft Power Coordinator Project
ADP-RDP	Animal Draft Power Research and Development Project, Magoye
ADP-TP	Animal Draft Power Training Project, Palabana
ADP-WP	Western Province Animal Draft Power Project
AES	Agricultural Engineering Section, Department of Agriculture
AETC	Agricultural Engineering Technical Committee
ARPT	Adaptive Research Planning Team
AT	Animal Traction
BV	Limited company (Dutch)
CARO	Chief Agricultural Research Officer
CBPP	Contagious Bovine Pleuropneumonia
CCU	Copperbelt Cooperative Union
CD	Cattle Development
COMET	Copper Mines Enterprise Trust
CPCMU	Central Province Cooperative Marketing Union
DAE	District Agricultural Engineer
DANIDA	Danish International Development Agency
DAO	District Agricultural Officer
DDSP	District Development Support Programme
DGIS	Directorate General for Development Cooperation, Ministry of Foreign Affairs, The Hague
DVTCs	Department of Veterinary and Tsetse Control Services
ECF	East Coast Fever
EC	European Community
FAO	Food and Agricultural Organization of the United Nations, Rome
FINNIDA	Finnish International Development Agency
FMDU	Farm Machinery Development Unit
FTC	Farmer Training Centre
GRZ	Government of the Republic of Zambia
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit, Germany
HS	Haemaerhagic Septicaemia
IFAD	International Fund for Agricultural Development, Rome
ILO	International Labour Organization, Geneva
IMAG-DLO	Instituut voor Mechanisatie, Arbeid en Gebouwen - Dienst Landbouwkundig Onderzoek (Institute of Agricultural Engineering), Wageningen
IRDP	Integrated Rural Development Programme
ITDG	Intermediate Technology Development Group, UK
K	Kwacha currency (at time of review mission the approximate exchange rates were US\$1=K40 and UK£1=K80)
KADICU	Kaoma District Cooperative Union
KAEC	Katapola Agricultural Engineering Centre
LCU	Luapula Cooperative Union
LCU	Lusaka Cooperative Union
LDP	Land Development Programme, Western Province
LENCO	Lusaka Engineering Company, Lusaka
LIAC	Larenstein International Agricultural College, Deventer
LIRDP	Luangwa Integrated Rural Development Project
M.Sc.	Master of Science degree
MAWD	Ministry of Agriculture and Water Development, Lusaka (subsequently re-named)
MDM	Name of an engineering company based in Kitwe
MoA	Ministry of Agriculture, Lusaka
NCAE	National Centre for Agricultural Engineering

NCU	Northern Cooperative Union
NEI	Nederlands Economisch Instituut (Netherlands Economics Institute)
NGO	Non Governmental Organization
NORAD	Norwegian Agency for International Development
NRDC	National Resources Development College, Lusaka
NWCU	North Western Cooperative Union
NWIRDP	North Western Integrated Rural Development Programme
ODA	Overseas Development Administration, United Kingdom
PAO	Provincial Agricultural Officer
PDTI	Palabana Dairy Training Institute
PTA	Preferential Trade Area (Eastern and Southern Africa)
PVC	Polyvinyl chloride
PVO	Provincial Veterinary Officer
RDP BV	Name of a consultancy company based in The Netherlands
RRS	Regional Research Station (Magoye)
SADCC	Southern Africa Development Coordination Conference
SDP	Smallholder Development Project
SIDA	Swedish International Development Agency
SIDO	Small Industrial Development Organization
SKF	Name of a multinational engineering and bearing company, based in Sweden
SNV	A major development and volunteer organization based in The Netherlands
SPCMU	Southern Province Cooperative Marketing Union
TDAU	Technology Development Advisory Unit, University of Zambia, Lusaka
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization, Vienna
UNZA	University of Zambia, Lusaka
US\$	United States dollar
VAP	Village Agricultural Programme
VODP	Village Oriented Development Programme
WPCU	Western Province Cooperative Union
ZADL	Zambia Agricultural Development Ltd
ZAFFICO	Zambia Forestry and Forest Industries Corporation
ZATCO	Zambia Agricultural and Trading Cooperative Ltd
ZCA	Zambia College of Agriculture, Monze and Choma
ZCF/FS	Zambia Cooperative Federation Financial Services
ZCF	Zambia Cooperative Federation
ZS	Zambian standard

Animal traction in Zambia: status, progress and trends 1991

Report prepared by

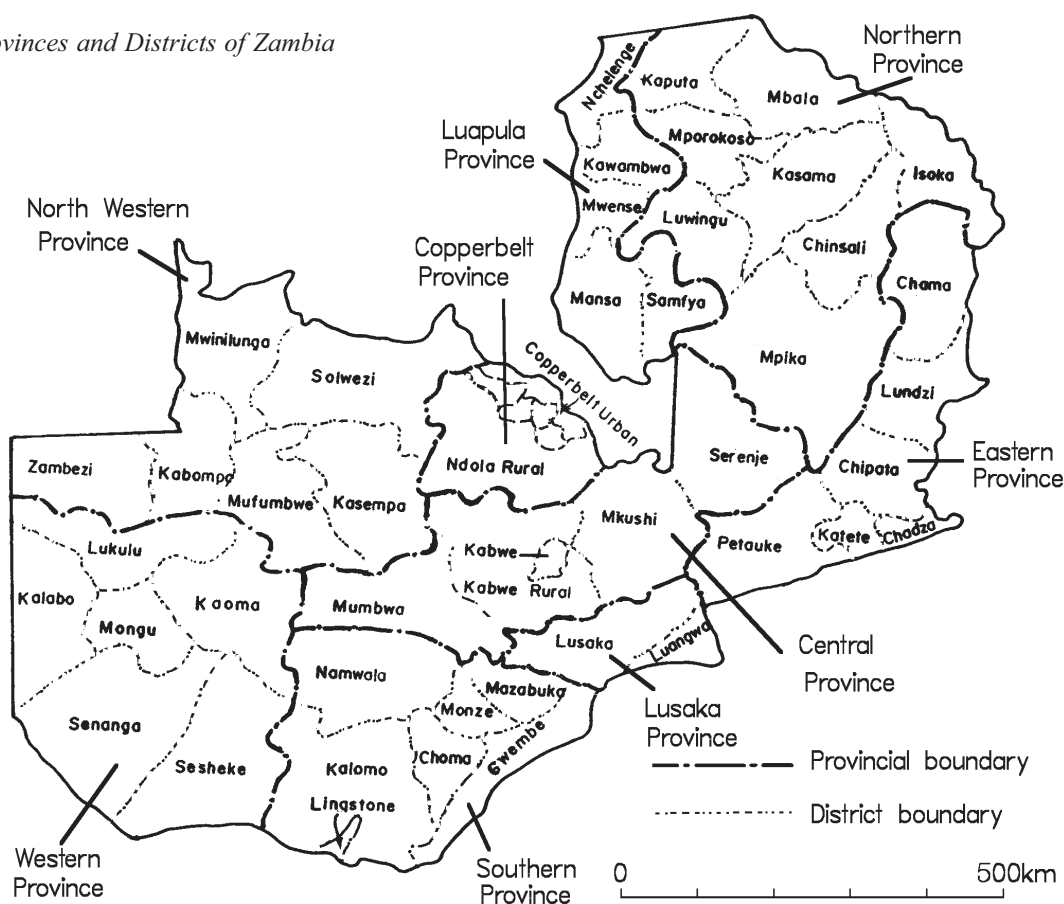
Paul Starkey, Henk Dibbits and Emmanuel Mwenya

Part 1

Overview of each province
Discussion of key issues
Conclusions

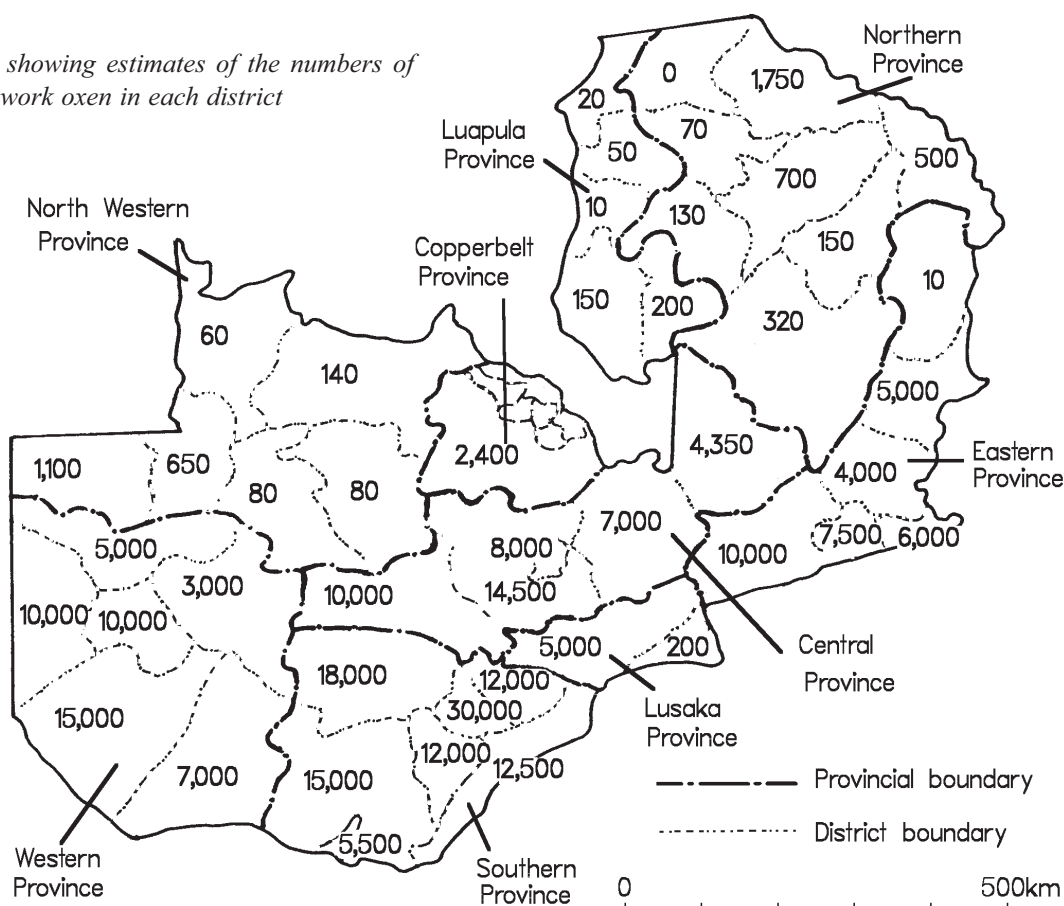
Map 2.

The Provinces and Districts of Zambia



Map 3.

Zambia showing estimates of the numbers of trained work oxen in each district



Overview of present situation

Northern Province

The Northern Province, comprising nine districts in the northeast of the country, is dominated by woodland ecology. It is sparsely populated, with about 750,000 people living in its 148,000 km². The rainfall is about 1100-1400 mm per year. The traditional “*chitemene*” system of shifting cultivation is still widely practised, although, in some areas, population pressures are limiting the length of the fallow periods. The cattle population of 100,000 is quite low. About 90,000 cattle are owned in the traditional sector and 11,000 in the commercial sector. Cattle tend to be concentrated in those parts of the province near the Tanzanian border, including Mbala and Isoka Districts, where cattle keeping is traditional. Kasama and Chinsali districts also each have over ten thousand cattle but in Kaputa, Mporokoso, Mpika and Luingu Districts very few cattle are found. The movement of cattle from Mbala, Isoka and Nakonde to other districts is restricted by veterinary regulations designed to prevent the spread of East Coast Fever, which exists in the border area. The tsetse challenge is thought to be highest in Kaputa District, where cattle are virtually absent. It is reported that herd productivity is generally low in the Northern Province.

Only a small proportion of the farmers in the province uses animal traction. In many areas, the rapid adoption of animal traction seems unlikely due to the combination of small numbers of cattle, low human population density, limited marketing opportunities and bush-fallow cultivation systems. Nevertheless there are areas where animal traction is increasingly being adopted.

The 1985 Animal Draught Power (ADP) investment plan assumed that 4200 work oxen were in use in the Northern Province. This had been calculated as 40% of the estimated 10,600 “oxen and tollies”. (For many years cattle censuses have been recording the number of “oxen and tollies”; there seems no clear definition of “tollies”, but these are generally assumed to be castrated males, older than “calves”, and younger, or smaller, than “oxen”.) The 1985 investment plan projected that by 1990 the number of work oxen would increase to 8000. In fact, by 1990 the total number of “oxen and tollies” had risen to 12,000, but the number of work oxen in use is estimated at only 3600. Since there is a widespread conviction that the number of draft animals has been in-

creasing in recent years, it is assumed that the 1985 estimate was inaccurate.

Animal traction is concentrated in the Mbala, Isoka and Kasama East Districts. There are few development projects working in these areas. Most cattle are found in the Isoka, Mbala and Chinsali Districts. It is quite possible that animal traction technology has been spreading informally by farmers in contact with Tanzania. Significant extension efforts in animal traction started in the late seventies. They have been implemented mainly by organizations and projects based in Kasama and Mpika, where cattle numbers are relatively low. Ministry of Agriculture (MoA) programmes working with animal traction have included the Village Agricultural Programme (VAP), Integrated Rural Development Programme (IRDP) Mpika, IRDP Kasama and the Rice Development Project. The MoA has designed and implemented an animal traction education programme for primary schools. Cinci wa Babili (an organization sponsored by the Catholic church) and the Zambia College of Agriculture at Mpika have also been assisting farmers to obtain and train oxen. These organizations are all operating in areas where animal traction is quite new and most farmers do not use oxen. Between them the various projects distributed about 1200 oxen between 1982 and 1989, with numbers increasing from 50 oxen in 1982, to 400 oxen in 1989. In 1990, about 1000 oxen were in use in Kasama and Mpika Districts. Also, in 1990, a small herd of donkeys was imported from Botswana for use in a rural roads programme.

One of the projects introducing work animals has been the Rice Development Programme. This has found that farmers can successfully and profitably use work oxen for rice cultivation. Provided animals are available for purchase, it is expected that numbers of oxen used for rice production will increase significantly during the coming years from the 120 animals now employed.

In much of the Northern Province, farmers are not accustomed to owning and handling cattle, and oxen are not readily obtainable in some districts. Thus introduction schemes have generally started slowly, constrained by shortages of easily available animals and by the labour-intensive training required to counteract farmer unfamiliarity with cattle.

Tick-borne diseases can pose health problems for work oxen, with East Coast Fever present near the Tanzanian frontier. Outbreaks of rinderpest and foot and mouth disease have also occurred in these border areas. Trypanosomiasis is likely to limit the introduction of cattle in some areas, notably Kaputa District in the very north of the country. Although the cattle population is relatively low (so that diseases are not easily spread), the veterinary services are also quite limited. This, together with the high demand for meat, means that new adopters of animal traction have tended to respond to animal sickness by slaughtering one or both animals.

The ban on moving cattle from Mbala, Isoka and Nakonde districts has restricted project options for supplying cattle. Projects have tended to supply animals purchased from Zambia Agricultural Development Ltd (ZADL) ranches at Mbesuma in Chinsali District and Kangwishi in Mporokoso District. However, output from these ranches is low (about 200 head per year). Even if, with improved management, output was increased to 300 per year, this would still be below the apparent demand.

Following initiatives taken by the MoA provincial agricultural engineering section, a provincial Animal Draft Power Steering Committee was established in 1988 and remains active. All projects and financial institutions involved in animal traction are represented in the Committee. In order to improve the efficiency of project activities relating to animal trac-

tion, MoA has proposed a Provincial Animal Draft Power Project. Under this, the animal traction activities of VAP, IRDP and the Rice programme would be merged. The various projects are already cooperating, and the new arrangements could start in 1991, provided funding can be obtained for the new programme.

The supply of ox-drawn implements in the Province is reported to be very erratic. In many districts, implements and spare parts are not available. The Northern Co-operative Union (NCU) attempts to keep some animal-drawn implements and spares in the provincial headquarters at Kasama. NCU is not sure of the demand in the various districts, and so few implements are sent out of Kasama. Consequently externally-funded projects tend to buy implements from outside the province for supply to the farmers. There are few support services for animal-drawn implements, but blacksmith training is due to start at the Vocational Training Centre near Kasama. Few animal-drawn carts exist in the province, but where they have been introduced, they appear to be profitable. Ox carts have proved particularly effective and profitable in the rice growing areas. Elsewhere the demand for carts is likely to depend on whether an effective maize purchasing system can be developed for the province. The present uncertainties and delays in maize marketing arrangements constitute a major constraint to smallholder agricultural development in the province.

Table 1. Estimates of the numbers of cattle, trained work oxen and steers in the Northern Province

	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Kasama	700	1 265	108	9 079	1 138	10 217
Mbala	750	3 435	780	14 714	5 196	19 910
Isoka	500	4 480	0	45 567	0	45 567
Chinsali	150	1 522	170	16 160	2 795	18 955
Mpika	320	710	144	2 461	687	3 148
Luwingu	130	293	93	1 416	543	1 959
Mporokoso	70	233	7	1 262	1 570	2 832
Kaputa	0	0	0	0	0	0
TOTAL	3 620	11 938	1 302	90 659	11 929	102 588

¹. Estimates of trained work oxen from questionnaire survey, site visits and mission discussions.

². Numbers of steers and oxen based on "oxen and tollies" classification within the provincial livestock census reports of the Department of Veterinary and Tsetse Control Services (DVTCS).

³. Cattle population derived from 1989/90 DVTCS livestock census figures.

⁴. Classification into "Traditional sector" and "Commercial sector" as DVTCS census.

Luapula Province

Luapula province is sparsely populated, with 450,000 people living in 50,500 km². The rainfall ranges from 1100 mm to 1400 mm. Bush-fallow agriculture remains dominant, although annual cropping of land is common around towns and large villages. Traditionally much of the population has been associated with fishing in Lake Bangweulu and the Luapula River, and fishing and fish marketing remain important. Cattle are rarely kept by farmers, and the total cattle population in the traditional sector remains low, at about 8300. A few ranches have been established, notably by the parastatal company Zambia Agricultural Development Ltd (ZADL), and the commercial herds total about 2500 animals.

Animal traction is a relatively new technology. It is thought that fewer than 100 oxen were in use in 1985 and that 430 oxen were being employed in the province in 1990. Many of these had been introduced as a result of recent credit programmes. These had been arranged by Luapula Cooperative Union and the Lima bank, in cooperation with MoA and the Finnida-supported Cattle Development/Animal Draught Power Programme. In the mid 1980s, the success rate of animal traction introductions was low, with many farmers deciding to sell their animals for slaughter. Recently the situation has improved, possibly due to better extension/training facilities and follow-up.

The low number of cattle in the province is a major constraint. In 1990, the Lima bank had 50 oxen loans available, but, owing to difficulties in obtaining oxen, only 17 of these were taken up. To help overcome this constraint in the long term, a programme is being initiated to enable selected farmers to develop small breeding herds. With a low population of cattle, infectious and tick-borne diseases do not now pose a major threat to cattle.

There might be a significant potential for ox carts in the province, although this system of transport is little developed. Few ox carts are in use, but those farmers with ox carts who were interviewed reported high incomes from hire fees.

The present low demand for implements seems to be met at provincial level by the cooperative union. If demand continues to increase, it is likely that implements will have to be available at district, as well as provincial, level. Blacksmiths are being trained and supported to make spare parts; they may become important if demand for spares and maintenance begins to grow.

Table 2. Estimates of the numbers of cattle, trained work oxen and steers in the Luapula Province

	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Mansa	150	585	37	2 983	634	3 617
Samfya	200	625		2911		2 911
Mwense	10	26	195	1 033	1 867	2 900
Kawambwa	50	334		1302		1302
Nchelenge	20	60		103		103
TOTAL	430	1 630	232	8 332	2 501	10 833

¹. Estimates of trained work oxen from questionnaire survey, site visits and mission discussions.

². Numbers of steers and oxen based on "oxen and tollies" classification within the provincial livestock census reports of the Department of Veterinary and Tsetse Control Services (DVTCS).

³. Cattle population derived from 1989/90 DVTCS livestock census figures.

⁴. Classification into "Traditional sector" and "Commercial sector" as DVTCS census.

Copperbelt Province

The Copperbelt Province covers an area of 31,014 km², which is 4.2% of Zambia's total area. Although the province is the second smallest in the country, it contains the largest population (approaching two million) with a density of about 60 persons per square kilometre. Mining is the major economic activity in the province and this directly and indirectly supports a large urban population. Some of the urban population cultivate small pieces of land inside and outside the towns, but most of agricultural production derives from the surrounding rural areas. Of the 1,577,000 ha of agricultural land in the province, 307,000 ha are under cultivation. Average rainfall is about 1200mm.

There is little tradition of cattle keeping and so animal traction is a relatively new technology. Most soil tillage is performed by tractors or hand hoes, but in recent years tractor ownership and hire have become increasingly expensive. The 1985 Investment Plan estimated that there were 1250 trained oxen in the Province. A detailed survey of one area in Ndola Rural District in 1988 suggested that there were about 1000 trained oxen in use. The total for the province may be in the region of 2400. Since there have been few promotional activities relating to animal traction in recent years, most farmers adopting and using work oxen would have done so without the assistance of development projects. Animal traction technology is informally diffusing into the Copperbelt from other provinces: a recent survey suggested that over 40% of oxen owners were migrants from other areas (SDP, 1989).

The promotion of animal traction in the province is said to be constrained by a shortage of steers, as cattle are not numerous in the province. The provincial herd is estimated at only 62,000, and most of these (48,000) are raised on commercial ranches. Most of

the animals consumed for meat are imported from Southern, Central or Western Provinces (those from the Western Province have to be slaughtered within 24 hours). Until recently, animal health was not considered a major constraint to animal traction, but the small outbreak of corridor disease in 1989 demonstrated the need for vigilance in tick control.

The proximity of urban centres makes marketing of produce relatively easy. It also makes it easy for thieves to steal and market animals. Crime is a major problem near the Zaire border.

The province has many manufacturing companies established to service the mining industry. Some of these manufacture ox-drawn implements, using their available tools and "jobbing" techniques. Companies with agricultural engineering divisions include Northland Engineering, MDM Engineering and SKF. Northland Engineering is the largest producer of implements in Zambia. It supplies implements to all provinces and sometimes exports to other countries. SKF, a bearing manufacturer, supplies axles for ox carts.

The Smallholder Development Project (SDP), supported by the European Community, is promoting animal traction in an area of Ndola Rural District. To date, the project, which started in 1988, has concentrated on preliminary activities such as information gathering and assessment. By December 1990, it had assisted about 30 farmers to obtain oxen and implements.

The Ministry of Agriculture has few other externally-assisted development projects in the Province. MoA personnel have little access to motorized transport. The parastatal timber company, ZAF-FICO, is using some oxen for extracting logs from its plantations.

Table 3. Estimates of the numbers of cattle, trained work oxen and steers in the Copperbelt Province

(Notes as Table 4)	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Luanshya	50	88	154	1 003	5 580	6 583
Chiliaboabwe	0	58	311	256	1 341	1 597
Kitwe	0	0	3 115	0	12 276	12 276
Kalulushi	0	0	500	0	1 509	1 509
Chingola	0	0	3 528	0	20 325	20 325
Mufulira	0	0	729	0	1 365	1 365
Ndola Rural	2 350	3 874	558	15 951	5 397	21 348
TOTAL	2 400	4 040	8 896	17 210	47 793	65 003

North Western Province

North Western Province contains large areas of sparsely populated woodlands. It has relatively high annual rainfall of 1100-1400 mm. Farming systems are mainly based on shifting cultivation, with the *chitemene* system of forest-fallow (or bush-fallow) cultivation being common in the Solwezi, Kasempa and Mwinilunga Districts. Such systems depend almost entirely on human labour, using simple hand tools such as hoes and axes.

There are approximately 60,000 cattle in the province, of which about 2000 are trained work oxen. The cattle are concentrated in the west, towards the border with Angola, where the tsetse challenge is low. Zambezi and Mwinilunga Districts are the most important cattle areas, with 35,000 and 13,000 cattle respectively. These districts provide most of the steers used for animal traction in the province. There are few restrictions on cattle movement. The ZADL parastatal ranch in Solwezi and the Kabukafu cattle breeding unit in Kasempa are other, much smaller, sources of oxen.

Animal traction has had a long tradition in the west of the country, notably in Zambezi District, where cattle ownership is common. Cattle and animal traction have been spreading eastward into Kabompo, a trend recently assisted by the North Western Integrated Rural Development Project (NWIRDP). Although Mwinilunga District has some herds of cattle, few animals are used for work. It is said that this is partly due to the traditional herding system, which does not encourage docility in animals. Animal traction is still a rare and new technology in Solwezi,

Kasempa and Mufumbwe. In these districts, animal traction has been introduced on a small scale as farmers have immigrated from other provinces and settled. Some adoption has been as a result of small extension programmes assisted the Norwegian Agency for International Development (NORAD) and the International Fund for Agricultural Development (IFAD).

Animal traction in the province has been boosted by the GTZ-supported IRDP working in Zambezi, Kabompo and Mufumbwe Districts. NWIRDP, in cooperation with the North West Cooperative Union (NWCU) has been assisting the adoption of oxen and ox carts. It has produced several detailed reports relating to this. More recently the NWCU has started a small IFAD-supported animal traction programme in Kasempa, Solwezi and Mwinilunga Districts. So far about 30 pairs of oxen have been introduced into this area under this scheme. Collaboration between the NWIRDP-supported and the IFAD-supported programmes is envisaged. Zambia Cooperative Federation Financial Services (ZCF/FS) has been providing credit for animal traction. In both areas, ox carts are considered to have great potential, with social and economic benefits.

Within the province, there is liaison and collaboration between the various organizations involved developing animal traction. In 1988, a workshop was held for people working in animal traction in all districts, and a provincial work oxen programme was drawn up.

Table 4. Estimates of the numbers of cattle, trained work oxen and steers in North Western Province

	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Solwezi	140	510	25	2 646	1 338	3 984
Kasempa	80	73	25	426	241	667
Mufumbwe	80	92		215		215
Mwinilunga	60	604		13 060	1 335	14 395
Kabompo	650	1 040		5 485	15	5 500
Zambezi	1 100	3 199		34 630		34 630
TOTAL	2 050	5 518	50	56 462	2 929	59 391

¹. Estimates of trained work oxen from questionnaire survey, site visits and mission discussions.

². Numbers of steers and oxen based on "oxen and tollies" classification within the provincial livestock census reports of the Department of Veterinary and Tsetse Control Services (DVTCS).

³. Cattle population derived from 1989/90 DVTCS livestock census figures.

⁴. Classification into "Traditional sector" and "Commercial sector" as DVTCS census.

Western Province

Western Province covers an area of almost 130,000 km² and has a population of about 550,000. About 30% of the rural households are headed by females. Average annual rainfall ranges from less than 760 mm near Namibia in the south, to 1150 mm in the north. About 10% of the Western Province is classified as lowlands or wetlands, and these are often areas of high agricultural potential, such as the large flood plain of the Zambezi and the Lui River Valley. Lowlands also include the low lying, poorly drained areas known as “pan dambos”, which provide dry season grazing. Much of the Western Province is part of the uplifted Kalahari-Okavango basin, and some soils are Kalahari sands with low agricultural potential. Kaoma District is considered by many to have relatively high agricultural potential. However, it has few cattle or work oxen. This may be associated with the high tsetse population along the borders the Kafue National Park.

The Western Province has a long tradition of cattle keeping and 510,000 cattle are owned. The total cattle population is increasing by about 2% per annum. Within the province the social and geographical distribution of cattle is highly skewed. Cattle are least common in the maize-growing Kaoma District. Cattle play an important role in the social and economic life of the Lozi people, and this has been stressed in several agricultural research reports. Although about 35% of households are female headed, few female farmers own cattle or oxen. Fishing and forestry are also important in the traditional economy. Crop production is often considered a secondary activity for Lozi farmers.

The use of animal traction is well-established in much of the Western Province. About 50,000 of the 87,000 oxen in the province are used for work. Animals, usually hitched in teams of four or six, are widely employed for transport and for cultivation.

Through traditional systems of loan and hire, many people who do not own cattle can have access to work oxen, and the majority of fields are cultivated using oxen.

Animal traction use dates back several generations. Animal-drawn sledges play an important role in rural transport, carrying seeds, fertilizer, consumer goods, crops and plows. In comparison with sledges, there are few ox carts, and these are mainly used near towns, or on rural trading routes (to Angola and elsewhere). Animal-drawn cultivation has existed in the province for many years, and has been steadily increasing for at least fifty years. Now, in some areas, 90% of farmers plow with oxen, the majority hiring or borrowing from the minority who actually own oxen.

Recent animal traction initiatives started in 1980, with the establishment of the Longe Ox Training and Supply Centre in Kaoma District. The Looma Oxen Supply and Training Centre was established in 1981. Animal traction work was also undertaken by the Cattle Development Programmes and the Adaptive Research Planning Team (ARPT). There is a Western Province Animal Draft Power Programme supported by The Netherlands. This was started in September 1989 and is attempting to operate throughout the province. It is mainly carrying out training activities, but has assisted with schemes to supply cattle, animal-drawn implements and ox carts. There is no formal Animal Draft Power Steering Committee in the province, but some animal traction discussion takes place within the provincial livestock committee.

The Department of Veterinary and Tsetse Control Services (DVTCS) is concentrating on preventive disease control measures. Curative assistance is not generally available. The risk of mortality of adult animals is quite high, at about 7%.

Table 5. Estimates of the numbers of cattle, trained work oxen and steers in the Western Province

<i>(Notes as Table 6)</i>	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Lukulu	5 000	7 800		66 468		66 468
Kalabo	10 000	19 329		105 501		105 501
Mongu	10 000	16 106		90 185		90 185
Kaoma	3 000	4 698		21 891		21 891
Senanga	15 000	26 429		158 898		158 898
Sesheke	7 000	12 942		69 851		69 851
TOTAL	50 000	87 304		512 794		512 794

Southern Province

The Southern Province covers 85,000 km², which is 11% of the area of Zambia. Annual rainfall is 700-900 mm. Cattle are economically important in the province. The one million cattle in the Southern Province account for 40% of the national herd. Of the 890,000 cattle in the traditional sector, 277,000 are “oxen and tollies”, and of these about 105,000 are trained animals.

The cattle population grew during the early 1980s but recently it declined slightly in the traditional sector as a result of corridor disease. This tick-borne disease is seen as a major constraint to cattle production and animal traction, but many farmers still do not dip their cattle regularly. The K5 per animal dip charge has been a major barrier.

Most smallholder farmers own cattle and use work animals for crop production. Animal traction has been well-established for many years, and is carried out with little external assistance. Farmers select and train their own work animals and use them extensively for plowing, weeding and transportation. Oxen are the main work animals, but cows are also worked. Plowing with teams of four animals is common, although pairs are also used. In one recent survey, 90% of farmers were reported to own oxen and plows. In this survey, 53% of farmers owned a cultivator, 48% a harrow, 20% a ridger, 7% a seeder and 45% an ox cart. Some large-scale commercial farmers use work oxen, mainly for on-farm transport.

The province has a small number of donkeys (600-1000) that are used for pack transport. They are mostly found in Gwembe South. In a recent survey, it was reported that they regularly make return trips of over 120 km to carry goods to and from markets. Some donkeys are used for carting, plowing and cultivation, in which case they are usually yoked, like oxen.

The Magoye Regional Research Station is located in the Southern Province, and this is the base for national-level testing and research relating to animal traction equipment and tillage. The Dutch-supported Animal Draught Power Research and Development Project has developed standards for the on-station and on-farm testing and evaluation of plows and carts. Tests have indicated design faults and weakness in many carts and several plows. On-station tillage trials have demonstrated the effectiveness of ridgers for weed control, and the relative efficiency of the traditional system of hand-metering maize seeds. Trials to demonstrate differences between various locally-available plows (design, stage of wear, adjustment) in weed control and crop yield have not yet yielded conclusive results. The province also includes the important livestock research centre of Mochipapa, in Choma.

The Ministry of Agriculture lacks any donor-supported animal traction initiative at provincial level, and MoA staff feel constrained by lack of

Table 6. Estimates of the numbers of cattle, trained work oxen and steers in the Southern Province

	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Livingstone	5 500	14 056	2 561	47 218	10 554	57 772
Kalomo	15 000	37 595	7 245	114 810	54 166	168 976
Choma	12 000	39 239	6 370	122 516	36 583	159 099
Gwembe	12 500	34 232	0	110 994	0	110 994
Monze	30 000	77 103	4 916	244 333	22 976	267 309
Namwala	18 000	46 730	0	167 813	0	167 813
Mazabuka	12 000	28 140	14 902	82 811	65 432	148 243
TOTAL	105 000	277 095	35 994	891 495	189 711	1 081 206

¹. Estimates of trained work oxen from questionnaire survey, site visits and mission discussions.

². Numbers of steers and oxen based on “oxen and tollies” classification within the provincial livestock census reports of the Department of Veterinary and Tsetse Control Services (DVTCS).

³. Cattle population derived from 1989/90 DVTCS livestock census figures.

⁴. Classification into “Traditional sector” and “Commercial sector” as DVTCS census.

transport and resources. As animal traction is an accepted part of most local farming systems, development initiatives in the province aimed at smallholder agriculture usually have some activities relating to animal traction. An example of this is the GTZ-supported Gwembe integrated rural development programme. MoA staff are concerned about developing the skills of local blacksmiths to support animal traction.

The Cooperative Union has recently started paying farmers with ox carts to transport maize from satellite depots to main depots. Under a new plan (developed by the Logistic Planning Unit), satellite depots will be phased out and farmers will be expected to deliver maize to the 80 major depots. To facilitate this, a substantial increase in the number of ox carts is envisaged. It is intended that the depots should stock animal traction equipment and spares and provide animal traction support services, such as puncture repairs, blacksmiths workshops and possibly dipping facilities.

Most plows sold by the cooperative union and private retail outlets come from Zimbabwe. These plows have a very good reputation for quality and price, and spare parts are generally available along the line of rail. The Northland plow is considered acceptable but too expensive. The first Rumpststadt/Lenco plow had been unpopular, as farmers found it too heavy. An Italian-funded project has recently imported 8,500 lightweight Italian plows and ridgers. These will be sold cheaply to farmers. They have yet to be evaluated by farmers. Two of the three plow designs failed initial tests at Magoye, but one of the ridgers was found to be competent.

Figure 1. Demonstration of weeding technology at Magoye Regional Research Station, Southern Province.



Notes for Table 7 (opposite).

- ¹. Estimates of trained work oxen from questionnaire survey, site visits and mission discussions.
- ². Numbers of steers and oxen based on "oxen and tollies" classification within the provincial livestock census reports of the Department of Veterinary and Tsetse Control Services (DVTCS).
- ³. Cattle population derived from 1989/90 DVTCS livestock census figures.
- ⁴. Classification into "Traditional sector" and "Commercial sector" as DVTCS census.

Central Province

Central province covers 93,374 km² and shares boundaries with all other provinces of Zambia. Annual rainfall varies from over 1100 mm in the north-east to 800 mm in the south.

The province is an important producer of many arable crops including maize, sorghum, sunflower and soya beans. These crops are mostly grown by emergent and traditional farmers, although there are also some large, commercial farms. While tobacco is grown on some commercial farms, most large farms concentrate on livestock. About 175,000 cattle are maintained in the commercial sector, and the majority of these are in Chisamba District, between Lusaka and the Copperbelt. There are about 310,000 cattle in the traditional sector, and 80% of these are found in the west and south of the province, in Mumbwa and Kabwe Rural (Chisama and Chibombo) districts. Mkushi and Serenje Districts to the north and east have 13,000 and 9000 smallholder cattle respectively.

In 1989, there were 100,000 "oxen and tollies" in the traditional sector, and it is estimated that 36,000 of these are employed for work. Animal traction is well-established in the south and west of the province, it has been increasing gradually in the past 25 years. Over 80% of the work animals in Central Province are to be found in Kabwe and Mumbwa districts, where farmers are experienced in selecting and training their work animals without external assistance. Farmers in Serenje District are not traditional cattle keepers, and most use hand cultivation. Only about 3% of the work animals are to be found in Serenje District, an area of recent introduction. In the mid 1980s, the IRDP (Chinsali-Mpika-Serenje) was working in Serenje, and assisted early adopters of animal traction. IRDP undertook socioeconomic studies and concluded that animal traction led to ex-

tensification (that is the cultivation of larger areas, with lower inputs and outputs per unit area). Animal traction technology was found to be economically beneficial as the area expansion more than compensated for the slight reduction in yield per unit area. IRDP regarded shortage of steers as a critical constraint and so animal supply centres were proposed. These did little to alter the overall supply situation.

Animal disease can be a serious problem in the province. Prophylaxis against trypanosomiasis is recommended in some areas. Corridor disease has recently increased mortality, mainly in the central areas. Quarantine regulations restrict the movement of cattle from Mumbwa.

There is no donor-supported provincial animal traction programme. The Ministry of Agriculture is assisting the training of work animals in the areas of introduction. It has also arranged plowing competitions. An EC-supported smallholder maize project organized animal traction loans for 500 farmers. Repayment rates were high, but only 60% of farmers continued with animal traction, with many cashing-in their loan benefits by selling or slaughtering their animals. In the follow-up programme, emphasis will be placed on loans for implements and carts rather than animals.

Wooden sledges are quite widely used. Ox carts are made by small workshops, using materials derived from old vehicles. The Copper Mines Enterprise Trust (COMET) has proposed establishing further cart-manufacturing capabilities. Implements are sold by the cooperative unions and by some private dealers, and supply appears adequate. Spare parts are scarce, although artisans in Mumbwa district have been trained to make shares and other plow parts.

Table 7. Estimates of the numbers of cattle, trained work oxen and steers in the Central Province

	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Mumbwa	10 050	41 740		126 843		123 843
Kabwe Rural	14 500	27 300		76 607		76 607
Chisamba	4 500	12 318	18 652	44 215	98 263	142 478
Kabwe Urban	200	562	10 938	1 760	43 612	45 372
Kapiri Mposhi	3 300	8 801		36 642		36 642
Mkushi	2 000	4 592	5 911	13 184	32 989	46 173
Serenje	1 350	4 493		9 304		9 304
TOTAL	35 900	99 806	35 501	308 555	174 864	483 419

Eastern Province

Eastern Province covers an area of about 69,000 km². Only about half of this is considered to have agricultural potential, and a small part of this (about 250,000 ha) is actually cropped. The annual rainfall varies between 870 mm and 1100 mm. The low-lying and tsetse-infested Luangwa valley runs from Chama in the north to Petauke in the south and contains a large population of wild animals. Most farmers in the Eastern Province are hoe cultivators but animal traction is rapidly being adopted in some areas. There is little commercial ranching, and most of the 270,000 cattle are maintained in numerous small herds in the traditional sector. The supply of draft animals is only a problem in tsetse-infested areas, such as Chama District. The major health problems are trypanosomiasis (throughout the Luangwa valley and its bordering areas) and tick-borne diseases such as East Coast Fever.

Animal traction has become well-established in the south along the Mozambique border in the more fertile areas away from the Luangwa valley. About 10,000, 7500 and 6000 work oxen are used in the Petauke, Katete and Chandiza Districts respectively. Oxen are also quite widely used in the relatively tsetse-free eastern strip of the province along the Malawi border, and 4000 and 5000 oxen are employed in Chipata and Lundazi districts respectively. In these areas ridgers are widely used for primary tillage, and along the Malawi border, more ridgers than plows are owned.

The MoA started an ox training programme in 1975 which helped establish or expand animal traction in several areas. It found that its own success made

continued promotion superfluous, for in areas where MoA ox trainers formerly operated, farmers started training oxen for themselves and for fellow farmers. MoA still conducts mobile oxenization courses where necessary. The Luangwa IRDP is starting to promote animal traction into the areas bordering the Luangwa valley. As this is a zone of introduction, training is considered necessary, as is routine prophylaxis.

The province has many traditional blacksmiths and carpenters and several projects and organizations aim to train and support them. Raw materials are being supplied to blacksmiths through the FAO Agricultural Mechanization Project and the provincial cooperative union. Some blacksmiths make complete plows and ridgers, which together with spare parts, are marketed through primary cooperative societies and hardware shops. Several entrepreneurs manufacture ox carts, using old car axles, sometimes bought in from Malawi.

The Katopola Agricultural Engineering Centre, supported by SIDA, tried for many years to promote the manufacture of wooden implements and ox carts with wooden wheels and wooden bearings. This scheme apparently had almost no success, and none of the trained carpenters are making wooden wheels for carts. The Msekhocika Project, supported by Austrian aid, started using similar wooden-wheeled carts, but changed to promoting the manufacture of carts based on imported axles and wheels. This programme was much more successful and its carts are increasingly used in the project area.

Table 8. Estimates of the numbers of cattle, trained work oxen and steers in the Eastern Province

	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Chama	10	50		417		
Lundazi	5 000	11 835		39 593		
Chipata	4 000	10 562		43 397		
Chandiza	6 000	17 876		62 888		
Katete	7 500	18 916		57 928		
Petauke	10 000	23 378		65 958		
TOTAL	32 510	82 617		270 181	3 449	273 630

¹. Estimates of trained work oxen from questionnaire survey, site visits and mission discussions.

². Numbers of steers and oxen based on "oxen and tollies" classification within the provincial livestock census reports of the Department of Veterinary and Tsetse Control Services (DVTCS).

³. Cattle population derived from 1989/90 DVTCS livestock census figures.

⁴. Traditional and "Commercial" classification as census. District statistics not available for commercial.

Lusaka Province

Lusaka Province was created from part of Central Province in 1980. With an area of 22,000 km², it is relatively small and its potential arable area is estimated to be 304,000 ha, of which about 60,000 ha is cultivated. In terms of population and economic activity, the province is dominated by the capital city, and about 80% of the population live in the urban centres of Lusaka, Kafue and Chilanga. About half the rural population stays in the fertile plateau areas to the west of Lusaka. Another 30% live in the densely populated Soli wa Manyika agricultural area south of Chongwe, which produces much of the maize of the province. The low-lying valleys along the Lusemfwa, Luangwa and Zambezi Rivers are dry, hot, sparsely populated and prone to drought. The annual rainfall in the agricultural areas is about 700-800 mm.

The highly-mechanized commercial farming sector is strong near Lusaka city and along the line of rail. The presence of a mechanized commercial sector, together with the workshop support available in the urban centres, means that tractor hire is a viable option for many smallholder farmers. While almost half the farmed area is in the commercial sector, much of this is used for animal grazing rather than crop production. Of the total cropped area, 70% is cultivated by smallholders.

There are about 40,000 cattle in the traditional sector, of which 11,000 are "oxen and tollies". In 1988 the number of working oxen was estimated at 3300. More recent estimates suggest the number of work animals has risen to 5200. In the 1988 survey, it was reported that there were about 1600 plows, 1000 harrows, 1000 cultivators, 570 ridgers, 330 planters and 650 ox carts owned by farmers in the province. Not all were in working order.

The provincial Ministry of Agriculture office acknowledges that most of the development of animal traction in the province is a result of the farmers' own efforts. Little attention was afforded to animal traction before 1988. Animal traction is now being promoted by the Department of Agriculture, through ox training courses. About 60 farmers were trained between 1988 and 1990. There is no donor-assisted provincial animal draft programme, and a provincial animal power committee has yet to be established. The provincial MoA office tends to be overshadowed by the presence in the province of the national MoA headquarters.

Several important institutions involved with animal traction are based in Lusaka Province. These include the University of Zambia (UNZA), and its Technology Development Advisory Unit (TDAU) and the Natural Resources Development College (NRDC). A national training centre for animal traction has recently been established at Palabana. The Kasisi Agricultural Training Centre is a small church-supported organization that has been actively developing and testing appropriate technologies since the early 1980s. It gained somewhat of a national reputation with its development and promotion of wooden-wheeled ox carts, nicknamed "Flintstone carts".

Lusaka, being the centre of many commercial and manufacturing activities, has a good supply of implements, ox carts and veterinary drugs. Among the commercial producers of equipment are Lenco and Gameco. Among the importers are Zambia Cooperative Federation Commercial Services Division (ZCF-CSD) and AFE Ltd. Implements and spares are inevitably more difficult to obtain in the rural districts, of which some, such as Luangwa, are 200 km from Lusaka.

Table 9. Estimates of the numbers of cattle, trained work oxen and steers in Lusaka Province

	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Luangwa	200	605		1 086		
Lusaka East	3 000	6 462		25 634		
Kafue	2 000	3 866		12 779		
TOTAL	5 200	10 933		39 499	50 000	89 499

¹. Estimates of trained work oxen from questionnaire survey, site visits and mission discussions.

². Numbers of steers and oxen based on "oxen and tollies" classification within the provincial livestock census reports of the Department of Veterinary and Tsetse Control Services (DVTCS).

³. Cattle population derived from 1989/90 DVTCS livestock census figures.

⁴. "Traditional" and "Commercial" classification as census. District statistics not available for commercial.

Table 10. Estimates of the total numbers of cattle, trained work oxen and steers in Zambia

	Work oxen ¹	Total steers and oxen ²		Total cattle population ³		
		Tradn ⁴	Com ⁴	Tradn ⁴	Com ⁴	All
Northern Province	3 620	11 900	1 300	90 660	11 930	102 590
Luapula Province	430	1 630	230	8 330	2 500	10 830
Copperbelt Province	2 400	4 040	8 900	17 210	47 790	65 000
North Western Prov.	2 050	5 520	50	56 460	2 930	59 390
Western Province	50 000	87 300	0	512 790	0	512 790
Southern Province	105 000	277 100	36 000	891 500	189 710	1 081 210
Central Province	35 900	99 810	35 500	308 560	174 860	483 420
Eastern Province	32 510	82 620	n/a	270 180	3 450	273 630
Lusaka Province	5 200	10 930	n/a	39 500	50 000	89 500
ZAMBIA TOTAL	237 110	580 850	81 980	2 195 200	483 170	2 678 370

¹. Estimates of trained work oxen from questionnaire survey, site visits and mission discussions.

². Numbers of steers and oxen based on "oxen and tollies" classification within the provincial livestock census reports of the Department of Veterinary and Tsetse Control Services (DVTCS).

³. Cattle population derived from 1989/90 DVTCS livestock census figures.

⁴. Classification into "Traditional sector" and "Commercial sector" as DVTCS census. (This information is not available for all provinces).

Figure 2. Plowing with oxen on a large farm in the Southern Province.



Discussion of some key issues

Inflation and interest rates

The overall national economic situation affects all farmers and all organizations working with farmers. Inflation is now very high, and the purchasing power of the Kwacha has been decreasing rapidly during the past year. As the inflation is associated with devaluation, the upward spiral of prices has tended to start with goods and services with a foreign exchange component. Village-based producer prices have reacted to the upward movement in prices, but have tended to lag behind. The result is that farmers' margins have been squeezed, and their purchasing power reduced.

Government departments and projects have found that the purchasing power of their annual Kwacha-based budgets has decreased. Some have found it difficult to implement programmes planned and budgeted when the Kwacha was more valuable. Government departments (such as the veterinary department) selling purchased items "at cost" have found that their generated income has been insufficient to replace their stocks. All revolving funds are very susceptible to high inflation, unless goods are always sold at their future replacement price.

Associated with the high inflation are high rates of interest. Commercial interest rates as high as 40% tend to discourage both borrowing and investment, unless very high rates of return are envisaged. High inflation may make it unwise to save and economically sensible to borrow. One can repay loans in devalued currency, provided one has the income to meet the high interest payments. However, small farmers are not sure of inflation-linked income, and so are reluctant to take such a risk.

With high interest rates, manufacturers and retailers find it expensive to maintain stocks of slow-moving items. This is a particular problem if there is customer resistance to frequent price rises, which is the case with animal traction implements. Thus high interest rates tend to reduce both the quantity and the range of animal traction implements held by suppliers.

With inflation higher than interest rates, credit-giving organizations have seen the value of their capital reduced. Funds established to give loans for animal traction may have retained their nominal value in Kwacha terms. Nevertheless, they have been greatly reduced in value, as the prices of oxen, carts and plows has risen dramatically.

The problem of inflation and interest rates is a national one, and is not specific to animal traction.

Nevertheless it is an important constraint that is affecting farmers and organizations.

Marketing

Animal traction in Zambia is heavily dependent on the profitability of crop cultivation. Crop cultivation is not the only benefit of work animals. Animal-drawn transport is important, being socially and economically beneficial. The growth in size of individual working animals can also be significant, as it can lead to large "capital gains" at the time of disposal. Nevertheless, for animal traction to be viable, there is usually the need for a profitable system of cropping and this requires a suitable market for the harvest. Successful marketing is important for all farmers (not just animal traction users) but it is particularly critical for those farmers investing in draft animals and implements for the first time. Many of these take out loans, and their repayment requires cash income.

Maize marketing has been a particular problem in Zambia in recent years. Small farmers have been encouraged to grow maize, but many farmers have had difficulties marketing their maize, and receiving timely payment. Controlled prices have made it difficult for the cooperative unions to recover the costs of maize collection in the more isolated areas. During the time of the mission, bags of maize from the previous season were still stacked at farms and at the roadside for collection in several provinces. Farmers were complaining forcefully that they had not received payment. In some areas, such as the Northern Province, the marketing of maize was cited by several people as the single most important factor affecting animal traction. Unless farmers were assured of a market, they would not take on new loans, and those with outstanding loans would be tempted to sell their animals to meet their repayments. Improvements in maize purchasing would stimulate investment in animal traction.

Rice marketing can also be a problem in some areas. In the isolated parts of the Lui River Valley in Western Province, some farmers use animal traction, but much high potential land remains uncropped. The farmers argued that if it were easy to sell their rice and purchase plows, many more farmers would use animal traction, and overall production would be higher.

Animal health

Patterns of animal disease greatly influence the distribution and use of animal traction in Zambia. Working animals are susceptible to the major cattle diseases, but few diseases and conditions are specific to draft animals. Those conditions associated with work, such as yoke galls and harness sores, do not appear to be of major importance in Zambia (although some unpleasant examples were seen by the mission). It is possible that the stress of work makes draft animals more susceptible to disease, and that low levels of disease or parasite infestation reduce working ability. Nevertheless the authors are not aware of any scientific or anecdotal reports of such interactions being important in Zambian farming systems.

The major cattle diseases are important in determining the size and productivity of the cattle populations in each province and district, and thus influence the availability of animals for work. The main diseases also largely determine the probability of individual animals dying, and thus influence the economic risks and costs of investing in work animals.

Trypanosomiasis

Trypanosomiasis is still a major cattle disease that restricts cattle keeping in many areas. Trypanosomiasis may be, or may have been, largely responsible for the small cattle numbers in some districts, and the lack of cattle-rearing traditions in some areas. Tsetse control measures, notably the use of insecticide-impregnated decoys, are continuing. Whether or not it is a direct result of reduced tsetse infestation, cattle now seem able to colonize new areas. Animal traction is playing a major role in this, as it provides a strong incentive for people to adopt cattle husbandry.

In several districts in the Northern, Luapula and North Western provinces cattle are being moved into new areas, as part of the oxenization programmes. Movement of cattle for draft work is also taking place in Kaoma, in the Western Province and Petaukwe in the Eastern Province. In some cases (e.g. in the Luangwa valley in the Eastern Province) oxen exposed to high tsetse challenge are provided with prophylactic doses of *Samorin*. As land is cleared for agriculture, and as population pressures increase, the habitat of tsetse flies is reduced. This, together with the tsetse control initiatives, suggests that cattle will increasingly be able to survive in these new areas, and that animal traction will be able to expand numerically and geographically.

Tick-borne diseases

The tick-borne disease East Coast Fever (*Theileriosis*) is enzootic in parts of Zambia, notably in the

east and northeast. Although this disease can be fatal, local animals tend to be fairly resistant. The disease can be controlled by regular dipping.

A more serious, and relatively recent, problem is corridor disease, a tick-borne *Theileria* similar to East Coast Fever. This serious and often fatal disease has effected the Southern Province, and to a lesser extent Lusaka, Central and Copperbelt Provinces. Corridor disease has caused a drop in the overall cattle population in the south.

A form of treatment is available, but it is expensive. In any case, veterinary staff do not have the resources to provide treatment services throughout the province. While there is some work on a form of vaccination (disease inoculation combined with treatment dose), this is unlikely to be available and affordable soon.

The disease can be controlled by regular dipping, and thus the commercial cattle herds have not been seriously affected. The traditional herds, with less rigorous dipping regimes, have been badly hit in some areas. Unless widespread dipping is adopted, which few people expect to happen, it is likely that many work animals maintained in traditional herds will die in the coming years.

The disease is likely to lead to a reduction in the profitability in animal traction in affected areas. Many farmers in the infected zones depend on animal traction, and they are unlikely to revert to hand cultivation. Thus there may well be an increase in the hiring of work animals, and, consequently, a slight reduction in the timeliness of operations. An increase in the use of cows for work may be seen, as surviving animals, whether male or female, are brought in as reserves to make up work teams when oxen die.

Dipping

Corridor disease, East Coast Fever and other tick-borne diseases can be controlled by spraying or dipping with acaricide, but almost all provincial veterinary offices reported problems with this practice. Government dipping services used to be free, then stood at 50 ngwee or K1.00 for a time. The more recent increase to K5 per head per dip has discouraged farmers from dipping. Most Provincial Veterinary Officers have noted a decline in the number of farmers bringing their animals for dipping. During discussions with farmers, the mission was told on several occasions that the cost of dipping was prohibitively high.

Based on the cost of the dip, and the risk of loss of an animal, the costs are not actually excessive. However, they do require a cash outlay that farmers do seem to find difficult, both financially and psy-

chologically. Payment for dipping is particularly complicated for herds owned by several people, as long-standing, traditional arrangements have yet to adapt to the cash-flow requirements necessitated by dipping costs.

In areas infected with corridor disease, weekly dipping between November and April is recommended (dipping every five days may be needed in the more extreme cases). Some farmers have dipped intermittently to save money, but in so doing, they have not provided their animals with adequate cover. Intermediate dipping makes it difficult for farmers to see clear differences between mortality in dipped and undipped herds. With occasional dipping, animals may well sicken and die soon after a dip, due to infection and incubation in the “unprotected” period between dips. In such circumstances, farmers and their neighbours will become even less convinced of the value of dipping.

In the Western Province, corridor disease is not a problem and the tick challenge is not sufficiently serious for dipping to be a prerequisite for successful cattle keeping. In such circumstances, the veterinary service considers that it is reasonable to allow animals to be exposed to ticks, so they may build up acquired immunity. Constant low exposure to ticks is often preferable to intermittent or unreliable dipping.

In the northern provinces, the low density of cattle makes it unrealistic to contemplate the provision of dip tanks accessible to all farmers. In such cases bucket spray pumps can be used, and these are included in some oxen loan packages. In most provinces, chemical dip solutions were available through the veterinary services, although not at all times. In some provinces, revolving funds are being established to improve the situation. Some people contacted pointed out that few farmers were aware of the importance of dilution rates and safety procedures - an observation that might equally apply to some extension staff.

Other diseases

Foot and mouth disease is seldom fatal, but it can affect an animal's ability to walk, which is a serious problem for a working animal. It is not common in Zambia, occurring mainly near the Tanzanian border, and it does not seem a critical constraint. Contagious bovine pleuropneumonia (CBPP) is sometimes encountered near the Angolan border. Black quarter, haemorrhagic septicaemia (HS) and anthrax do occur, but they can be vaccinated against, and offer no special threat to work animals.

Veterinary restrictions

Sanitary regulations, designed to stop the spread of disease, do affect the ability of projects to purchase work animals. All parts of the country can be affected by temporary bans, designed to isolate disease outbreaks. In the northern province, it is not permitted to move cattle into the western districts (where animal traction is being introduced) from the cattle-raising districts near the Tanzanian border. Cattle exported from the Western Province have to be slaughtered within 24 hours, although cattle raised in Kaoma are now exempt from this.

Animal quality and quantity

Several different breeds are used for animal traction, including Zambian Zebu (towards the east), Barotse (towards the west) and Tonga (towards the south and central). In addition, cattle obtained from ranches may be derived from crossbred Boran, Afrikaner, Brahman, Sussex or other exotic breeds.

All breeds seem capable of performing draft work and there is no suggestion that animal quality is a limiting factor. The imported breeds are generally larger and more powerful than indigenous breeds. It is likely that indigenous animals will be more hardy and disease resistant than imported breeds (although the mission encountered no evidence of this). Within breeds, individual animals differ in size and temperament, and some will be better than others. Such differences between individuals are likely to be more important than differences between breeds. The present system by which farmers and organizations choose the breed that is most readily available, and then select individual animals on merit, seems to be working well.

Some people felt that a move to larger animals was desirable. This could either be achieved in the short term by using larger breeds, or in the longer term by selective breeding of local breeds. With larger breeds, more farmers might use two rather than four animals. However, there are both disadvantages and advantages of large size. Large animals require more feed than small ones, although one large ox may require less than two small ones. Individual large animals are more expensive, and entail greater risk (one accident or death is more serious for a farmer that owns two large animals than four smaller ones). Also, as draft animals often have multiple social and economic functions, a large number of smaller animals is useful for economic flexibility. Large breeds are probably preferable in those few cases where animals are maintained for specialized work functions (on commercial farms, for forestry, for road construction and for full-time transport). The team believes that in most cases, small farmers will be

better off with the available indigenous breeds, selecting individual animals that suit their needs and budgets.

Animal supply

The shortage of available animals was commonly cited as a major constraint to the adoption of animal traction in certain provinces and districts. Yet there is no shortage of potential draft animals in the country as a whole. The problem is one of distribution. Moving cattle from areas of surplus to areas of deficit is difficult to organize and is expensive in transport. It involves risks of injury and disease and may be restricted by veterinary regulations.

Given the problems of moving animals large distances, it would be best, in the long term, if all districts had sufficient locally-raised steers for use as oxen. For this reason some projects are encouraging, and financing on credit, the establishment of small privately-owned breeding herds. One such programme is starting in Luapula, and a similar scheme has been proposed in the Northern Province. If these work they will provide an easily available and sustainable supply of young animals, which farmers will be able to purchase themselves. Such schemes appear most desirable and might usefully be encouraged in the other areas of deficit. As one project put it: the long-term sustainability of "oxen-ization" depends on "cattle-ization".

Another possible means of overcoming the oxen supply problem is by encouraging private traders to specialize in the purchase of young steers, for sale to potential oxen users in other areas. Such schemes are working to a limited extent in the Western and North Western Province, where traders buy cattle in the plains, for sale in Kabompo and Kaoma Districts. Private trading systems should be sustainable, once the traders are assured of a market and a profit. Nevertheless such trading is vulnerable to veterinary restrictions, and to the competition of butchers.

Purchase of animals from large ranches, such as those of ZADL (a commercially-orientated parastatal) and private farmers has been the preferred arrangement of most projects. Dealing with large ranches can be administratively easy for projects, as they deal in fixed prices and a single source of supply. One disadvantage is that animals from ranches are not used to close human contact and can be difficult to train. This problem was not widely reported, although one ranch in the Copperbelt has agreed to pre-train its animals prior to sale. Another problem is that it becomes difficult to match supply and demand. There have been reports of ZADL being unable to meet an order for an agreed consignment, and others when ZADL was ready to supply

steers, but the authorities were unable accept and distribute them.

Some projects have attempted to set up breeding centres themselves. These have frequently been beset with problems of weak management, low productivity and commercially unsound practices. Examples include the Kabukafu Cattle Breeding Unit in Kasempa, North Western, which at one time sold animals at pre-inflation prices, at a tiny fraction of their market worth. Several MoA personnel in the provinces indicated that they favoured the establishment of oxen supply ranches, which would be run by their departments. With the recent emphasis (both in Zambia and worldwide) on reducing direct public-sector involvement in agricultural production and supporting private-sector solutions, few donors are likely to support such MoA breeding ranches.

There is more likely to be donor support for temporary district-level holding grounds. These are not intended as breeding centres, but are designed to help equilibrate supply and demand. They allow consignments of steers to be bought in from the private sector (ranches or traders), and held until they can be satisfactorily sold to farmers. Such holding grounds have been effectively used in Northern and Luapula provinces.

Implement manufacture

Introduction

Prior to 1978, most animal-drawn implements were imported into the country. They were generally of the "Safim" type, brought in from factories in Zimbabwe and South Africa. In 1978, the firm of Northland Agriculture was formed by the "jobbing" company Northland Engineering Ltd of Ndola, part of the Anglo-American group. This started producing animal-drawn implements of the "Safim" type. Since 1978, Northland Agriculture has been the major, and often the only, manufacturer of animal-drawn implements in Zambia. It has been meeting about one third of the annual demand for animal-drawn implements, the balance being met by imports, mainly from Zimbabwe.

Until recently, Northland has had little local competition. Small numbers of plows have been produced by blacksmiths, notably in the east of the country. A few "jobbing" engineering firms on the Copperbelt have made small numbers of implements. More serious local competition has started in the past few years, with the two firms of Lenco and Gameco producing significant numbers of plows. Gameco has fabricated plows using second-hand plow beams and has also assembled several thousand plows from South African components. Lenco has assembled plows from components manufactured in The Neth-

erlands and has recently built a production line for the local manufacture of these plows.

Northland Agriculture

In the five years since 1985, Northland has manufactured a total of 19,000 plows, 4000 ridgers, 3000 cultivators, 2000 harrows and 500 carts (figures from Northland, rounded). Its annual output has generally been limited by lack of steel and its own production problems, rather than by market saturation. Indeed, even when there were national shortages of plows, Northland was unable to respond effectively.

The basic design of the Northland plow has proved acceptable to farmers. For many years there has been recurring criticism within the Ministry of Agriculture of the poor quality of Northland implements and their lack of standardization. Quality does seem to have been improving in recent years, although Northland implements do not yet appear to be up to the standard of those imported from Zimbabwe. Problems of implement quality do not seem to have affected Northland's ability to sell implements: the company has not suffered from problems of unsold plow stocks.

Some of the quality and output problems of Northland stem from its system of production and its installed machinery. Northland started making ox-drawn implements using old machines and "jobbing" batch techniques (no clear production line and few accurate jigs and specialized tooling). It has continued a similar system of production for twelve years. Northland anticipates it could increase production and improve quality if it invested heavily in new plant and equipment. This would allow accurate and cost-effective production techniques to be introduced. Such investment would be expensive, in capital cost, in interest payments and in foreign exchange. It might be justified if turnover could be improved, but Northland faces competition from the Zimbabwe factories, that have easier access to steel, and may also benefit from local subsidies on steel and exports. Northland also faces market distortion from donor-assisted importation of implements and components. While Northland now seems prepared to invest in machinery and tools, it claims it is finding it difficult and expensive to obtain foreign exchange.

Northland's production has also been constrained by shortages of materials and foreign exchange. All steel has to be imported into Zambia, and this requires scarce foreign currency. Northland notes that certain sizes and grades of steel for plow beams and shares cannot be obtained locally or from Zimbabwe. To import these from South Africa requires a minimum order of 400 tonnes of each type. In 1990, Northland was able to purchase just over 1000 ton-

nes of steel using the foreign exchange facility of the SIDA (Swedish International Development Agency) steel programme. Payment conditions were very easy (payment in devalued local currency at a highly favourable rate of exchange, with no apparent time-limit for payment).

Northland claims that it does not need technical assistance, and that its production and its problems have been entirely due to old equipment, lack of accurate tooling and shortages of foreign exchange. Nevertheless, external visitors to the factory (including the present mission) have been given the impression that Northland could have improved both its quality and its production, through better organization and management of its existing resources.

Northland has not been adventurous in its designs, sticking to the established "Safim" range. Northland did prepare an original design of ox cart, using bronze bearings, spoked metal wheels and solid rubber tyres. It was light and had puncture-proof tyres but its bronze bearings wore rapidly. The combination of high price and weak bearings meant the cart did not sell well.

Northland claims that, with available steel and some new equipment, it could make 20,000 plows a year, as well as several thousand ridgers, cultivators and harrows. Such an estimate seems extremely optimistic, given the recent track record of the company. Nevertheless it is clear that with some investment and good management, the company could meet most, if not all, of the national demand for animal-drawn implements.

Lenco

The Lenco (Lusaka Engineering Company) involvement with animal-drawn implements is two-fold. It has been making small numbers of ox carts. These have had pneumatic tyres, all-steel bodies and imported Italian axles fitted with roller bearings. The carts are acknowledged to be very good, and they were one of the few designs to be passed for quality and durability by the ADP-RDP testing unit at Magoye. Sales have been low, as the carts have been expensive, and marketing effort has been minimal. The company has sufficient axles to manufacture at least 1000 more carts. It has therefore designed a cheaper cart body, based on an angle-iron frame to which the purchase can fit wooden planks. Lenco intends to actively market these carts, which will be available as kits.

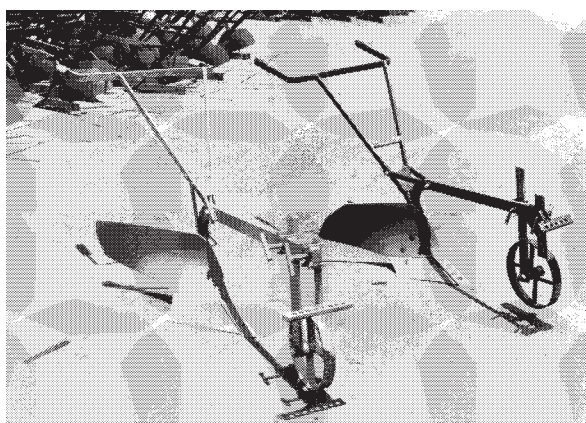
Lenco's involvement with animal-drawn implements started in 1984, when it started collaborating with the firm of Rumpstad of The Netherlands. This collaboration has been funded by DGIS, the national aid programme of The Netherlands.

In 1985, components 4450 Rumpstad plows were received for local assembly. Samples of these Rumpstad plows had been tested at Magoye and Looma (Western Province); as the plow beams were considered too weak, heavy duty plow beams were supplied to Lenco. Marketing of these Rumpstad/Lenco plows commenced in 1986, which was just after 14,000 inexpensive plows from Zimbabwe had been imported. Sales were slow, due to the temporary saturation of the market, relatively high price, problems of plow design (excessive plow weight) and limited strategies for marketing and making spare parts available. By 1990, there were still stocks of this first Rumpstad/Lenco plow remaining in warehouses.

A report was prepared for the aid programme of The Netherlands. In this it was recommended (subject to various conditions) that Lenco be assisted to move from simple assembly to full manufacturing of animal-drawn implements (Jansen and Dibbitts, 1986). Although the financial models indicated such a project would be viable, it was acknowledged that the margin of profitability was very sensitive to key assumptions, including that the Rumpstad-designed plow could command a significant price premium. It was therefore recommended that the project be delayed until late 1987, to give time to assess the marketing arrangements. A project proposal was then prepared in 1988 (MoA, 1988). Rumpstad was contracted to establish a production line for ox-drawn implements. In 1990, Lenco was provided with equipment that included heat-treatment furnaces and pressing, cutting and drilling machines. Assembly jigs were supplied, as were the services of a full-time Rumpstad production engineer. The new machines, steel and components were supplied under favourable financial conditions, with Lenco providing the Kwacha equivalent retrospectively.

Figure 3. Rumpstad/Lenco plows.

Left: Rumpstad Sandy II "heavy" plow assembled at Lenco. Right: Rumpstad/Lenco Sandy III plow, locally fabricated from components imported under the SIDA steel programme.



In addition to the plows, small numbers of Rumpstad multipurpose toolbars, seeders, ridgers and cultivators have been imported for testing. Plans exist for marketing a ridger body that can be bolted to the plow beam in place of the plow body.

Prior to the arrival of the production line equipment, Lenco ordered components for 2000 plows (of a modified design, see Figure 3) from Rumpstad, which were paid for under the SIDA steel support programme. Lenco received the same subsidized terms as other importers, with delayed, retrospective payment in devalued Kwacha at a favourable exchange rate. However, despite these favourable conditions, it was not able to sell these plows at a profit.

In the initial years of the programme, Lenco has not really been manufacturing plows, but has been assembling plows from components manufactured in The Netherlands. A small amount of cutting and drilling has now commenced, and the amount of manufacturing of components is due to increase rapidly during the coming two years. In the first three years, the steel will continue to be supplied by Rumpstad (it is argued that this is necessary for Rumpstad's quality control criteria). The production line being installed, will have a capacity of at least 10,000 plows a year. Lenco hopes to be able to manufacture and sell at least 5000 plows a year, but it is concerned about profitability. The Rumpstad/Lenco plow uses expensive materials, but has not yet commanded a significant price-premium over Northland or Zimbabwe plows. Lenco seems unlikely to make a profit on plows if it has to keep its prices competitive with plows manufactured with cheaper steel.

The driving force behind the Lenco "local-manufacturing" has been Rumpstad, with support from Dutch aid. There has been much work in the past five years in evaluating, modifying and redesigning the early Rumpstad designs. Lenco engineering staff have not been closely involved in this, and so have missed a valuable learning opportunity. The fact that Lenco has not recruited an agricultural engineer, and the Rumpstad production engineer does not have a direct counterpart, has given cause for concern about the long-term sustainability of the Lenco programme.

It has been six years since the Dutch-funded Lenco programme was started, but Lenco has not yet succeeded in producing implements that farmers find acceptable and affordable and that will secure a sustainable profit for Lenco. The aim of this on-going programme is still the sustainable manufacture and sale of a good range of animal-drawn implements. It

is too early to know whether this will indeed be the end result.

Gameco and other workshops

Gameco is a small “jobbing” workshop in Lusaka, that is entirely owned and managed by a Zambian entrepreneur. It started producing animal-drawn implements in 1988 and first made 1000 plows (according to its own estimates) using second-hand beams. In 1989 and 1990 it imported plow components from South Africa, making up to 3000 plows a year, as well as smaller quantities of ridgers, cultivators and harrows. The implements were all of the “Safim” type. Gameco's locally-manufactured plows were made in small batches, to artisanal standards. Its locally-assembled plows appeared to be much more uniform.

Based on Gameco's own production figures, its output has exceeded that of Lenco, and it is beginning to rival that of Northland. This seems remarkable considering that it is a very modest workshop, that undertakes small fabrication and repair work, often using scrap material. Much of its “production” has effectively been assembly work (as has Lenco's). While Gameco plows have not been made of the same quality of steel as those of Lenco, Gameco has been much more successful than Lenco in rapidly marketing its products. It has generally identified and secured markets prior to manufacturing, and thus has not had to maintain high stocks.

Gameco considers that its ability to manufacture is limited mainly by lack of local raw materials and foreign exchange for importation. Surprisingly, Gameco did not benefit from the SIDA steel-import programme. Gameco has received some support from an industrial charity in Sweden, in the form of production machinery (mainly second-hand). It intends to use this new-acquired equipment to increase the number of locally-made plow components, but is likely to continue to import plow beams, possibly from Agro-Alpha in Mozambique. Gameco is actively pursuing export markets for its plows in Angola and Namibia.

Several other workshops in Lusaka and the Copperbelt have made small numbers of implements. These include MDM Engineering, Kaleya Engineering and Gilmer Engineering. Their modest production of harrows, cultivators and spares is briefly noted in the relevant provincial reports. These are all indigenous “jobbing” engineering workshops, prepared to make agricultural implements provided designs can be obtained and markets secured. In general, they lack knowledge of agricultural operations and are unaware of the exact needs of farmers. Thus when they have copied other implements, they have tended to make simple, but devastating, design errors (for ex-



Figure 4. Gameco ridger, plow and harrow.

ample, carefully aligning the teeth of harrows, rather than off-setting them!). They have not received significant technical assistance (although MDM did benefit from the SIDA steel import programme). They do not seem likely to have a major influence on the animal-drawn implement market in the near future.

Manufacturing problems

Manufacturers of animal traction implements in Zambia face many problems. Obtaining steel is difficult and the capital cost of maintain stocks of raw materials and manufactured implements is very high. Market demand appears very variable, and sales (and cash-flows) can be suddenly affected when parastatals and donors import large consignments of implements manufactured elsewhere.

Perhaps the biggest problem faced by manufacturers in recent years has been the shortage of suitable steel in the country, particularly hardened steel and specialized cross-sections. There has also been a shortage of foreign exchange to allow companies to order steel. Private importations of specialized steels have been made more difficult by the large orders necessary to justify their importation (minimum orders of 400 tonnes of each type have been cited).

To a certain extent steel-supply problems have been overcome in recent years, thanks to the SIDA programme to support steel importation. Under this programme, administered by Zambia Cooperative Federation Commercial Services, firms were able to order steel from abroad. This was paid from from the SIDA-supplied funds (about US\$1,000,000). The firms were then able to pay for their steel later in local currency, and a highly favourable exchange rate. (In practice, to date, very few companies have actually made their local currency payments, even at the favourable rate.) Northland has benefited most from this programme, followed by MDM Engineering, Lenco, Chipata Blacksmiths and SKF.

Since 1990, the government has made steel imported for the fabrication of agricultural implements exempt from duty and tax. This followed considerable pressure from several manufacturers, the Ministry of Agriculture and from donors supporting animal traction.

Shortage of foreign exchange has also made it difficult for manufacturers to invest in machines and tooling. Lenco was greatly assisted in this by Dutch aid, and Gameco has received some Swedish support. Other manufacturers, such as Northland, would like a scheme similar to the SIDA steel programme to help them to import machines and equipment to allow them to develop their infrastructure.

A further major manufacturing problem relates to cash-flow, capital, inflation and high interest rates. To make implements, particularly plows, manufacturers have to maintain stocks of specialist materials. Maintaining such a capital stock is expensive during periods of high interest rates (presently around 40%), yet high steel stocks are almost inevitable unless there is a convenient and reliable local source of supply. (It may be noted that during times of high inflation, it is better to maintain stocks of materials than money in the bank. This is inflation beating, but is not productive or profitable.)

Farmer demand for plows is highly seasonal, and this requires stocks of manufactured implements to be built up during much of the year, ready for the principal buying period. Such stocks are also very expensive to maintain, particularly if capital is charged at 40%. In recent years ZCF-CSD (formerly Namboard) and the cooperative unions have taken the pressure off the manufacturers by their bulk purchases of stocks. Thus the cooperatives rather than the manufacturers have had to bear the main costs of implement stockpiling.

With the serious financial difficulties experienced by the cooperative unions, they are unlikely to be able to hold large stocks of implements in future. This will put increasing pressures on the finances and the cash-flows of the manufacturers. Northland and Lenco are sufficiently well-established and resource-rich to survive these pressures, but they will naturally wish to pass on the high costs of maintaining stocks to their customers. Farmers will probably resist price rises, since agricultural produce prices tend to lag behind in the inflationary spiral. Lower sales volumes will increase cash-flow pressures on manufacturer still further.

The smaller firms and workshops are unlikely to be prepared to tie up their limited capital in slow-moving stocks. Much higher turnover, and lower interest charges, can be achieved through "jobbing" work or the fabrication of items of constant demand

such as window frames and burglar bars. Small workshops are therefore increasingly likely to restrict their manufacture of agricultural implements to firm orders from cooperatives or projects.

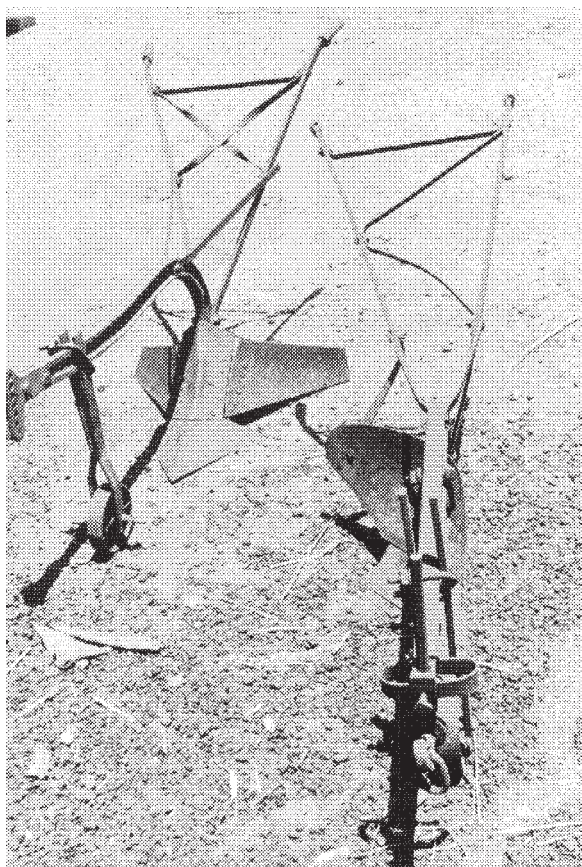
Artisanal manufacture and spare parts

In the Eastern province, several artisans manufacture plows and ridgers. Often they make use of second-hand plow beams. Some have been trained under the FAO-supported Agricultural Mechanization Project. The implements are of variable quality, but they appear to be effective and there continues to be a market for them.

The main problem for the blacksmiths is obtaining raw materials, and they can waste much time and money travelling in search of small quantities of good scrap steel. (For repairs, some blacksmiths insist that their customers search for their own spring steel, so the farmers waste time and money instead).

In the Eastern province, blacksmith support schemes have made steel available at the district or primary cooperative level. The SIDA steel programme assisted Chipata Blacksmith Service with about six tonnes of imported steel. The blacksmith support schemes have also helped blacksmiths market their plows and spares through the cooperative societies.

Figure 5. Ridger and plow made by blacksmiths in Eastern Province, under supervision of the Agricultural Mechanization Project (FAO).



The major advantage of blacksmith fabrication is that farmers can have a nearby source of implements and repairs. They can provide feedback to the blacksmith on their specific needs and desirable innovations. Blacksmith-farmer interactions were extremely important in the development of animal traction in Europe. Many modern agricultural machinery companies started as blacksmith workshops in the last century.

Blacksmiths in other districts also manufacture spare parts, notably shares and landsides, and carry out repairs. In general the supporting infrastructure is less developed than in the Eastern province. Such provision, by blacksmiths, of spare parts and repair services is considered extremely important, and should not to be underestimated. There are large numbers of plows in the country that are not in use for want of spares or repair. Results of the recent animal traction survey provided some insight into the scale of the problem. Several provinces reported some initiatives in blacksmith training and support, but it was also acknowledged that this was generally an area requiring greater attention. In the past, blacksmith training has concentrated on imparting specific techniques and skills. Little work has been attempted on teaching blacksmiths aspects of design and agricultural engineering, such as plow adjustment principles and implications of design on soil-implement interactions.

Implement supply and marketing

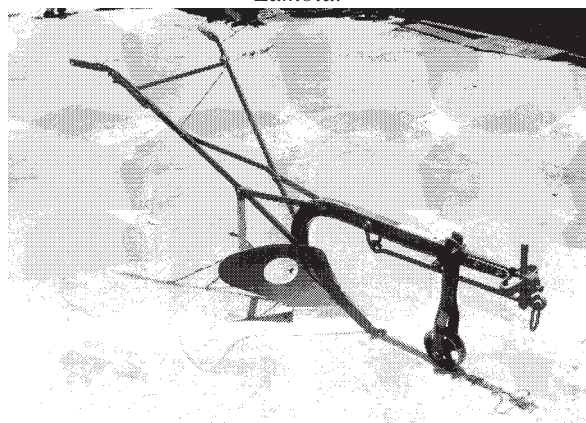
Within Southern Africa as a whole, there is no shortage of supply of animal-drawn implements. Besides the manufacturers in Zambia, several manufacturers in the region are capable of serving the Zambian market, provided foreign exchange is available and imports are allowed. Zimplow and Bulawayo Steel both have a proven track record and surplus capacity. They are well-placed in terms of geography, raw materials, infrastructure and rail transport. Provided their supplies of specialized steel continue, they are unlikely to continue to market well-proven implements at an acceptable price. Agrimal in Malawi, and Agro-Alpha in Mozambique also have surplus capacity, but are less well-placed and equipped. In the medium term, it seems possible that a political settlement in South Africa could lead to a major liberalization of trade in the region. In such circumstances, some South African manufacturers may try to capture some more of the market for animal-drawn implements in nearby countries.

In national terms, there has been little or no national planning or coordination between the various importing organizations and manufacturers. There have been alternating shortages and gluts, which have benefited no one.

Based on the figures given to the review mission, in late 1990, the supply position seemed good. This is a record only of apparent numbers available, with no regard for suitability or quality. Lenco had stocks of Dutch components and steel to manufacture 2,000 plows. An Italian-supported project in the Southern Province had over 6000 lightweight Italian plows. ZCF-CSD had recently received 3000 Zimbabwean plows and was expecting the arrival of 3000 Indian plows. AFE Limited was expecting the arrival of 3000 Zimbabwean plows. Some importation from Zimbabwe was also likely from other trading firms that had previously been successful in selling Zimbabwean plows. Gameco was intending to assemble/fabricate at least 2000-3000 plows in 1991, using some components from Mozambique or South Africa. Northland had recently received over 1000 tonnes of steel through the SIDA programme, and considered itself capable of manufacturing 13,000 plows in the coming year (20,000 if it were able to replace its machines). This would give a potential national supply of 30,000 plows, which would be about twice the "normal" annual demand. Even discounting the Italian plows (weak design), and Northland's apparently optimistic forecasts, it appears that Zambia, as a whole, is likely to be well-supplied for implements in the immediate future.

While plows are likely to be available within the country, this does not mean that farmers will necessarily be able to buy plows and spare parts easily. Implements are likely to be reasonably available in the towns along the line of rail, in the Copperbelt, Central, Lusaka and Southern Provinces. In the rural areas, where they are needed, they are likely to be quite difficult to obtain. The marketing unions contacted seemed to have little idea of actual demand patterns within their provinces and districts. They also have major cash-flow problems. In the circumstances, they are unlikely to provide an efficient service for the sale of implements and spares to

Figure 6. A "Master Farmer" plow made by Bulawayo Steel, Zimbabwe. Safim-type plows manufactured by Zimplow are also regularly imported into Zambia.



farmers. Implements and spare should be available in the areas directly served by donor-assisted projects (e.g. Copperbelt SDP area) or by cooperative unions assisted by projects (e.g. KADICU).

No manufacturer has built up an efficient network of distributors and agents. Manufacturers have historically relied on bulk orders to the cooperative movement and to the large outlets along the line of rail. With the present system of cooperatives increasingly being regarded as inefficient, unresponsive and almost bankrupt, there seems to be an urgent need for improved systems of distributing and marketing animal-drawn implements and spares.

Implement testing

Most plows in use in Zambia are based on the long-standing and well-proven "Safim" designs. Apparently similar plows (Northland, Gameco, Zimplot, Bulawayo Steel and Agrimal) are certainly not identical and the standardized testing of such plows should help to identify weaknesses, manufacturing defects and design problems. The ADP-RDP has not yet published detailed test reports on the range of "Safim-type" plows available. Nevertheless in preliminary tests it has identified several problems including mouldboard shape (Gameco) and wheel size/quality (Zimbabwe plows). A consignment of Indian "Safim-type" plows is due in Zambia in 1991. Distribution will be through the cooperative movement, and it is likely that by the time these plows are fully tested, all will have been sold to farmers.

Testing appears particularly important for innovative plow designs, not used in Zambia before. The very first Rumpstad plow had been tested on-station, and was found to be too weak. Heavy duty plow beams were then tested, and the plow proved effective in on-station trials. Nevertheless the Rumpstad/Lenco plow had not had been submitted for detailed farmer-acceptance trials before the major consignment was dispatched to Zambia. As a result neither Rumpstad nor Lenco escaped the embarrassment of having supplied 4500 unpopular (excessively heavy) plows. A modified, lighter design was then prepared by Rumpstad and (fortunately) ADP-RDP Magoye purchased samples for testing. This design had a light, weak beam that failed its initial test at Magoye. This independent testing appears to have saved Rumpstad and Lenco from the embarrassment of supplying another consignment of unsuitable plows to Zambia. By the time the 2000 plow components were sent in 1990, the design had been re-modified, with a stronger beam. Other modifications have also been made by Rumpstad, for reasons not relating to the ADP-RDP test. Thus the new plow

being marketed by Lenco has yet to pass the full ADP-RDP testing procedures.

A large consignment of about 6000 Italian plows was recently imported without any testing at all. In late 1990, these started to be sold to farmers, and, shortly afterwards, samples were submitted to ADP-RDP for testing. Preliminary test results suggest that at least two of the makes of plows are unlikely to pass the standard tests. It seems their plow beams are quite weak, and are likely to bend irreparably during use. It is too late to change the specifications, since several thousand of them are in the headquarters of the Italian-funded project in Choma. These plows may also become an embarrassment to the agencies concerned.

The examples of the imported Dutch and Italian plows clearly illustrate the great importance of testing. They also illustrate a major problem, still to be solved. No manufacturer or supplier has yet indicated that they are prepared to wait for test results. They have been prepared to respond retrospectively, and correct mistakes. No supplier or manufacturer has yet been prepared to delay their schedules in order to avoid such mistakes being made.

Full testing, with farmer assessment, is clearly necessary to avoid all mistakes (such as unacceptable plow weight), but simple technical errors, such as plow beam strength, could be detectable very rapidly. One suggestion is that Magoye ADP-RDP should provide an express "preliminary testing service" to alert manufacturers and importers of implements. Fortunately, through informal channels, a procedure such as this was adopted in the case of the weak Rumpstad plow beams, and action was taken prior to major importation. Unfortunately, preliminary testing did not happen in the case of the Italian plows; nor will it happen for the Indian plows.

The testing of carts has also proved to be important. Unlike plows, which have been manufactured or imported in large numbers by a small number of organizations, animal-drawn carts have been made in small numbers by many manufacturers and projects. It has thus proved impractical to test a wide range of locally produced carts. Nevertheless, the detailed testing by ADP-RDP of 20 cart designs provided many lessons for Zambia, particularly in relation to axle quality (Dogger, 1990). It is clearly desirable for any new axles, whether locally made or imported, to be well-tested before they are actively promoted.

Plow design

As noted, most plows in use are derivatives of the old Safim or Victory design. This type of plow is

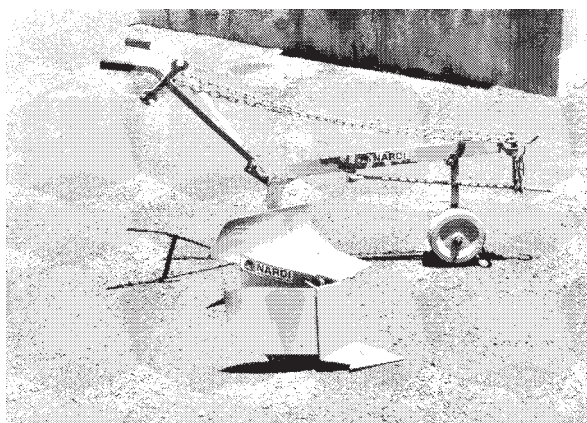


Figure 7. Nardi plow and ridger body, imported by Italian cooperation.

generally popular and has been well proven by farmers in the region. Examples of this type of plow include those of Northland, Gameco, Chipata blacksmiths, Zimplow (Zimbabwe), Bulawayo Steel (Zimbabwe), Agrimal (Malawi), UFI (Tanzania), Agro-Alpha (Mozambique), Isico (Swaziland/South Africa) and Safim (South Africa). The most common implements are those of Northland, Zimplow and Bulawayo Steel.

The two types of plow from Zimbabwe appear to be quite uniform in quality, and seem popular, although there have been complaints concerning the wheels. Plows from Northland appear to be more variable in design and quality. Agricultural engineers have been dismayed at the variation between Northland implements, particularly when poor alignment of parts has been evident. Such faults would be expected to reduce the life or performance of the implement. Nevertheless farmers seem very tolerant of such faults, and few complaints were heard. Copies of Safim plows made by blacksmiths around Chipata also have great variability, but again farmers seem to tolerate these as well.

Agricultural engineers point out that a good, well adjusted plow should lead to better plowing, with less effort for the operator and animals. Farmers almost invariably remove the front adjuster from their plows. They also seem to consider weight and strength to be the critical factors in plow design, with widespread complaints that the first Lenco plow was “too heavy”. Field trials at Magoye Research Station have yet to prove that plow design or adjustment does effects yield in a consistent manner (in one year a well-adjusted plow was superior, in the following year, a worn, poorly adjusted plow gave better results).

The supposition is that, within reason, small differences in plow body design, such as those that exist between the different Safim copies, are not very critical. Farmers, it seems, can plow acceptably well

with the main Safim-type designs now available. To put it another way, the conditions under which plows are generally used (environment, plowing proficiency, plow adjustment etc.) are such that small differences in plow design become masked. One difference that is evident on the farm is plow weight, and this was often cited as the reason for rejecting the first Rumpstad/Lenco plows. Strength on impact is also important, particularly in farms with many stumps, and weak plows would almost certainly be rejected by farmers. For this reason ADP-RDP Magoye rejected the second Rumpstad/Lenco plow and two light Italian plows, as their tests led them to believe these plows would bend when used by farmers.

In order that true farmer preferences can be gauged, and the weaker designs can be eliminated, farmers would have to be offered real and sustained choice. Although many makes and designs have been present in the country in the past few years, most outlets have had only one type in stock at any one time. There seem to have been few, if any, cases where farmers could actually choose between the different Safim-type plows over a period of time, and thus give the retailer feedback on their preferences.

There seems to have been little attention to brands and sources, and few farmers or depot keepers have been certain of the brand and manufacturer of their plows. While there has been a general impression that “Zimbabwe” plows have been good, there has been virtually no differentiation between the two main brands. Few people could recall whether the Zimbabwe plows they referred to had been the Mealie (Zimplow) or the Master Farmer/Silver Medal (Bulawayo Steel) plow brands.

There has, however, been some choice and brand differentiation between Safim-type plows and Rumpstad/Lenco plows. The combination of clear colour difference and obvious design differences has made it easier for people to differentiate between plow types. When offered a choice, the Rumpstad/Lenco plow has generally been rejected by farmers in favour of the more traditional plows (Safim types). This has been despite some promotion of the Rumpstad/Lenco plow as an “improved” plow by the Ministry of Agriculture and several development projects. The Lenco brand name does not seem well known: most people refer to the Rumpstad/Lenco plows as the “yellow” or the “heavy” plows.

Design of other implements

Plows are the most important cultivation implement and relatively little is known about the merits and demerits of the various ridgers, harrows, cultivators

and seeders available. Work on these implements is beginning to be undertaken by the ADP-RDP, Magoye, but this project has, quite naturally, concentrated its initial activities on plows and carts. Preliminary results have suggested that ridgers have high potential for weeding, an operation that can be a major bottleneck on farms using oxen for plowing. The animal-drawn seeders tested seem to offer few advantages over hand seeding. Further work is required, including on-farm evaluation trials of the various designs of cultivators and ridgers in different systems of use. Such work is already planned within the ADP-RDP programme.

Harness design

Most work oxen are harnessed with simple wooden withers yokes. Sometimes they are poorly finished or badly made and cause sores on the animals. Such problems appear mainly due to poor individual yokes, rather than the general design. There is no objective evidence to suggest that the common yokes are a limiting factor. There is some subjective opinion that with a little extra shaping yokes can be made more comfortable, and possibly more effective. One example of such a yoke is the Looma yoke. A few carpenters in the Western Province have been trained to make these for sale to farmers. A small number of farmers have adopted these yokes, but even in the Looma area, where these yokes have been promoted for several years, overall adoption rates remain very low. Until there are more signs of farmer enthusiasm and adoption, it may be unwise to promote such yokes vigorously. Nevertheless they may well be demonstrated during shows and plowing competitions.

Attempts were made during the past five years to assess and lightly promote the use of three-pad harnesses for single oxen. Two training courses were arranged and several people (including some commercial farmers) expressed interest in these harnesses. Nevertheless there seems to have been no adoption. One farmer explained that the beauty of animal traction was its simplicity, and the collar harness was more complicated than the yoke. There therefore seems little prospect for such harnessing systems in the foreseeable future.

There are few donkeys employed in Zambia, and farmers have tended to adapt ox yokes for use with donkeys. Although such systems may work, they appear inefficient and there is evidence that they cause injury. As donkeys may well become increasing important in Zambia, there seems scope for some adaptive research, in which farmers could assess donkey harnesses from Botswana or elsewhere.

Rural transport

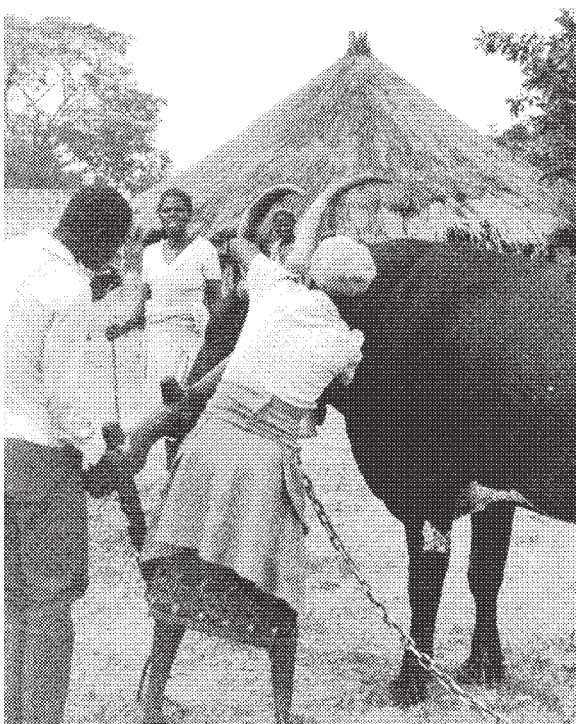
Animal-drawn transport is already very important for rural transport in some areas of Zambia, and it could increase in importance nationally.

Simple, locally-made wooden sledges of various designs are widespread in Zambia, particularly in the west. These are available and affordable and they can negotiate quite narrow paths. They are not very efficient at carrying large loads, and in some countries they have been discouraged as sledge tracks may accelerate erosion. With wheeled carts, animals and their operators can transport more goods for a similar work effort. The main disadvantages of carts are their price, their need for wide, clear paths and their greater need for maintenance and repairs.

Compared to the numbers of animals and plows in use, the number of ox carts is presently low. In some countries in Africa, including certain parts of Zimbabwe, Malawi, Senegal and Mali, most farm households own a cart. Only in a very few areas is this situation approached in Zambia.

The most obvious example is Kabompo, where carts are widely owned and seen to be in use. They are used to transport maize, vegetables, fertilizers, people, firewood, water, building materials, and many other items. As with cars, once they are obtained, the owners discover new transport uses, and new social and economic benefits. The reason for their success in the Kabompo area seems to be the combination of available credit, suitable cart design, appro-

Figure 8. Women in Western Province being trained to fit the "Looma" yoke to their animals.



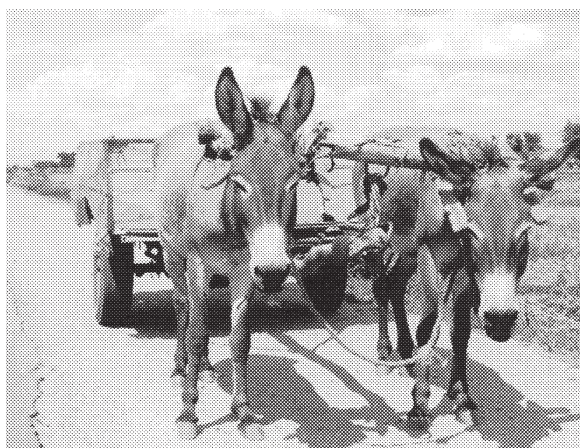


Figure 9. Donkeys, fitted with a yoke, pulling a cart made from an old pickup in Southern Province.

prate terrain and marketing opportunities. The carts have not been subsidized in terms of manufacturing cost (only in project overheads), and credit has generally been repaid. The NWIRDP is reluctant to continue to promote carts, feeling that the transport market is already saturated. The authors are not convinced of this.

Certainly a good income from hire fees may be important in cart purchase, and hire opportunities decrease as the number of carts increase. Nevertheless, carts can lead to an expansion of economic activities, so the total market may be a growing one.

In several regions in Africa, one cart per farm household is economically sustainable and socially extremely desirable. This was also the case in Europe, and in present day Europe each household wants its own car, whatever the economists say.

Several examples were given of the high incomes that can be generated by carts. Farmers near Mansa

reported that in a few months they had earned more in hire fees than their carts had cost. Farmers in several provinces were reportedly prepared to pay 10-15% of the value of the grain, to have it transported a few kilometres.

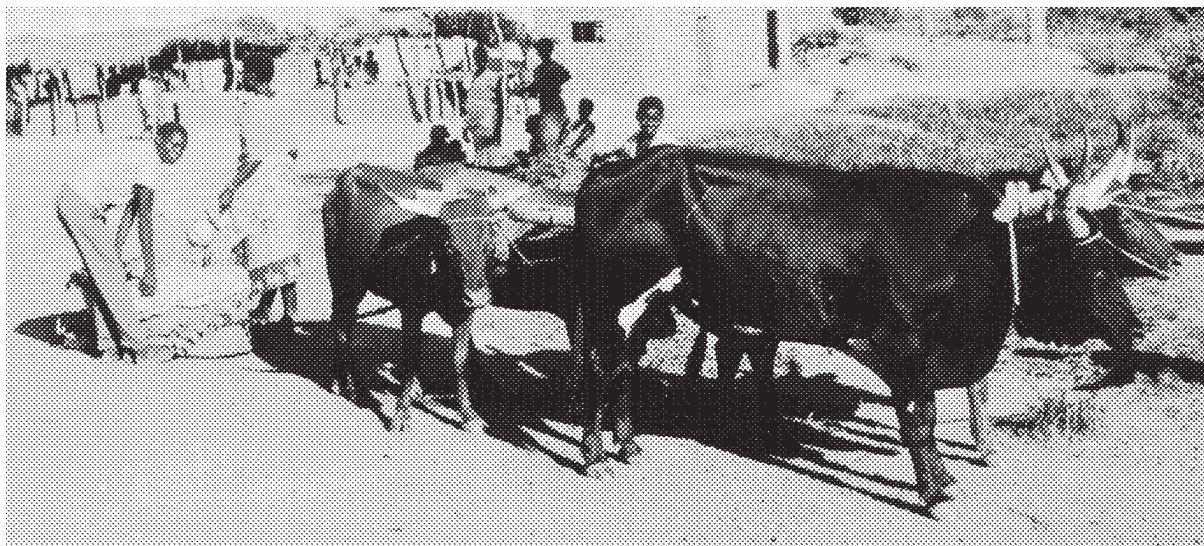
While there are examples of cart transport being highly profitable, there are also examples of small-scale cart manufacturers having problems in selling their carts. Although it may have been because their carts were not good, the explanation of the manufacturers seems very likely. The costs of the axles and wheels had risen dramatically in recent months, but the incomes of farmers had not done so. Farmers did not have the cash to buy carts, and so sales were only occurring where farmers were being helped with credit provision.

Cart design

Most carts that in Zambia have been made by local workshops from the old axles of pick-ups and Landrovers. These carts are generally strong and long-lasting, and the limiting factor is usually the shortage of scrap axles, wheels and tyres. Such carts are used in many parts of Africa.

Over the past thirty years, there have been several "appropriate technology" ox cart designs developed in Zambia. Examples include the wooden wheeled carts made by Katopola workshops in Chipata, TDAU (Technology Development Advisory Unit) carts developed at the University of Zambia and "Flintstone" carts developed at Kasisi Mission. While there have been cases of such "appropriate technology" carts lasting for over ten years, with little maintenance, they have generally suffered from serious problems with their wheels and bearings. Some have been abandoned, and some are to be seen rotting in project yards (for example at Kato-

Figure 10. A sledge with three oxen and a cow being hired to carry produce to market in Central Province.



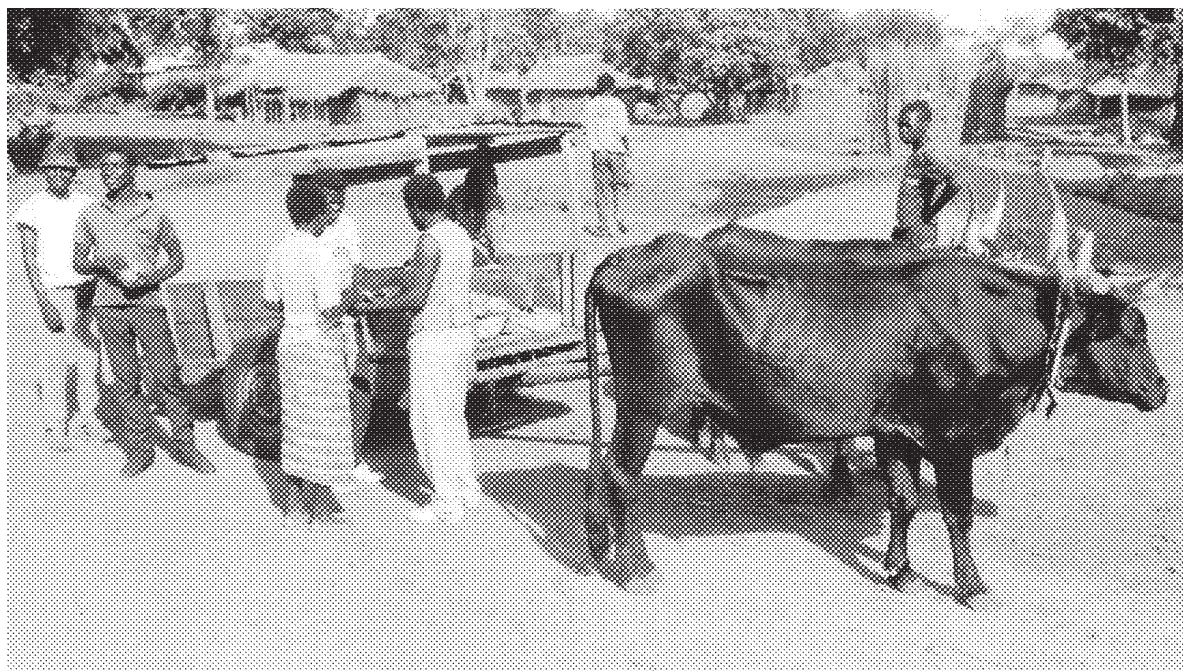


Figure 11. Ox cart in North Western Province being used to transport and sell tomatoes.

The NWIADP helped to introduce ox carts, emphasising their role in the transport and marketing of maize. It was found that the carts were used for a wide variety of purposes which stimulated local trade.

pola workshop and at Manyinga). Despite some promotion, these “appropriate technology” designs have not generally caught on. (This should not be taken as a blanket criticism of all aspects of “appropriate technology” carts: for example, one TDAU cart has recently passed an on-station test in Magoye, outperforming several other carts, although like most other carts in these trials, it failed the longer term on-farm testing).

The North Western IRDP spent much time testing a variety of wheels and axles, including some with

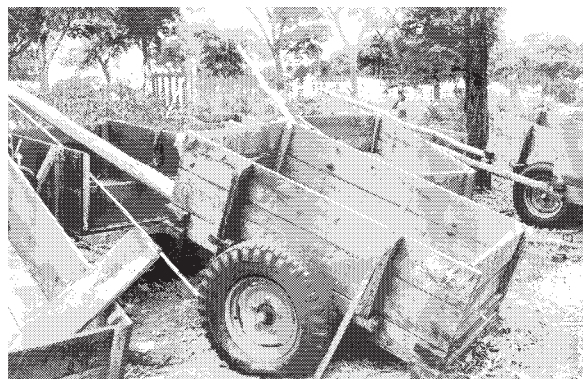
wooden, bronze and PVC bearings. They finally standardized on steel axles with imported steel roller bearings and pneumatic tyres. These seem to have been satisfactory, and have been widely used and adopted. Several hundred are in use around Kabompo.

There are few other commercially available carts. Northland developed an ox cart, using solid rubber tyres and bush bearings. This was reported to have had major technical problems. It passed on-station tests, but failed on-farm trials carried out by ADP-

Figure 12. Ox cart made from an old axle in Lusaka Province.

Most carts in Zambia are made using scrap axles.





Figures 13 and 14. One of the “appropriate technology” carts (left) with wooden wheels made in North Western Province. Such carts were subsequently abandoned in favour of carts made with imported axles using roller bearings and pneumatic tyres (right). A simple wooden cart body was retained.

RDP Magoye. It has not been widely used and it is not being routinely manufactured.

Lenco has manufactured and marketed a steel cart, using imported Italian axles fitted with tapered roller bearing and pneumatic tyres. This has been well received, and is reportedly working well in the Northern Province, in the area of the Rice Development Scheme. It was the only cart to pass both the on-station and the on-farm tests carried out by ADP-RDP Magoye (Dogger, 1990). Its main problem is its high price: not only is it expensive to purchase, it is also costly to transport as it is ready-assembled.

In view of the perceived demand and the shortage of good cart axles in the country, the engineering and bearing company SKF, developed ox cart hubs using ball bearings. This was designed to be used with Landrover (or other) rims and tyres. Launched in 1988, production has been about 500 hubs a year, sufficient for 250 carts. Response has been mixed, with some reports of complete satisfaction and some of hub failure. Carts with SKF axles passed on-station tests at Magoye, but failed the on-farm testing. Unfortunately, if there are problems with the bearings, adjustment and replacement of the bearings is virtually impossible in rural workshops, and so whole hubs have to be replaced, at high cost. Although the price of the axles is high, relative to farmer income, it appears it may be acceptable to farmers, provided the axles and hubs can last for several years. A project proposal was prepared to assist SKF meet national demand (MoA, 1988). The Dutch government (DGIS) agreed to fund this, but importation of components was postponed when hub failures started to be reported. Imported components finally arrived in early 1991, but by this time SKF had decided started developing a new design. The new hubs, which will not be available until 1992, will use tapered roller bearings.

The SKF axles (and other local designs) depend on the availability of rims and tyres. In order to relieve

the shortage of these, the ADP Coordinator project has imported scrap wheels and rims from Europe. The importation of complete scrap axles has also been considered. The supply of tyres and rims has been popular with the recipients, mainly development projects and institutions. However, such provision of materials is unlikely to be sustainable.

It appears that most farmers prefer carts based on roller bearings and pneumatic tyres, whether the hubs be new or are from scrap vehicles. Although these carts may seem the most expensive option, requiring higher capital and maintenance costs, the carts are durable, they can take heavy payloads and their wheels can negotiate mud and sand.

Evidence from other countries in Africa appears relevant to the Zambian experience. Wooden wheels are only common in north Africa and Madagascar. Carts made from old vehicle axles exist in many places, but seldom in large numbers, probably due to the limited supply of old axles. “Appropriate technology” options are found in several countries, but seldom in large numbers; their bearings and wheels are almost always cited as a source of problems. In contrast, the use of animal-drawn carts has been seen to increase rapidly, when a reliable supply of high-quality axles has been made available. In West Africa, there are about 100,000 carts in use in Senegal, 100,000 in Mali, and 40,000 in Burkina Faso. These are nearly all of designs based on high-quality axles assemblies using roller-bearings and pneumatic tyres.

In contrast to these West African examples, Zambia still has very few animal-drawn vehicles in relation to the number of animals used for cultivation. Cause and effect cannot be ascribed, but it seems that Zambia farmers have not yet had a good supply of affordable, high-quality carts. The exception may be in Kabompo District, where many carts have recently been adopted. Tanzania has tended to follow an “appropriate technology” approach similar to that

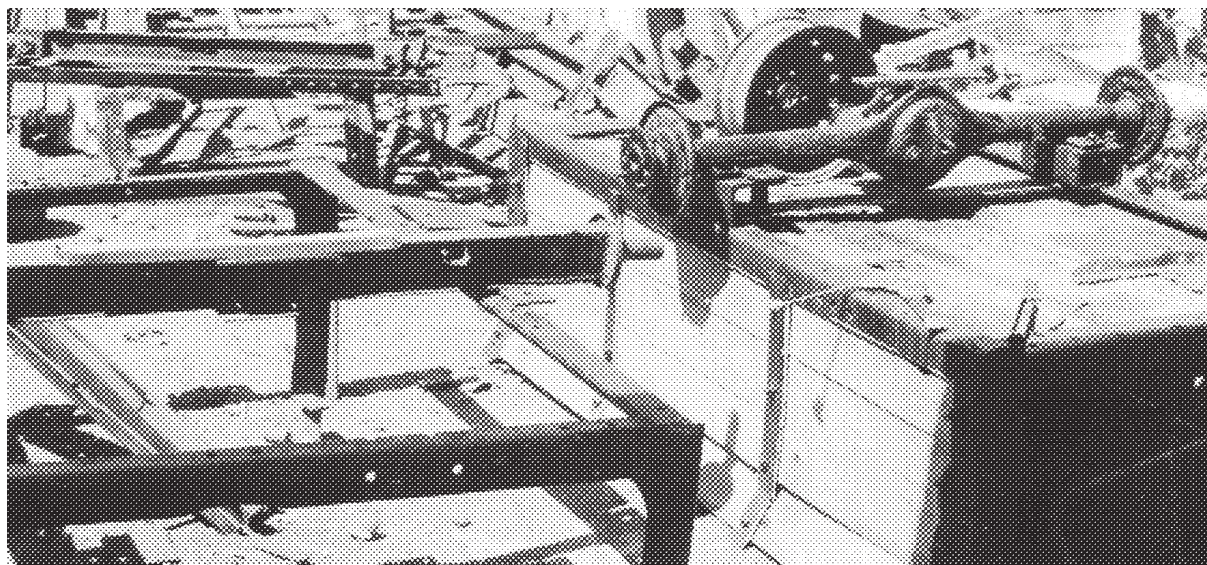


Figure 15. Local workshop making carts from scrap axles in Southern Province.

some Zambian organizations, and also has few carts in use. In contrast, private enterprise firms in Malawi have manufactured and marketed high-quality carts with pneumatic tyres. Although Malawi is a much smaller country, there are now about 20,000 carts in use, almost one cart for every two plows. Such statistics should be treated with great caution, for they are only illustrative. Direct comparisons between different countries are fraught with problems since it is not possible to separate the different supply and demand situations from the numerous other variables. Nevertheless there does seem to be evidence that farmers elsewhere in Africa can afford and maintain carts with "high-quality" roller bearing axles.

Experience from within Zambia and elsewhere suggests that the design of the body of the cart is not nearly as important as that of the axle and wheel assembly. Furthermore as bodies are generally made locally, it is easier for manufacturers to receive feedback from the users. Thus weak points can be strengthened and dimensions adjusted to accommodate the major loads.

The transport of fully assembled carts is normally prohibitively expensive. On the other hand, axle and wheel assemblies may be packaged for bulk transport, and they are also small enough to be carried on public transport. Thus the SKF approach seems very sensible, provided their design is good (the author's impression is that the SKF design should be improved to make them more durable and repairs easier).

If manufacturers (SKF, Lenco, Northland or others) make available sets of good axles, at an affordable price, they are likely to be in demand. They would be purchased by organizations such as Muzama

Crafts, as well as by projects and small workshops (such as those proposed by SDP in the Copperbelt). These, or other, manufacturers might also consider a steel cart frame as an optional extra. These could be supplied in kit form for ease of transport. The frames would be assembled in rural workshops, with the cart platforms and sides being constructed locally from wood. Such kits would not sell in very large numbers, but would be attractive to project-assisted workshops with little experience of cart manufacture.

A small number of four wheeled carts are in use. Some are owned by commercial farmers, who may use the same trailer with oxen one day, and a tractor the next. One four wheel trailer has been built by the Msekhocika project in the Eastern province. This is a strong, expensive cart that is intended to be a sustainable, long-term replacement to an unaffordable pick-up. Four wheel trailers are expensive and complicated, and are unlikely to be used by small farmers. They are more efficient for pulling heavy loads, and may be preferred by animal-using commercial transporters (movement of urban goods, road building, forestry applications, etc).

Unusual applications of animal power

In Zambia, animal power is used almost exclusively for transport and soil tillage. There are a few examples of other uses such as milling and logging.

One project, supported by the German Appropriate Technology Exchange (GATE) has been installing and evaluating a few animal-powered mills. One mill was recently installed at the Msekhocika Project near Chipata, but its ground wheel and tyre were stolen, as they were compatible with those of private cars. It is too early to say whether such mills

will prove suitable for use in Zambia. In the past year, the present design suffered from excessive tyre wear and problems with the grinding stones. These are being rectified, but a more fundamental problem is the slow milling rates. In tests at Magoye, donkeys and oxen have been used to draw the mill, which has a draft of about 500 Newtons. Two millings have been found necessary with maize to give an output efficiency of 53-69% (final meal as proportion of the grain input). The output has ranged from 15 to 37 kg per hour, and has been highly dependent on the moisture content of the maize.

The Msekhocika Project in the Eastern Project has received Austrian technical assistance in the development of a mill for extracting oil from sunflower seeds. The mill apparently works effectively. Women's groups come with their own pairs of animals, and also pay a fee, currently K300 per day. Output can be 18 litres of oil during a six hour working period.

Another system designed to harness animal energy was tested at Kasisi Mission, Lusaka Province in recent years. It was a "rope engine" developed at Warwick University, in UK, and was intended to drive grinding mills and other machines. Unfortunately the installed prototype was broken by the ox that was testing it, before it could be fully evaluated. Similar problems have been experienced in other countries with this prototype design.

Oxen are used for timber extraction by Zambia Forestry and Forest Industry Company (ZAFFICO) in Ndola. It is reported that oxen are substantially cheaper than tractors for logging work. A community forestry project in Luapula, supported by the Finnish Volunteer Service, is currently investigating the use of oxen for transporting logs.

A rural roads project in the Northern Province, supported by the International Labour Office (ILO), has imported donkeys for use in its road maintenance programme. They will mainly be used for transport of materials. In other countries animals have been used to pull earth moving scoops and graders, for road construction, and historically such techniques were used by some commercial farmers in Zambia.

The specialized applications cited here are recent initiatives. They illustrate some innovative attempts to make more use of animal power. Nevertheless the total numbers of animals involved are few, and there seems little likelihood of such applications spreading widely in the coming few years.

Organizational issues

Most government-supported activities relating to animal traction suffer from chronic underfunding, exacerbated by inflation. These include MoA extension services and Ministry of Education colleges. However, there are many donor-supported projects in the country, which help maintain the government infrastructure. It appears to be relatively easy to obtain donor funds to support animal traction activities. Thus often, while "lack of funds" is strictly correct, it may also imply lack of initiative to obtain external support and/or funds.

In theory, within government ministries and projects, the position is always more important and permanent than the individual. Staff are interchangeable, and staff movements are frequent. In practice, the success of many programmes and projects is highly dependant on key individuals. The success of animal traction programmes can often be traced to the enthusiasm and vision of individuals, some Zambian nationals and some expatriates. The lack of progress

Figure 16. Four-wheeled ox cart used by the Msekhochika Project in Eastern Province as an alternative to a pickup vehicle.





Figure 17. Animal-powered mill installed by the GATE Animal Power Project for evaluation at the Magoye Regional Research Station.

elsewhere is often more to do with the individuals (Zambians and expatriates) than the various excuses given. This situation is not restricted to animal traction, but animal power does seem an area where enthusiastic individuals without too many preconceptions can make an impact, while unenthusiastic ones merely list constraints. (Enthusiastic individuals restricted by their own ideas may also fail to make an impact). It may be difficult to use this observation in the planning of future strategies, but projects should obviously try to attract suitable individuals. When programmes appear to fail, it is important to distinguish between those problems attributable to the technology itself, and those due to human failures.

Women and animal traction

In Zambia, as in most other countries, animal traction technology is dominated by men. The main work animals are cattle, and these have numerous gender-related traditional roles.

Men and youths generally work with draft animals. It is quite rare for a woman to plow, although it is not uncommon for women to lead or encourage the animals, as a man plows. It is generally a woman, rather than a man, who drop seeds into the furrow, behind the plow. In areas where animal traction is widespread, women who do not own draft animals, usually hire or borrow oxen (and a plowman) from male relatives or neighbours. Even when women farmers own cattle, it is usually a male relative or

employee who works with the animals. There are many and complex reasons for this, mainly to do with social traditions. There do not appear to be significant technical or ergonomic reasons why women do not generally plow. Although the implements are quite heavy, they can certainly be used successfully by youths and girls.

Studies in Western and North Western Provinces have shown that through hiring and borrowing arrangements, women do have access to animal power for cultivation and transport. All hirers, male or female, have to make use of the draft animals when it is convenient for the owner, which may well be after the ideal time. Although this is inconvenient, and may cause poor timeliness, it does allow women access to draft power, without the associated capital investment, management responsibilities and risks. In the Eastern Province, some women's groups have been assisted to obtain ox carts, and have reported considerable benefits from the transport.

In recent years, women farmers have been trained in animal traction at farmer training centres. Women extension workers have been trained at Palabana Animal Draft Power Training Centre. The impression gained by the present mission is that women are no more disadvantaged in relation to animal traction, than they are in society as a whole. Their more active involvement in animal traction will tend to follow automatically as more liberal social traditions evolve. Thus, while there is always a need to



Figure 18. Women being trained to plow with oxen in Western Province.

be sensitive to gender issues, animal traction technology itself does not seem to be a major problem for women. Should donkeys start to become more popular, these may well be particularly useful for women. Donkeys are smaller than cattle, easier to train, and they have few, if any, traditional “gender” associations.

Donor-supported projects

Although all MoA projects in Zambia are the ultimate responsibility of the Government of Zambia, donors have a much influence in the planning and implementing of the projects. Sometimes the self-interest of the donors, or the implementing firms, seems to have become more important than the needs of the recipients. Two examples illustrate this point. The Italian-supported agricultural mechanization project has already benefited the Italian companies who have supplied the Italian ox plows, small tractors and consultancy services. There seems little optimism among project staff or MoA officers that this equipment will greatly benefit the smallholder farmers in whose name the “aid” is being given. Similarly, the Dutch firm of Rumpstad has already gained from the sale of its plow components (all models) and the provision of consultancy services. In contrast, its partner firm, Lenco, has gained little, so far, from the project. It first had problems shifting the first, slow-moving consignment of heavy plows and then resorted to selling the second consignment of plows at below cost price. The farmers, in whose name the money was ultimately spent, have, so far, gained very little. Both projects are on-going, and may eventually prove to be valuable for all concerned. Nevertheless, both projects have been based on the use of equipment manufactured in the donor country, rather than from an entirely objective assessment of the local needs of Zambian farmers.

Although all donors and GRZ talk of the importance of counterparts, there seem to be several examples of expatriate specialists in animal traction working alone. This wastes a major training opportunity, and greatly reduces the long-term value of the technical assistance. Two examples illustrate this point. A full-time counterpart has only recently been assigned to the expatriate national Animal Draft Power Coordinator. The Rumpstad engineer working at Lenco still does not have a direct counterpart with whom to work as he establishes the ox plow production facility.

It seems difficult for either side to justify such lack of counterparts. If expatriates are really experts, then it would seem sensible for them to have Zambian counterparts to work closely with them and learn from them. If the expatriates are not really experts, then their duties could probably be performed by Zambians anyway. In either case, Zambian nationals would appear necessary. In some cases assigned counterparts are absent due to overseas training. In such circumstances, the benefits of the technical assistance can be maximised if another person is assigned to receive the on-the-job training within Zambia.

There is much evidence that animal traction programmes need a long period to achieve results. One reason is that it takes several years for the expatriate and national experts to see through their original preconceptions to the real problems facing the farmers. The Intermediate Technology Development Group assistance to Magoye in the 1970s terminated after just four years, before the lessons learned from the initial mistakes could be start being applied. Two successful programmes, the GTZ-supported IADP in the North West and the Msekhocika Project required several years of trial and error before they arrived at suitable ox cart designs. Had they both been terminated after four years, they too would only have had

the failures to show. By continuing for over seven years, and learning from their early experiences, they have gone on to promote suitable ox carts in their respective zones. However a long time scale by itself is not a panacea: it needs to be combined with willingness to learn from experiences. The long-term SIDA-supported Katopola project in the Eastern Province still continues to promote the construction of wooden-wheeled ox carts. This is despite that fact that it has been apparent to everyone during the past five years, that these carts have not been accepted by farmers, and few, if any, are in use. Clearly long-term animal traction projects have to be responsive to farmer feedback.

This previous example illustrates another problem with some animal traction projects: they can become the slaves, rather than the masters, of their own planning matrices. The Katopola project was intended to promote “appropriate technology” wooden implements and carts. When these were found to be inappropriate, those involved did not seem to have had the vision to modify their work plans, and let their programme evolve into more viable areas. The successful NWIADP seems also to have been unnecessarily restricted its planning matrix. When its initial ox cart targets were met, the project stopped supporting the ox cart programme. This was despite the fact that farmers did not believe that the ox cart market was saturated.

Some donor-assisted projects have been insensitive in the way they have concentrated resources within provinces. MoA staff within the North Western and Copperbelt provinces made particular reference to this. While it has been quite legitimate to concentrate project activities within specific target-areas, it would have been quite possible to have done this without making staff in the provincial agricultural offices feel neglected. Small levels of support and training for provincial staff would have assisted long-term institution building, and need not have detracted from the districts of concentration.

Training and education

Animal traction has only recently become an important element of agricultural education and training. Consequently relatively few staff of the ministry and projects have had training in this field. Few graduates have skills in animal handling, plowing or plow adjustment and consequently they tend to lack confidence in these areas. Many extension workers also lack animal traction skills.

The University of Zambia does not have draft animals on its farm. Its teaching staff would be willing to improve coverage of animal traction, but with limited time available, something else would have to

suffer. In any case the staff feel over-loaded, due to staff shortages, and they lack suitable texts.

The Natural Resources Development College (NRDC) of the Ministry of Agriculture has been, and still is, orientated towards tractor-based agriculture. The irony of this has not been too obvious, as the college is located in high-technology environment of Lusaka. The College's “commercial” farm uses tractor cultivation entirely, but a pair of oxen are to be found on the training farm. Some attempt has been made to improve the situation, with staff trained in animal traction in Zimbabwe. Nevertheless the staff acknowledge that the curriculum needs updating and more emphasis put on animal traction operations and implements. Lack of suitable text books was cited as a constraint.

The Zambia Colleges of Agriculture at Mpika and Monze, situated in a rural areas, have updated their curricula, and placed more emphasis on animal traction. The colleges lack text books, but their students are able to train and use draft animals themselves.

Some of the past shortcomings in training will be corrected by the Palabana Animal Draft Training Centre. This has been established to improve the training of MoA and project extension workers. Different courses will cater for various levels of staff, whether they have certificates, diplomas or degrees. All will emphasize practical issues, but attention is also being given to theory and socioeconomic aspects of animal traction. Training materials are being developed, and these may well assist the other training institutions fill their present gap.

Research and documentation

Most recent research relating to animal traction has involved either the testing and development of implements or assessing the impact of animal traction on farming communities. Very few research findings have been published. The Regional Research Station at Magoye has been undertaking on-station and on-farm implement testing, with some replicated on-station trials. Several organizations have worked on ox carts, emphasizing practical development rather than open-ended, questioning research. Socioeconomic studies concerning animal traction have been sponsored by projects in the Northern, Northwestern and Western provinces.

It has been noted that many reports have been produced that relate to animal traction in Zambia. A list of many of these references is provided as part of this report. Many documents cited are thick and verbose and lack clear and concise summaries. This makes them difficult to read, and expensive to reproduce and distribute. As a result the lessons contained within them are seldom passed on to col-

leagues and successors within the same projects, nor to other projects and organizations.

As few of the documents that are produced are widely circulated, there is little cross-referencing of publications. Few documents, whether research reports, progress reports or evaluations, contain any rigorous reviews of the available literature, whether national or international.

Few reports relating to animal traction in Zambia have been published internationally. This is regrettable, for international publications are likely to boost the confidence and standing of the authors. They also allow Zambia's experiences to be shared elsewhere, and may appear as attractive documents that are easily disseminated within the country.

There is no obvious library where someone starting work on an animal traction programme could go to learn of what has taken place before in Zambia, and what is the experience of neighbouring countries. The most comprehensive collection of documents is held in the office of the National Animal Draft Power Coordinator, in the Ministry of Agriculture in Lusaka. These documents are presently stored in various archive boxes. They could be listed, classified and more attractively presented within the Agricultural Engineering Section. Alternatively the documents (or photocopies of them) could be passed on to Palabana, to become the basis of a national collection of animal traction documents. Palabana, as a national training centre, seems a more appropriate home than Magoye. It will have many people interested in animal traction visiting it, and it is relatively accessible to students of the University or NRDC who may wish to undertake projects in this field.

Attitudes

Appropriate technology

In the 1960s and 1970s, in Zambia and elsewhere, animal traction was often considered as an outmoded and undesirable technology, that was inferior to tractorization. Such attitudes still exist in some African countries and among some donor agencies, and it would be surprising if they were not present in sections of Zambian society. Nevertheless, from the discussions held by the review mission, it seems that few, if any, people concerned with agricultural development in Zambia hold such negative attitudes. Animal traction now seems widely perceived to be an appropriate technology. The fact that some large-scale commercial farmers owning tractors are also using animal power, illustrates the view that work animals and motorized power sources can be complementary.

Narrow project vision

Throughout the country, there is a tendency for the staff of the Ministry of Agriculture and externally-assisted development projects to limit their horizons. In their presentations of the current situation, staff frequently considered only those farmers who had received official assistance. For example, in several provinces, data were provided for the numbers of draft animals and/or ox carts in use. It was often implied (and genuinely believed) that these figures referred to the whole province or selected districts, whereas in fact they related only to official extension activities. Official project figures therefore tend to underestimate the numbers of draft animals and minimize the overall growth in the use of work oxen. Often farmers have been obtaining and training animals privately, and purchasing their own plows and carts. In a similar way, project staff have tended to highlight the problems that projects have had in obtaining animals. They not always noticed that some farmers have been able to obtain animals themselves, without project assistance.

In a few cases, the review mission felt that the "constraints" noted by Ministry staff came more from past theoretical training than from close liaison with farmers. For example, some ministry staff suggested that lack of commercially-available cattle feeds and the lack of "improved" bulls were constraining the introduction of animal traction. There appeared to be no evidence that such inputs were actually required, or would be affordable or effective.

Public sector solutions

Although it appears that both aid agencies and the Zambian government (GRZ) wish to avoid further expansion of public sector, many ministry and project staff proposed public sector solutions to overcome constraints. For example, it was commonly proposed that public sector or parastatal agencies should be responsible for breeding draft animals: only in a few cases was the possibility of developing private multiplication herds mentioned.

Farmer innovation

While ministry staff have tended to emphasize extension-led innovations, there is much evidence of changes introduced by farmers. Perhaps the most obvious is the use of cows for work. The use of female animals for work is seldom, if ever, mentioned in ministry or project reports, and most ministry staff contacted thought it would be unwise, possibly even illegal. Nevertheless there is no doubt that Zambian farmers are using cows for work. Many teams watched by the review mission included one female animal. While such passing observations may not be used to estimate the proportion of cows

currently being worked, they do illustrate that the practice is more widespread than had been previously reported.

The spread of animal traction to new areas has sometimes been due to farmer innovation, rather than project initiative. In several places, farmers reported that the first person to use animal traction in the locality had been an immigrant from another province, or another country. For example, it was stated that farmers moving from the southern province, and from Zimbabwe, had brought knowledge of animal traction into specific areas in the north of the country. This is substantiated by the results of one survey from in the Copperbelt province: it was found that a high proportion of the ox-using farmers were immigrants from other areas.

Effect of 1985 investment plan

The 1985 ADP investment plan recommended that the use of animal traction in the country be encouraged, and proposed various investment strategies and provincial work programmes to achieve this. The investment plan considered that its proposed activities would directly benefit an estimated 14,240 farmers who would progress from hoes to plows. It was suggested that this would lead to an increase in area cultivated on 12,650 ha. This may have been achieved, but it is very difficult to verify this.

Unfortunately, the 1985 investment plan was not accompanied by reliable baseline surveys that would have provided a scale by which progress could have been measured. On an anecdotal basis, however, it is

widely believed by farmers and by staff of the Ministry of Agriculture and development programmes that animal traction has increased in the last five years. While it seems extremely likely that the various provincial programmes have played important roles in the expansion of animal traction, it would be incorrect to ascribe conclusive cause and effect relations. The developments observed might have occurred anyway. Even in those districts and provinces with few formal ADP programmes, animal traction appears to have been increasing through the efforts of the farmers themselves.

It is noteworthy that all the persons contacted by this mission were positive about animal traction and its prospects. This cannot be dismissed as mere politeness. Many people had specific ideas and action plans they wished to discuss. Such a widespread positive attitude was not present in Zambia in the 1960s and 1970s, and even today it is quite rare to find this in sub-Saharan Africa. Again it is impossible to ascribe cause and effect. (Is the present favourable public opinion the result of the activities of the investment plan? Might it not be that the investment plan itself derived from an existing groundswell of positive animal traction interest?). Nevertheless the investment plan period did end on a high plane of public support and optimism for the animal traction technology. This must be viewed as very encouraging for those planning, implementing and funding the various animal traction programmes.



Figure 19. Farmer plowing with three oxen and one cow (back left) in Central Province. The use of cows for work seems to be a recent, farmer-led innovation.

Conclusions and recommendations

Status of animal traction

There has never been a detailed survey of animal traction in Zambia, and all data and statistics quoted in this report must be treated with caution. However there does seem to be good agreement between the results of the 1990 questionnaire survey, the data in the reports and literature reviewed, the comments of farmers, the experiences of extension workers and project staff and the field observations of the authors. This consensus allows the authors to feel confident about their presentation of the general picture of animal traction in the country.

Animal traction is extremely important in Zambia. In some areas, notably in the south and the west, the great majority (perhaps 90%) of smallholder farmers uses animal traction. In such areas animal traction seems quite stable. There seems no evidence, during the past five years, of any significant move away from animal traction to either tractors or hand cultivation. On the other hand, there are reports of yet further adoption even within regions of widespread animal traction use. In regions of high animal traction adoption, the actual number of work animals may be locally increasing or decreasing as cattle numbers expand (through long-term multiplication) and contract (through short-term disease outbreaks). Work animals are mainly used for plowing. There is a slow increase in the number of ox carts employed, but little diversification into other operations.

In most other regions of the country, animal traction is clearly increasing. In much of the north, and in some tsetse infested areas, it is still at a very low level. In these areas, animal traction may seem unimportant, if considered purely in terms of the numbers of farmers using this technology. Nevertheless, animal traction is growing in importance and is bringing social and economic benefits to adopters (notably through transport and by increasing production through area expansion). No one seems to doubt that this trend will continue in the foreseeable future. Animal traction is therefore expected to increase in Zambia in the coming years.

Recent changes

Changes in animal traction are occurring as a result of both farmer innovations and project interventions. There has been a tendency for MoA staff to consider only the project activities. The migration of farmers and technologies within the country and between countries is also important. Farmers from the south-

ern province are bringing animal traction into central and northern regions, and farmers are bringing in ideas and technologies from bordering countries, notably Zimbabwe, Malawi and Tanzania. Examples of farmer innovations are the employment of female work animals and the use of breastband harnesses from Zimbabwe for donkeys.

In several provinces and districts, projects have accelerated the adoption of animal traction for both cultivation and transport. In the Northern province, one project has introduced animal traction for rice cultivation. Other examples of diversified uses of animal power are quite small and local.

The human resource base for animal traction is being strengthened. In the past few years, many Zambians have received practical and theoretical training relating to animal traction, that was not readily available in the previous decade. Some extensionists have been trained in Zimbabwe, and others at Palabana and Mpika. Local training for extension workers and farmers has been arranged in several provinces and districts. There is still much room for improvement, but there appears to be a definite positive trend within the country of increasing knowledge and understanding concerning animal traction.

Animal traction is widely perceived as a valuable technology that is well-suited to the economic and ecological conditions of Zambia. It seems that the "image" of animal traction within the Ministry of Agriculture, development organizations and the rural areas has improved in recent years.

General constraints

The biggest constraints to animal traction are general economic problems rather than technical ones. If farmers were able to market their produce easily, they might invest more in animal traction. With assured payments for their crops, farmers would be more prepared to take up loans to purchase animals and implements. With funds from sales, they would be more able to support private-sector solutions to the various input constraints and technical problems (including supply of animals, new implements, spare parts, drugs and training services). **The development of an efficient and reliable system for purchasing farmers' maize, at a fair price, would probably be the most effective means of boosting animal traction in the country.** Until this is achieved, programmes promoting animal traction will continue to be seriously constrained by the fi-

nancial problems of the farmers operating in farming systems of marginal profitability.

Throughout the world, farmers require credit to allow them to invest in inputs and new technologies. Zambia is no exception, and there are many examples of animal traction adoption in Zambia being dependent on credit. In most cases repayment rates for animal traction loans have been good, indicating that the technology is profitable, provided that there is credit to “prime the pump”. Nevertheless the present high interest rates will deter farmers from investing in animal traction (or other technologies), particularly when marketing arrangements are uncertain.

The present high inflation will also discourage farmers from investing in animal traction, as increases in crop prices will tend to lag behind the increases in the inputs. High inflation will also rapidly erode the budgets and revolving funds of organizations currently trying to assist the development of animal traction.

Implements

Although much has been said about plow design in Zambia, farmer statements and experimental trials suggest that actual make and design do not appear to be very critical (provided they are not too weak and not too heavy). Farmers seem prepared to tolerate imperfections and design faults, provided the plows are available and affordable.

Poor designs and poor manufacturing will only be improved if farmers have a genuine and sustained choice. If farmers are to be offered choices, cooperatives and projects will have to change their present “top-down”, central-planning attitudes.

Farmers do not seem to mind whether their plows are locally-manufactured or imported, provided they are affordable and spare parts are available. In the past, about one half of the plows in Zambia have come from factories in Bulawayo, Zimbabwe. The Zimbabwean plows appear popular, inexpensive and of good quality. While manufacturers in Zambia should be encouraged to meet a greater proportion of local demand, they should do so in the context of free-market competition from other manufacturers in the region. Genuine and fair competition within the region should provide farmers with real choice, and force all manufacturers to pay attention to farmer preferences in price, design and quality.

The use of ridgers and weeders is low in most districts. It is not clear whether the diffusion of these is constrained by implement design, implement marketing, or lack of appropriate and profitable systems of utilization. Studies being undertaken by the Magoye ADP-RDP may provide some answers. These trials could well be combined with a detailed on-

farm study and analysis of the ways in which these implements are now being employed. Farmer feedback could also be gained from plowing competitions involving “weeding competitions”.

Many animal-drawn implements are in need of repairs and spare parts. In most provinces spare parts are difficult to obtain in the rural areas. Schemes to train and equip blacksmiths have improved the situation in some districts, notably in the Eastern Province. The supply of suitable steel is one constraint to blacksmiths, that can be temporarily alleviated by project interventions. The establishment of viable, long-term mechanisms for providing training, credit and inputs for blacksmith groups should indirectly help the farmers using work animals.

Animals

In most parts of Zambia, cattle perform several productive, economic and social functions. Animal traction is just one of these, and few work animals are maintained purely for work. Staff of animal traction programmes should be aware of this, and realise that farmers' strategies may be highly rational, even if they do not seem to maximise animal traction productivity and profit.

Nationally there is no shortage of oxen, and in many provinces, supplies are sufficient for the present demand. In the long term, local supply problems can be solved by the establishment of small farmer-owned breeding herds. In the short and medium term some redistribution of animals will be necessary. In the medium term, sustainable private-sector solutions with traders or ranchers are to be preferred to public-sector cattle breeding initiatives. In the short-term the use of project-supported holding grounds, to allow bulk purchases of cattle, seems justified in some areas of introduction. For the foreseeable future, smallholder farmers are likely to find indigenous breeds of cattle highly appropriate for animal traction.

Although most work animals are oxen (castrated males), cows and heifers are also being used for work. This may be a new trend as the Zambian literature contains little reference to female work animals. The use of work cows is likely to increase. There is no reason to discourage this trend. Some agriculturalists may be concerned that this will lead to a decrease in fertility and milk production of existing cows. However, even at low rates of fertility, work cows will always give more calves and milk than oxen ever could!

The use of donkeys is also likely to increase, but numbers are now very low, and almost insignificant from a national perspective. The potential development and expansion of donkey power seem to jus-

tify some project support. In particular there is need to make available some simple donkey harnessing systems as an alternative to the present yokes.

The risks of disease in work animals are comparable to those of other cattle. The importance of disease risk, however, is greater, for farmers risk losing not only the capital value of the animal, but also the income-generating work potential. The risk of corridor disease appears to be a new, important problem, that may discourage farmers from investing in work animals. To protect newly-adopting farmers, animal insurance premiums can be built into loan packages (although such schemes can be expensive to administer). To protect the animals, a clear and determined policy is needed on tick control procedures. In several threatened areas, smallholder farmers are not yet convinced that dipping is cost-effective. It should not be beyond the combined imagination and resources of the veterinary department and the smallholder farmers to devise and implement tick-control systems that are economically and socially acceptable to all parties.

Animal nutrition does not appear to be a crucial limiting factor to animal traction in Zambia. Forage availability can be a local problem in areas of high stocking density in the south, in areas of high cropping intensity in the east and in heavily forested areas in the north. In such cases, the cheapest and easiest solution would be to improve the stocking and storage of crop residues, including maize stover and groundnut hay. Such storage is likely to be practised only if ox-drawn carts are available.

Data and statistics should be maintained on the numbers of work oxen in use in the country. The cattle census classification "oxen and tollies" should be replaced by two classes: "Trained oxen" and "Untrained steers". The possibility of including a new category (or sub-category) for working cows should be considered.

In areas where there is a demand for draft animals but few cattle available, the establishment of smallholder breeding herds should be encouraged. Cattle supplied for work purposes should not be sold to farmers below their market value for meat.

Animal-drawn transport

Evidence from several provinces of Zambia shows that animal-drawn transport has many economic and social advantages for farmers, and for the local, provincial and national economies. The valuable role that ox carts can play in maize marketing has only recently been exploited, and then only in some provinces. Animal-drawn carts can lead to agricultural and socioeconomic "synergy", with transport availability creating many new opportunities. The adop-

tion of ox carts can stimulate agricultural production by allowing crops to be marketed, crop residues to be stored and manures to be applied. The hire of ox-drawn transport may be more profitable than the farming itself. It appears easier to develop and sustain the employment of ox carts once several are installed in a locality. Such a "critical mass" leads to specialization in puncture repairs and, as more carts are owned, more uses of animal-drawn transport are developed.

Animal-drawn transport is currently underdeveloped in Zambia, compared with many other developing countries. Large numbers of cheap and simple animal-drawn sledges are employed, but these are only efficient when small quantities of goods are transported. One reason for the low number of ox carts in use, may have been the past emphasis by projects on "appropriate technology" carts. These were ideologically impeccable, but technologically inappropriate. The wooden-wheeled carts of TDAU, Katopola, Kasisi and NWIADP have had little real impact, and are not being copied by private sector workshops.

Pneumatic tyres are the preferred choice for most farmers. The profitability of ox carts is such that puncture problems can usually be overcome, particularly once a "critical mass" of farmers has adopted the technology, and local repair services have become established.

Roller bearings for ox carts seem both durable and affordable. The axles of scrapped cars and pick-ups can form the basis for suitable carts, but their numbers are insufficient to meet the demand. There is therefore a need in Zambia for another source of strong and long-lasting cart axles of good quality. The well-meaning SKF initiative has tried to achieve this, but has yet to succeed. The axles imported by Lenco, NWIADP and Msekhoicika seem better, and have been used to produce durable carts. Further importations of such axles (or their local production), with compatible rims and tyres, seems fully justified.

Once the axles and wheels are available, cart bodies can be produced in provincial and district workshops. For convenience, several projects would be prepared to purchase basic cart frames in kit form, for local workshops to assemble and fit with planks.

Extension strategies

While it is recognised that there are many differences in animal traction between, and within, the various provinces and districts in Zambia, for the planning of extension strategies, a clear distinction can be made between areas where animal traction is

already widely used and areas where animal traction is still an innovative technology.

In areas where draft animals are little used at present, animal traction technology is slowly diffusing, due largely to the migration of farmers from other areas. In these areas of new adoption, there is evidence that Ministry of Agriculture programmes and donor-assisted projects have had some impact. The existing basic extension messages do seem to be required and have been proven to be effective (for example, how to train animals and how to use implements). The combination of extension work (farmer training), provision of inputs and the availability of credit has certainly led to farmers adopting animal traction technologies in recent years. The training of farmers and animals within villages by specialised extension workers appears to have been effective. Ministry experience in several provinces suggests that such basic training is a relatively short-term need in any one area: once animal traction has become firmly established farmers cease to require basic training. However, animal traction farmers continue to require infrastructural services (credit, supply of inputs and marketing of outputs).

In areas where animal traction is already well-established, there have been very few changes in animal traction technology that can be attributed to recent activities of the Ministry of Agriculture and its associated projects. Most farmers in the country use the same type of plow (Safim /Zimplow /Northland type, usually without a regulator) as they did five, ten and twenty years ago. Secondary tillage implements are still quite rare, and are of the same designs used twenty years ago. Ox carts are still uncommon, and most are made from scrap axles, as they were twenty years ago.

Some development projects and MoA extension agents have been advocating that farmers in areas where animal traction is well-known should adopt “improved” animal traction technology, including “improved” plow designs, “correct” plow regulation, better training of animals and use of carved yokes. There is, however, little evidence to suggest that farmers are actually adopting the “improved” techniques being advocated. This lack of adoption suggests that these “improvements” are not significantly better than the present techniques. Perhaps they are not considered by farmers to be very important because they are not addressing the key problems limiting the production, profitability or well-being of the farmers.

From the lack of changes in animal traction technology, it appears that the research, development, training and extension services presently seem to have little “adoptable” advice to offer farmers already fa-

miliar with animal traction. Until the extension services have some clear extension messages that farmers will definitely accept, it would seem that priority should be given to programmes that improve infrastructural support to farmers who are confident with animal traction technology. Such support might include facilitating the supply of inputs known to be needed, like well-proven implements and spares, ox carts, credit and, in some areas, animals. By preference these should all be supplied through the private sector, but there is likely to be an important catalytic role for public-sector organizations, including donor-assisted projects.

It seems sensible that farmer extension and training in animal traction should be concentrated in those areas of possible new adoption with most chance of success. These will normally be areas of high agricultural potential where draft animals are presently little used. Success is likely to be highest in areas with good infrastructure and easy access to markets for farm produce. Area-specific projects, assisted by appropriate donors, could well assist animal traction introduction through extension programmes (enhancing the mobility of extension workers) and by facilitating the provision of critical inputs and/or credit.

There is evidence that some projects, institutions, ministry officials and extension workers have tended to be overconfident with their animal traction advice, placing too much trust in new technology and too little trust in the farmers' judgement. Naturally, extension advice will only be adopted if it is economically, socially and technically appropriate. New designs of plows, yokes and carts will not be adopted unless they are actually better or cheaper than existing ones. Sometimes the technology promoted by organizations in Zambia has proved inferior.

One means of overcoming this problem is for farmers to be informed of various choices, rather than to receive heavy promotion of one technological option. Such options could well be presented at plowing competitions, where different plows, carts, yokes and training systems could be shown along side each other. An implement, cart or harnessing system that is affordable, and can be seen working well in the hands of another farmer, may well be adopted. Similarly farmers might be able to see that one farmer using a pair of well-trained animals can sometimes achieve the same output as three people working with a span of four. Extension workers themselves may become less dogmatic if they see that a farmer using “poor” yokes, training systems and implements can sometimes achieve as much as those using “improved” techniques.

It seems that animal traction is subject to the principle of “critical mass”, and research, extension and training programmes should try to work in this direction. Animal traction and the relevant support services are quite difficult to maintain at low levels of adoption, but can become self-sustaining once it becomes common place. Thus it may be more rewarding and sustainable to strive to achieve (say) a 20% adoption rate in one area, rather than 5% adoption rates in four different areas.

Adaptive research

Research, development and extension services should try to identify means of improving animal traction utilization in areas where farmers are already familiar with draft animals. This could be achieved through one or more open-minded, farmer-orientated, multidisciplinary programmes which would aim to build on existing knowledge and experience to accelerate the evolution of ADP in Zambia.

Within pilot adaptive research/extension programmes, farmers familiar with draft animals could be facilitated to try out and assess alternative animal traction systems, such as weeding with ridgers or tine tillage techniques. To avoid wasted efforts, the techniques being assessed should all have proven to be acceptable and profitable to farmers in comparable circumstances elsewhere, preferably within Eastern and Southern Africa. Such programmes should make particular efforts to avoid preconceptions of the superiority of particular technologies. Their work should be highly orientated to the specific goal of obtaining new technical extension packages, proven by farmer adoption.

Projects

Donor-assisted development projects have played a key role in promoting animal traction, and they are likely to be important in the coming years. Not all have been very successful: some have been too

short, some have been dominated by expatriates and some have resolutely promoted technologies that farmers did not consider appropriate.

Donor-assisted animal traction programmes must be prepared to operate for many years. They must be constantly responsive to farmer feedback, and continually reassess their plans of operation. They should be very careful to ensure that the smallholder farmers are the main beneficiaries of project funds, and not merely the nationals of the donor country. Expatriate “experts” should work closely with Zambian counterparts and provide on-the-job professional training. If a designated Zambian counterpart is sent for overseas training, another person should be assigned to work with the expatriate to maximise the value of the technical cooperation arrangement.

Training and publications

There is a shortage of suitable training materials relating to animal traction, and the development of these (as planned by Palabana) continues to be a priority.

An attractive animal traction documentation centre should be established. Important documents and reports should be reproduced and made available to key institutions, such as Magoye and Palabana.

Projects engaged in animal traction should try to improve the standard of their publications. All new animal traction reports and documents should include concise summaries. An annotated list of animal traction research studies and evaluation reports that have been carried out in the country should be prepared and circulated to all relevant organizations. Those containing particularly important lessons should be reproduced and circulated, and possibly summarized in international publications.

Animal traction in Zambia: status, progress and trends 1991

Report prepared by

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Part 2

Provincial reports and
organizations contacted

Northern Province

Ministry of Agriculture, Kasama

Staff of the Ministry of Agriculture at Kasama reported that one major constraint to the development of animal traction in Northern Province was the shortage of weaner steers. The shortage was most noticeable in the Kasama, Chinsali, Mporokoso and Mpika Districts where demand for draft animals is increasing but where few farmers are traditional cattle keepers. In these districts the introduction of animal traction involves the training of farmers and oxen.

The MoA is actively encouraging oxenization and has launched a school information programme on the subject with extension pamphlets in English and Bemba. The MoA has also promoted oxenization through ox-plowing competitions.

MoA staff considered that the present demand (estimated by some at 1000 oxen per year) is far beyond the present supply capacity. The supply problem is exacerbated by the veterinary restrictions that prevent the movement of cattle from the cattle raising districts of Mbala, Isoka and Nakonde. As long ago as 1978, it had been proposed that quarantine stations should be established to allow animals to move westwards. Two possible stations existed. It was suggested that such stations should be used to allow heifers, bulls and oxen to be purchased from the border areas. Farmers could then be assisted to purchase (say) one bull and three heifers to start small breeding herds. There were not enough heifers available within the non-quarantine districts to establish such herds. Without such breeding herds "oxenization" might be unsustainable. The upgrading of the quarantine stations to alleviate the animal supply problem was discussed by Dibbits (1990).

In the three districts in the east where cattle were available, animal traction adoption was also slow. This was partly due to lack of externally-assisted development projects in these districts, shortages of implements, lack of credit and limited marketing opportunities for farm produce. MoA staff noted that throughout the province the maize marketing system was a major problem. It was a severe constraint to animal traction and all other farm investments. Last season's maize had not all been collected, and farmers had not been paid. This made repayment of credit difficult for farmers, who became reluctant to invest in maize production.

Some staff of MoA considered that lack of commercially available feed stuffs for oxen could be a limit-

ing factor, since farmers had been taught to feed their animals every working day. There were also suggestions that the poor quality of local breeding bulls represented a limiting factor to animal traction. [The authors report these two views without necessarily agreeing with them].

It was generally agreed by MoA staff that although animal health constraints existed, they could be overcome with good management. There exists persistent threats of rinderpest and foot and mouth disease along the Tanzanian border. There was concern that the Department of Veterinary and Tsetse Control Services was overstretched. It had limited drugs and veterinary materials, few staff and no extension materials. The Department will receive donor assistance to set up a revolving fund for drugs that will be distributed to the district and sold to farmers. The dipping programme has suffered from insufficient dip tanks. Furthermore, the increase of the fee from K1 to K5 per animal per dip made farmers reluctant to dip their animals. (The actual cost for dipping has been estimated to be K15-20 per animal). Where dip tanks do not exist, spraying against ticks was quite feasible, but expensive.

In order to improve the efficiency of project activities relating to animal traction, MoA has proposed a Provincial Animal Draught Power Project (MoA, 1990; Karlson and Nestande, 1990). Under this, the animal traction activities of VAP, IRDP and the Rice Development Project would be merged. The various projects are already cooperating, and if funding can be obtained, the new arrangements could start in 1991.

Provincial ADP Steering Committee

A Provincial Animal Draught Power Steering Committee was established in 1988. The Committee is chaired by the Permanent Secretary and all the main projects and associated institutions (such as the Northern Cooperative Union) involved in animal traction are represented. The committee remains active, and sometimes meets at field sites. For example, at a forthcoming meeting was to be held at the Chilube Mission, where demonstrations of the use of the imported donkeys were to be held.

Village Agricultural Programme

The Village Agricultural Programme (VAP) is a development programme supported by NORAD. A total of 560 oxen (280 pairs) had been distributed by

VAP from the beginning of its oxenization programme in 1982 until the end of 1989. The programme has never reached its target output of oxen, owing to various constraints, primarily related to logistics and the supply of oxen (VAP, 1989; VAP, 1990). Formerly VAP worked outside the normal MoA structures and staff were employed by the project. VAP activities were being integrated into the MoA. The project is expected to be phased out in 1991, with its animal traction activities being merged with others in the planned Provincial Animal Draught Power Programme.

Rice Development Project

The Rice Development Project is implemented by the MoA with assistance from the European Community. The project is developing rice production in the Chambeshi Flats, in Kasama East and on the other bank of the Chambeshi River in Kaunga Ward in Chinsali District. The project, which builds on earlier work of the IRDP, includes an oxenization programme, with extension work, credit support and assistance with the development of cooperatives. Earlier attempts at mechanization were not successful, and production declined when the tractors broke down.

It was reported that the ox programme, although small, seems most encouraging, and ox power now contributes significantly to the production of rice. The total area of rice increased from 2500 ha in 1989 to 3300 ha in 1990, and much of this increase could be attributed to the use of oxen. Manual farmers can cope with about one hectare of rice, while oxen-using farmers can farm 4-5 ha. Only 25% of the land was cultivated with oxen in 1987, but this had increased to 75% in 1990. There were likely to be 120 oxen in use in 1991, and further expansion seems likely. It is envisaged that the area could sustain 2000 farming families, who between them could use 1000 oxen (500 pairs).

Farmers have been assisted to purchase oxen and plows, and ox-owners provide a hire service for other farmers, who pay in cash or kind. Farmers could hire out their services for K1600 per hectare (K400 per lima) and could earn K5000 per season. A plowing competition had been arranged for extension purposes, and it had been found both successful and enjoyable.

As the Northern Cooperative Union (NCU) was not providing a regular supply of implements in the project area, the project had been supplying ox-drawn implements and cart axles bought in Lusaka. Both Lenco and Northland plows had been sold to farmers and both were considered acceptable in the light sandy soils. Farmers complained that the Lenco

plow was heavy, but thought its wide cut allowed faster cultivation. Farmers tended to prefer the Northland plow, although some quality problems had been noted. Farmers did not use the adjustment on the Northland plow, and some replaced the wheel with a skid.

The use of ox carts to transport rice to depots is profitable for farmers, and economical for the project. Farmers could charge K500, or one bag of rice, for transporting ten bags of rice over 3-4 km. The project reported major problems with the Northland cart (bush bearings), and minor problems with the SKF axle (locally-manufactured hubs with ball bearings). The Lenco cart (imported roller bearings) had been found best, but it was expensive.

Although the cost of oxen increased rapidly during 1988 and 1989, the value of rice also increased, and farmers were actually in a better position to buy oxen in 1989 than in 1988 (RDP, 1989). However, although animal traction is affordable, there were doubts whether the supply of animals could be maintained in the absence of the project (which may terminate in September 1991). Only a few farmers in the area have breeding herds. While these are being encouraged to sell weaner steers, the supply of animals from outside the area will be necessary for some time.

IRDP Kasama

The Integrated Rural Development Programme (IRDP) based at Kasama has been supported by SIDA. It has worked with and through the MoA, NCU and the District Councils in Chilubi, Luwingu and Kasama West. IRDP provides loan packages for oxen and implements. IRDP supports two holding grounds for oxen in Matiba and Chifwile to alleviate the problem of ox supply. Steers are bought from ranches and transported to holding grounds where they are castrated and trained. The initial training of animals occurs prior to their purchase by farmers. Between 1982 and 1989, IRDP was responsible for the placement of about 130 oxen. IRDP plans to maintain its oxenization programme until its activities are taken over by the Provincial ADP Programme. Staff of IRDP noted that only a very small proportion of farmers in its target area used oxen. However, oxen were likely to increase in importance, not only for cultivation, but also for crop marketing using ox carts. Much would depend on whether maize production in the province could be sustained by an effective marketing system.

DDSP-Mpika

The District Development Support Programme (DDSP), Mpika, was formerly part of the IRDP that

was active in promoting oxenization in Mpika, Chinsali and Serenje Districts. The work of the IRDP in promoting animal traction in areas where it was little known has been documented by Francis (1988) and others. He reported some of the benefits of animal traction, with adopters of animal traction being able to increase their cultivated areas and thus their total yield of maize. Although DDSP continues to support the oxenization initiatives of MoA in three districts, it ceased playing a direct role in 1989. Its ox-training centre and ox-holding ground in Mpika have been handed over to the District Council, and this has apparently led to a severe reduction in the activities of the centre.

Northern Cooperative Union (NCU)

Staff of NCU reported some of the problems of attempting to supply animal traction implements. The working capital of the cooperative union and the purchasing power of the farmers were both severely limited. It was difficult for NCU to assess the market demand, as farmers did not place orders for implements at NCU Kasama. Similarly the various District Cooperative Unions did not place firm orders with the provincial NCU, and they might be ordering plows directly from suppliers. NCU estimated the demand for ox plows in the province might be 400 units a year, but it was not clear to NCU in which Districts they would be required. At the time of the review mission NCU had 25 plows in stock and on order. The Lenco plow was not popular as farmers found it too heavy. They appeared to prefer the Northland Engineering plow that was cheaper. They had had one consignment of plows from Zimbabwe and these had proved popular.

Zambia Cooperative Federation

Zambia Cooperative Federation Finance Services (ZCF/FS) has been actively involved in the animal traction programme in the Northern Province. Several donor agencies have channelled loan packages through ZCF/FS. In such cases ZCF/FS operates as follows:

- The medium term loans for animal traction are not given as cash, but are dispersed "in kind" in the form of oxen, implements, etc.
- Potential oxen are identified and branded. Their value is determined before the loan agreement is drawn up and oxen are handed over.
- ZCF/FS is responsible for the loan agreement and loan recovery.
- Money reimbursed is used to create a revolving fund.

Unfortunately, ZCF/FS has little capacity to supervise the oxen loans due to lack of transport. To sup-

port its programme, ZCF/FS has employed two ox-trainers. It would like more ox-trainers but these are too costly and no training fee is charged at present. It also feels that ox-training should be the responsibility of the MoA. ZCF/FS noted that animal health was a risk to the loans, particularly as drugs and dip tanks were not readily available in the province.

Zambia College of Agriculture, Mpika

Activities relating to animal traction at the Zambia College of Agriculture at Mpika are reported to have increased markedly in recent years. Prior to 1986, the syllabus, developed with Swedish assistance, had been biased towards the use and maintenance of tractors. Since then, there had been an increasing emphasis on animal power, both in theory and in practice. Lack of good publications and training materials are a constraint to effective teaching. A shortage of available oxen has restricted the numbers of animals that classes of students have been able to train and use.

In 1988, following a request from the Provincial ADP Steering Committee, the college started to train oxen and ox trainers. It has subsequently trained staff of several development programmes in the region, including IRDP and VAP. One course was arranged on the harnessing of single animals. The college has also been working with ox carts, but it is restricted in its ability to purchase inputs. The college could carry out more training, if it could obtain more animals. Its own herd of 130 cattle is too small to meet the demand for oxen (and heifers). The college has sufficient land to expand its herd, but not the resources. Due to budgetary restrictions and cash-flow problems, the College has great difficulty in building up funds and assets. It would therefore appreciate external assistance to help it play a greater role in the development of animal traction.

Vocational Training Centre, Musa

The Vocational Training Centre at the Farm Training Institute, Musa, was formerly known as the Appropriate Technology Centre. It was taken over from VAP by the MoA Agricultural Engineering Section in 1989. The Centre is being renovated and plans to hold three three-month courses in blacksmithing and carpentry each year. Trainees will be taught to make their tools. The Village Industry Service (VIS) and the Small Industrial Development Organization (SIDO) will help in conducting the planned courses.

Chilube Catholic Mission, Kasama

In 1990, the ILO Road Maintenance Project in Kasama imported 34 donkeys from Botswana. They are intended for use in road maintenance and transporta-

tion. The donkeys are now kept at the Chilube Catholic Mission. The donkey herd will be partly used for breeding purposes. It was reported that obtaining the donkeys from Botswana was slow, with many bureaucratic processes to be followed. The mission staff were not entirely satisfied with the selection of donkeys. They would like to have a few strong male donkeys for breeding purposes.

Farm visits

Among the farmers contacted was one in Mpika District, who had been using oxen since 1981. He was transporting goods in his old cart, and reportedly also owned a plow, harrow, weeder and a cart. He used all, but mainly the plow. Since adopting draft animals he had increased his cultivated area (to about 0.7 ha) and also plowed for 12 neighbours for a fee of K300 per day.

Three farmers were contacted at the Kasama Demonstration Farm Settlement Scheme. This model settlement scheme is within easy reach of Kasama, and appears to have received much attention from MoA. The farmers visited had been provided with animals and equipment free-of-charge between 1986 and 1988.

One farmer had come from the Southern Province and was familiar with draft animals. He considered the main problems for the spread of animal traction were the shortage of animals and farmer unfamiliarity with the technology. He had access to a communal ox cart that could have been used for transport into Kasama, but it had fallen into disrepair (motorized transport was often available from visiting MoA staff and others). He owned several plows and weeders. Only one plow looked well used, and this was in need of repairs. He would like to increase his animals, with one pair of animals for each of his three wives. He would also like to start breeding cattle.



A second farmer had also received animals from the scheme. He had plowed 3 ha, before one of his animals had died of "bad management" (according to the farmer). His remaining animal had been slaughtered by his family while he was away. Due to his lack of success, he would not be able to approach the scheme for more animals, but felt confident he could buy them locally, should he have the need and the resources.

Another farmer on the scheme had recently plowed 2 ha in nine days. He had then helped his neighbour to plow and train at the same time, by hitching his own trained oxen in front of his neighbour's young animals. He had been given a wooden spike-tooth harrow to evaluate. He reported (in the presence of the supplier/designer of the implement) that it was good. (Actually it had several broken tines and appeared neglected and/or abandoned).

In a very different area, far away from the provincial centre, an ox-owning farmer was visited in the remote district of Mporokoso. He had obtained animals in 1989, from the Chitoshi oxen holding ground run by VAP. His animals were in good condition, benefiting from the by-products of his maize mill. Although he had used his animals very little, plowing just one hectare, they were very docile and used for pulling a simple sledge. He wanted to use them for carting, and so had purchased a pair of very large, cast iron wheels that may have come from the mining industry. As they were excessively heavy he was therefore still searching for a more suitable cart. Although there were few cattle in the area, and little land without stumps in it, he was confident that his oxen would prove useful for farming as well as transport.

Luapula Province

Ministry of Agriculture

Staff of the MoA, Mansa, reported that in 1986 there had been about 50 pairs of oxen in use in Luapula Province. By 1990, this number was thought to have increased to about 200 pairs. (The Investment Plan had suggested there had been 470 trained oxen in 1985). Since 1988, MoA has been assisted in its Cattle Development/Animal Draught Power Programme by Finnida, who were providing technical assistance, logistical support and funds for credit programmes.

MoA runs animal traction training courses at its Lubwe Ox Training Centre, which has been undergoing refurbishment. The number of animal traction courses for extension staff and farmers increased from three in 1986, to eight in 1990. Training relating to animal husbandry is considered particularly important as few farmers in Luapula have any tradition of cattle keeping. Blacksmith training has been arranged in villages and at Lubwe.

The Province has established an ADP Steering Committee that includes representatives of organizations involved in animal traction and cattle development activities, including MoA, Finnida technical assistance, Lima Bank, LCU and ZADL.

MoA staff considered that the shortage of oxen is a major constraint to the development of animal traction in Luapula Province. The number of weaner steers from Chishinga Ranch and Mansa Rural Dairy cannot meet the demand. Of the small number of farmers who own cattle, very few seem willing to sell weaner steers. In order to relieve the animal supply constraint, the MoA ADP/Cattle Development programme has plans to help a few selected farmers to establish breeding herds of indigenous cattle. The target is five farmers per year who will get each 20 animals for breeding. The farmers will receive loans and technical support to construct fences and cattle handling facilities and to develop 10 ha of pasture. Farmers will be trained in cattle management and farm economics. A bull exchange programme is also envisaged to improve herd productivity.

In October 1990, a joint GRZ/Finnida evaluation of the Luapula Rural Development Programme recommended the development of an import support programme for blacksmiths, with tools, steel and coal being supplied through LCU. It was also recommended that the programme should assist the local production of low-cost ox cart wheels, such as the wooden ones used on the Kasisi "Flintstone" cart.

SKF axles had been tested, but their bearings had worn rapidly and three had failed.

The Department of Veterinary and Tsetse Control Services considers that the animal disease situation is favoured by the present low population density of animals. It plans to set up drug revolving funds at district level.

The provincial Adaptive Research Planning Team (ARPT) is intending to carry out some simple trials on animal traction technologies in 1991. This may include trials on the use of ridgers, which are not yet employed in the province.

Chishinga Ranch, Mansa Rural Dairy

Chishinga Ranch and Mansa Rural Dairy, which are run by Zambia Agricultural Development Ltd, are the main suppliers of weaner steers for oxen. Traditional herds are few, and their owners often will not agree to sell their young animals (unless they urgently need some cash). Mansa Rural Dairy has a Boran breeding herd. It received funding from Finnida on the understanding that it would be able to supply both young oxen and some breeding heifers. It has sold some oxen, but has yet to release heifers for sale to farmers. Mansa Rural Dairy uses three pairs of animals on the station for transport operations. Chishinga Ranch is the main supplier of weaner steers for the animal traction loan scheme. Steers that have been sold are kept at the Chimengwa farm holding ground before they are trained at Lubwe Ox Training Centre.

Credit institutions

Loan facilities are provided by Finnida through ZCF/FS and Lima Bank. These facilities are for packages, which may include oxen, a plow, chain and sometimes an ox cart. While the Luapula Cooperative Union (LCU) has a standardized procedure, Lima Bank has a more individual approach to the farmers' needs and financial capabilities. Sometimes loan packages cannot be given owing to shortages of funds or oxen. For example, in 1990, Lima Bank promised 50 loan packages but could only give out 17, mainly due to lack of readily-available oxen for purchase. One farmer considered that the package system made it difficult for someone already owning animals to obtain a loan simply for an ox cart. It was mentioned that some farmers who had obtained loans to purchase oxen did not have sufficient funds

to purchase implements, so they eventually slaughtered their animals.

Implement supply

Implements and spare parts are supplied through LCU. At present the demand for implements within the province is quite small, and it was reported that availability of implements at Mansa is not currently a problem. The small numbers of implements are kept in Mansa, not in the various districts.

Manufacturers

The Boat Building, Carpentry and Joinery Workshop in Mansa had made the ox carts used in the loan schemes. Production continued erratically, and did not seem a priority for the workshop. Orders placed with the workshop were not always met on schedule, and this had limited the placement of ox carts through the loan scheme in 1990.

Farm visits

The four farmers visited all obtained their oxen and implements through the ADP/CD programme and were trained by the Department of Agriculture. Two of them had ox carts and used the animals for both plowing and transport. Two farmers reported there was a great demand from neighbouring farmers for the hire of their ox carts. In 1990, they had delivered 720 and 800 bags of maize respectively to the de-



pots over distances of 2-5 km. Their charges varied between K30 to K40 per bag depending on the distance. They had both earned considerably more than the cost of their carts in one season. One farmer, who had in recent years had his fields plowed by tractors, had started using oxen on part of his land. He reported that the high cost of tractor hire, and the unreliability and uncertainty of tractor availability at the optimal time, had encouraged him to adopt animal traction in 1990.

Copperbelt Province

Ministry of Agriculture

The Ministry of Agriculture reported that there were 65,000 cattle in the province, 44,000 in the commercial sector and 21,000 in the traditional sector. Of these 13,000 were “oxen and tollies”, and 7300 of these were in the traditional sector (MoA-CBP, 1989). Only a minority (perhaps 30%) of the oxen in the traditional sector were used for work. Despite this small number of oxen in use, the MoA staff reported a shortage of draft power. The area of land under cultivation was apparently being progressively reduced as tractor power became less available, or less affordable.

In 1988, the province arranged for six MoA extension workers to be trained as ox trainers at the Masaiti Farm Institute. In 1990, these were based at training centres in the province. They trained farmers and their oxen, as part of a free MoA service. Nevertheless, most farmers using animal traction did so without assistance. MoA staff considered that their animal traction extension activities were constrained by a severe lack of transport and other resources. MoA has had few project-supported interventions relating to animal traction in the province. The Smallholder Development Project (supported by the European Community) has recently started, but its operations are confined to the Mpongwe area.

The MoA staff considered that a key constraint to the development of animal traction was the shortage of steers in the province. Some steers could be bought from commercial farmers and institutional farms (such as Nchanga Farms). Other steers were bought in from Central and Southern provinces. In an attempt to alleviate the oxen supply problem, MoA was developing a cattle breeding centre in Mufulira. It intends to sell animals at low cost to farmers wishing to adopt animal traction. [N.B. The authors report this, and other information, without necessarily agreeing with it].

Smallholder Development Project

The Smallholder Development Project (SDP) has been established with assistance from the European Community. Based at Mpongwe, it commenced its activities in 1988, with a detailed baseline survey of its project area (SDP, 1989a). This reported that prior to the start of the project there were about 1000 trained work oxen in the project area. While 7% of farmers owned trained oxen, 23% of farmers

reported plowing with oxen, indicating that hiring out of oxen was widespread. Immigration, from other provinces and from neighbouring countries, appeared to be an important influence on the spread of animal traction. Although only 9% of all households in the SDP survey were immigrant households, over 40% of farmers owning work oxen were immigrants (SDP, 1989a).

SDP planned to assist a total of 300 farmers in five years to obtain oxen. It was envisaged that the number of project credit packages for oxen would steadily increase during the project lifetime. They would increase from 35 pairs in 1989/90, 55 pairs of oxen in 1990/91, 85 pairs in 1991/22, to 130 pairs in 1992/3. The purchasing power of the loan fund might be adversely affected by inflationary price rises, but other loans would be available to farmers from ZCF. The project was trying to obtain animals for the farmers, and found it best to purchase steers from local commercial ranches, including Nchanga Farms. However at K38 per kg, these animals were not cheap. The project takes the recipient farmers to identify the animals at the ranch. The animals are then trained on the farmers' fields, with the assistance of project ox-trainers. The first oxen supervised by the project were insured against death at a premium of 6.7% per annum for the full period of the loan.

The project initially organized the placement of 20 pairs of cattle, but an outbreak of corridor disease in 1989 temporarily stopped the project from purchasing and moving cattle. Restrictions had since been lifted and the project was now hoping to place 15-20 pairs of oxen per month, provided supplies could be maintained. Credit was being provided by the project itself and by ZCF.

Locally-made ox carts were used in the project area, and it was thought that carts might become increasingly important as liberalization policies affect maize marketing. The project hopes to facilitate the establishment of marketing cooperatives. The project would like to assist local workshops to manufacture ox carts. It arranged for two ox carts to be constructed, but neither were very satisfactory. SDP has purchased five SKF axles for sale to local workshops, and will also arrange for the purchase of imported axles. The project considered that Lenco equipment was acceptable. It had been having discussions with Lenco to help establish two private agencies to supply Lenco implements and spare parts in the project area.

The project aimed to establish a revolving fund for veterinary drugs. One proposal was that loans would include an animal health element. This part of the loan would automatically go to the revolving fund as a deposit. Farmers would have the right to that value of drugs in the coming year(s).

Project staff have developed a computer programme, based on Lotus spreadsheet software, to assess the economics of animal traction. This has been tested in collaboration with staff of Palabana and it has been found useful in performing sensitivity analyses. These have shown that the animal traction loan package appears economically attractive, provided soya bean and groundnut prices remain high and interest rates do not exceed 30%.

Credit institutions

In 1990, the major institution providing credit for oxen in the Copperbelt was ZCF/FS, working through the Copperbelt Cooperative Union. SDP provided some oxen loans within its limited project area. The Cooperative Union was reported to have provided eight pairs of oxen to selected cooperative societies.

Implement supply

The Copperbelt province is the most industrialised province in Zambia. Several companies set up as “jobbing” manufacturers to service the mining industry have recently diversified into the production of agricultural tools. The companies manufacturing ox-drawn implements include Northland Agriculture Ltd, MDM Engineering and Gilmer Engineering Company. Demand for implements within the Copperbelt province itself is low, and these firms hope to meet demand from other areas of the country.

Implements and spare parts have been supplied through the Copperbelt Cooperative Union. Supply at the provincial level does not appear to have been a major constraint. Nevertheless farmers have often had to travel into the towns to buy equipment, which is both time-consuming and costly. In the Mpongwe area, the SDP was trying to encourage the establishment of local agencies that would sell implements and spares.

Northland Agriculture Limited, Ndola

Northland Agriculture Ltd of Ndola is the oldest and largest producer of animal-drawn implements in the country. It was formed in 1978 as a subsidiary of Northland Engineering, a large “jobbing” engineering firm serving the mining industry in the Copperbelt. It is part of the Anglo-American group of companies. Northland Agriculture derives 70% of its revenues from agricultural implement production. It

started making ox-drawn implements using old machines and “jobbing” techniques, without a clear production line and without specialized jigging and tooling. It has continued this system of production for twelve years, although in the past five years, the company has attempted to improve both quality control and tooling. It has recently installed a forging unit to manufacture hand tools. This unit can also be used for heat treatment of plow parts, and this should allow the company to improve the quality its mouldboard plows and other ox-drawn implements. In the coming years Northland expects to place greater emphasis on hand tools.

Most of the implements made by Northland are of long-standing “Safim” designs. These include (in descending order of sales volume) a mouldboard plow, ridger, cultivator and harrow. Northland considers that the designs it manufactures have been well-proven in the region, and its sustained sales figures over many years illustrate their popularity with farmers.

Northland prepared an original design of ox cart, using bronze bearings, spoked metal wheels and solid rubber tyres. The tyres were specially made in Zambia by Dunlop, but by late 1990 their cost had risen to K6000 each. This is likely to be prohibitively expensive. The bronze bearings wore rapidly, and this, together with relatively high price, meant the cart did not sell well. In late 1990, Northland was no longer making carts regularly. In recent tests by ADP-RDP Magoye, the cart passed its first on-station test. However it failed its longer on-farm test, because its bronze bearings wore very rapidly, and causing axle damage. It was complemented for its light weight and puncture-proof tyres, although farmers felt its wheels were too narrow (Dogger, 1990).

The Northland management acknowledges it has had problems in quality control and in meeting production targets. One reason cited for low production and poor quality was the limited availability within Zambia of suitable sizes and grades of steel. In order to obtain I-section beam steel and share profile steel of suitable quality foreign exchange was needed. The steel then had to be purchased from South Africa, in minimum orders of 400 tonnes.

Northland also attributes its quality control problems to its current method of production, its old machines and its lack of accurate jigs and tooling. It anticipates it could increase production and improve quality if there were major investment in new plant and equipment. This would allow accurate and cost-effective production techniques to be introduced. Northland is prepared to make such investment, but it is difficult and expensive to obtain foreign ex-

change. The procedure involves advance payment followed by long waits for foreign currency transactions, for the dispatch of the goods and for shipping. This means capital is unproductively tied up for long periods, and at a time of high interest rates, this is expensive.

The major customers of Northland are the cooperative unions, which buy large quantities of plows. Other organizations, projects and customers may also purchase direct from the company. Northland noted that transport costs could be reduced if the provincial or district cooperative unions were to establish assembly units. Damage in transit would also be reduced, if implements were sold in kit form. Northland did not itself wish to establish such subsidiary assembly workshops or agencies. Northland does not generally win export orders, but it once exported a large consignment to Tanzania.

Northland has participated in several national activities relating to animal traction, including shows, seminars and technical committees. It has tried to respond to criticism of its cart and plow made by the MoA Agricultural Engineering Section. It has been in contact with ADP-RDP Magoye in this regard. Apart from this, Northland does not feel that it has received sufficient useful technical feedback from the Ministry of Agriculture. While it has heard many criticisms of poor quality, it does not feel that it has been kept abreast of technical developments in implement design and current farmer requirements.

Northland feels that donor-assisted projects are distorting and undermining the market for animal-

drawn implements in Zambia. They do this both by the dumping of cheap imports and by selectively supporting some manufacturers. The company does not feel threatened by genuine local competition, provided all firms have equal access to donor and government support.

Although Northland regularly receives visits from personnel employed by aid agencies, the only external support it has received is through the SIDA steel importation programme, of which it was the major beneficiary. In 1990, it received 1039 tonnes of steel, including 236 t plow beam steel, 485 t flat bars, 160 t steel plate, 50 t nuts and bolts, 17 t angle iron and 26 t welding electrodes. It was allowed to pay for these in Kwacha, at a highly favourable rate of exchange. [According to Jonsson et al 1991, by March 1991, Northland and other manufacturers had only paid for a small proportion of the steel they had received under the SIDA programme.]

The company did not feel that it needed technical assistance. It would like foreign exchange support to allow it to tool-up for effective production.

Northland provided figures that indicate that in the five years from 1985, it manufactured, in total, approximately 19,000 plows, 4000 ridgers, 3000 cultivators, 2000 harrows and 500 carts. With improved tooling, access to steel and market demand, it feels it could manufacture such quantities annually. Its past and projected production levels were given as follows:

Implement production at Northland Agriculture							
Implement	Annual production					Projected production	
	1985	1986	1987	1988	1989	1990	1991
Plows	6,398	2,819	2,256	1,888	5,704	13,000	20,000
Ridgers	1,384	946	865	391	292	2,500	5,000
Cultivators	493	567	331	1,073	567	3,500	5,000
Harrows	698	114	75	411	664	1,920	5,000
Ox carts	-	108	41	168	153	200	5,000
Value of spares manufactured (in million Kwacha)					1	7	

Source: Northland Engineering quoted by Sindazi (1990)

MDM Engineering, Kitwe

MDM Engineering company started manufacturing agricultural tools and equipment in 1989 and formed an Agricultural Division in 1990. At present this division represents 20% of the company, but it could increase to 50% if markets were secured. It produced 500 steel harrows in 1989, and hoped to increase this to 3000 in 1990. It has started manufac-

turing spare parts for plows (1000 each of some items), but it is unlikely to start production of complete plows in the near future.

MDM developed a prototype toolbar with cultivator tines. [Initial tests have suggested several design problems.] MDM has marketed its products mainly through the ZCF Commercial Services Division, although it also encouraged direct sales. The company

felt its production levels were initially constrained by lack of raw materials and foreign exchange restrictions. However, MDM Engineering benefited from the receipt of 92 tonnes of steel imported under the SIDA-supported steel scheme.

SKF Zambia Limited, Kitwe

SKF Zambia Limited provides engineering services to the mining industry, with specialization in the supply of bearings for conveyors and other machines. Its multinational parent company, based in Sweden, has an international reputation in the manufacture of bearings. SKF Zambia had no business connections with agriculture, but during the mid-1980s, it heard that several donor-assisted projects had tried to develop ox-drawn carts. Many of these carts had had problems with bearings made of wood, bronze or PVC. Therefore, SKF undertook the development of a stub axle specifically designed for ox carts.

SKF developed a stub axle with locally-forged hub fitted with a double row of ball bearings. The bearings were those used on a popular small car in Europe. The hubs could take Landrover wheels, and could be easily modified for other types and sizes of rims. In 1988, 576 hub units were made, and a further 409 were made in 1989. The company made about 800 hub units in 1990, and by 1991 had produced a total of around 2000 complete axles. It anticipated producing 3000 per year thereafter, subject to market demand.

SKF has advertised its products and sells them to provincial cooperative unions, projects and manufacturers. Several workshops in different parts of the country have made carts with SKF hubs. Among cart manufacturers that have used SKF hubs are Power Equipment, Foxy Metal, Turning and Metals and Muzama Crafts.

The reception of the SKF axle has been mixed. Some axles have reported to be working well, but some have seized and some have worn rapidly.

[The Magoye ADP-RDP tested several carts that used the SKF axle, both on-station and on-farm. All carts failed the tests, for various reasons, and although some axles survived the tests, several did not. Some axles were reported poorly assembled and the dust seals were generally inadequate. A more serious problem was signs of internal damage that implied the bearing units were not strong enough for their task. The most serious design "fault", noted by

ADR-RDP Magoye and some manufacturers, was that the stub axles were factory-sealed units, and could not be easily repaired or replaced in the event of problems. Repair was impossible at village level, and even Magoye ADP-RDP could not repair damaged bearings. Thus the stub axles were effectively expensive "disposable" items: many worked well, but those that failed were unrepairable (Dogger, 1990).]

SKF has been assessing the various reports it has received, but considered that most feedback has been very encouraging. It had doubts about the ADP-RDP testing procedures and conditions. Nevertheless, SKF decided to develop a new design of stub axle, which would take a tapered roller bearing, similar to those used in ox carts elsewhere. This new design is likely to be ready for testing in mid-1991.

Two donor-assisted attempts were made to assist SKF in its ox cart axle initiative, but neither proved particularly helpful. In 1988, a project was drawn up whereby SKF would receive foreign exchange support from Dutch aid, in order to import the bearings and materials for making the hub units. However, due to Dutch doubts as to the acceptability of the hub design, the first shipment of bearings supplied under this project only arrived in Kitwe in March 1991. This consignment, sufficient for the production of around 1200 axles of the old design, arrived when SKF was already working on its new design. SKF had also been offered assistance through the SIDA-supported steel importation project. Due to difficulties in obtaining suitable steel in Zimbabwe, by mid-1991, SKF had not yet received the ten tonnes of steel it had requested.

Gilmer Engineering and CODECO

Gilmer Engineering and CODECO are both "jobbing" engineering companies serving the mining industry. They are ready to manufacture any product, if they are provided with technical drawings and a firm order. During the 1989/90 agricultural season Gilmer started to manufacture prototype harrows. A total of 40 harrows were made, but the company found them difficult to sell. Gilmer would like to produce more implements for the agricultural sector, but it is unlikely to expand in this direction unless it is assured of a market outlet. CODECO made some spiked hoes, but is unlikely but it seems unlikely to take further agricultural initiatives in the near future.

North Western Province

Ministry of Agriculture

The MoA provincial headquarters are based in Solwezi, in the north east of the province. Most of the animal traction is in the west of the province, in the area of operation of NWIRDP. MoA staff reported that there were 52,000 cattle in the province, most of which were in the Zambezi and Mwinilunga districts. There were estimated to be about 1800 trained oxen, most of which were in the Zambezi and Kabompo Districts (Mukuka, 1990). [More recent survey data suggests the figure may be 2100 trained oxen]. Animal traction is increasing in the province, and, consequently, so is the demand for oxen. Some animals are trained at Farm Training Centres (FTCs) with the help of MoA ox-trainers. In the 1989/90 season, MoA trained 23 farmers in the Solwezi area in the use and management of oxen. NWCU also conducted some ox training courses in conjunction with MoA.

The provincial MoA staff reported that there are 500 artisanal blacksmiths in the province. These are mainly farmer/artisans with few facilities. The MoA agricultural engineers intend to provide technical support to these people, and initially four artisans per district have been identified for assistance.

The PAE reported that demand for implements is not very high in the province. Farmers are not adopting animal traction due to the lack of available steers. Plows supplied by Lenco are said to be readily available through the NWCU, but farmers have complained that they are not appropriate. No other

animal-drawn implements are said to be available from the NWCU (Mukuka, 1990).

A recent report (Strahl, 1990) considered that the Agricultural Engineering Service in the province lacked staff, resources and professional supervision, and that moral was low. In relation to the provincial animal traction programme, the report complained of poorly-trained staff, excessive prices for oxen and implements, lack of coordination between donors and institutions, unrealistic targets and unreliable data. It also complained of MoA administrative procedures, lack of supervision from MoA headquarters and lack of feedback on the submitted provincial reports. The report called for more emphasis on promotion of cattle breeding by local farmers to make animal traction sustainable. It also called for more support to village artisans, which were essential for maintaining and repairing implements (Strahl, 1990).

The veterinary department considers that support to animal traction is an important aspect of its work in the province. It manages revolving funds for the purchase and resale of drugs, and these are supported by IFAD and IRDP. Cattle are free to move in the province, except close to the Angola border, where contagious bovine pleuropneumonia (CBPP) and haemaerhagic septicaemia (HS) are prevalent.

Integrated Rural Development Project

The Integrated Rural Development Project (IRDP) of the North Western Province, with headquarters in



Kabompo, has been operating in the Zambezi, Kabompo and Mufumbwe Districts since 1977. It has received considerable financial and technical support from GTZ. In the interests of long-term sustainability, the project itself is now phasing out, with its activities being taken over by other organizations. The animal traction work has been implemented by the NWCU since 1987.

IRDP Kabompo reported that about 600 pairs of oxen had been introduced in its working area between 1983 and 1990. In addition, loans had been given for the purchase of implements by farmers who already owned animals, or who could obtain them. About one quarter of farmers that were growing cash crops in the project area were using oxen. In 1989, about 37% of the area planted with maize or other cash crops was plowed with oxen (IRDP-NWP, 1990). Ox transport had been widely adopted, and over half the marketed maize was being carried to the NWCU in ox carts. The project believed that there were now sufficient ox carts to transport the maize harvest, and so it was restricting the provision of ox cart loans.

The work oxen activities of IRDP are widely seen as successful, and they have been the subject of many studies, carried out by project staff, GTZ and Berlin University. An early evaluation study highlighted that oxen-using farmers were increasing their areas of cultivation (Mack, 1984). Sommer (1987) agreed with this, but suggested that while farmers might achieve an early increase in area as high as 50%, this might later be reduced, so that, in the longer term, a 20% increase might be sustained.

Studies have stressed the very positive effect the project has had on the project area. The provision, by farmers, of hire services for ox plowing and animal-drawn transport has been beneficial to rural communities (Börgel, Fischer and Holler, 1989). Women have benefited from being able to hire plowing teams and ox carts, but few have been able to own them themselves (Beck and Dörlöchter, 1987). Other studies on the animal traction component of the project included those of Löffler (1987), Smotzok (1988 and undated) and Soko (1990).

The project has not been without its problems. It took several years to develop a suitable ox cart, and attempts to use PVC bearings had proved a significant failure. The project had intended to assist in the supply of animals through the creation of a cattle breeding unit, under the Zambezi District Council. This aspect of the project has had little impact and most oxen derive from the private sector. Nevertheless, on the positive side, the project believes its oxenization programme has contributed substantially to an increase in cropped area and the production of

maize. It has also helped marketing through its ox cart programme. It attributes its long term success to an appropriate programme, gradually developed over many years, and to a suitable environment. Conditions favouring oxenization included a suitable climate, little animal disease, nearby availability of animals and underutilized dambo grazing areas.

Kabukafu Cattle Breeding Unit

Kabukafu Cattle Breeding Unit (KCFU), located in the southeast in Kasempa District, was started in 1976. This unit was set up to provide a reliable and inexpensive source of work oxen to emergent farmers in the district. Once the herd had grown to 140 breeding cows, it was intended to supply heifers as well. In 1986, it was estimated that cattle population at KCBU was 234, including three oxen and 44 steers. The unit had hoped to have produced 362 steers between 1986 and 1990. This was not achieved due to slow herd growth, limited government funding and financial procedures that prevented revenue from cattle sales being retained and reinvested. The Dutch development agency, SNV, was considering support for the revitalising and upgrading of the unit, to enable it to supply and train at least 50 steers per annum. There were problems over KCFU's pricing policy (it was selling animals at a fraction of their commercial rate) and its lack of revolving fund. Consequently the proposal has yet to be implemented.

Provincial Planning Unit

In 1988, the Provincial Planning Unit organized a workshop to plan the provincial work oxen programme. This brought together many people involved in animal traction at district, provincial and national level. One aim was to allow the areas of new introduction in the east of the province to gain from the experience of the western districts. It was hoped that the benefits of ox transportation could be brought to the eastern districts. A report of the meeting and its conclusions was circulated (PPU, 1989).

Credit institutions

Ox loan packages have been available through NWCU with funds provided by ZCF/FS, IFAD (ADP area), GTZ (IRDP area) and SNV (Zambezi District). By 1988, IRDP (GTZ) had provided loans for 482 pairs of oxen while ADP (IFAD) and ZFC/FS gave out 30 and 34 pairs respectively. The Lima Bank financed five pairs of oxen in 1988, and approve ox loans for nine farmers in 1989. In 1989, SNV provided funds to the Zambezi Agricultural Project to assist 30-40 farmers with pairs of oxen.



Implement supply

The NWCU is responsible for purchasing and distribution of animal-drawn implements and spare parts. NWCU obtains the implements, mainly plows, from Northland Engineering and Lenco. It was reported, by the PAE, that NWCU distribution of spare parts within the province was not related to actual demand.

Manufacturers

Muzama Craft Limited is the main manufacturer of ox carts in the province. It has workshops situated at Manyinga (20 km from Kabompo), Zambezi and Mufumbwe. Muzama was established with assistance from the IRDP, and has been the main supplier of ox carts to the work oxen programme. It is also supported by SNV.

The workshop has tried many cart designs, including ones with wooden wheels and with bearings made from PVC, bronze and wood. It has now standardized on carts with imported axles using roller bearings and pneumatic tyres. The wooden bodies are fabricated from local timber, but most (over 90%) of the manufacturing cost of the cart relate to the costs of purchasing and transporting the axles and tyres.

Manyinga workshop has a capacity of about 20 ox carts per month, while 10 carts can be built at Zambezi workshop. It was felt that production of the carts at the central workshops would assist quality control. However, the cost of distributing fully manufactured Muzama to all districts in the province were high. It was therefore recommended, in 1989, that ox cart production be decentralised as far as possible. Manufacture/assembly was due to start in the Nyangombi and Jiwundu settlement schemes.

Farmers contacted

One young farmer contacted near Kabompo was plowing with small, young oxen in a field with many stumps. It was his first year of using animal traction. He had purchased and trained his animals himself, without project assistance. His Northland plow had been bought from the Cooperative Union. He had tried to obtain an ox cart loan, but had been told that this would be unlikely. He anticipated increasing his area, and would be plowing for other farmers as well.

Several cart-using farmers were contacted near Kabompo. They had obtained their carts through the IRDP/NWCU. All considered their carts to be very profitable, and all were used several times a week. One farmer, who was seen selling his tomatoes directly from his cart, had that morning come in several kilometres from his farm. He had been able to increase his production greatly now that he had a means to market the tomatoes easily.

One farmer in Kasempa District had started using oxen with his brother. He had recently retired, and had come to settle in the province. He had not received assistance, but had managed to purchase oxen and implements. There were few cattle in the area, and no nearby farmers using animal traction, but he had started plowing for neighbours, and several people had expressed interest in animal traction. A big problem was marketing the produce of the farm.

Western Province

Ministry of Agriculture, Mongu

The MoA reported that the use of animal traction for sledge transportation and crop cultivation and has had a long history in the Western Province. Although animal traction is widespread, animals are seldom employed intensively. In many parts of the province, crop production is not the major economic activity for rural communities. Cattle herding, fishing and forest exploitation are often of more importance to people, and crop production is primarily for family subsistence requirements. Much land is only marginal for crop production due to several factors including (in different areas) poor soils, limited rainfall and seasonal flooding.

Some, but not all, ethnic groups have a long history of cattle keeping. About 550,000 cattle are owned, of which 87,000 are oxen and tollies. Only about 50,000 of the oxen in the province are trained for work. The others are retained as a source of wealth. Within the province the social and geographical distribution of cattle is highly skewed, and the many farmers do not own cattle. Nevertheless, the majority of fields are cultivated using oxen. Traditional systems of loan and hire operate for farmers who do not have their own oxen. The families who hire or borrow oxen are at a disadvantage, as their fields are generally plowed later than those of ox-owners. Although about 35% of households are female headed, few female farmers own cattle or oxen. Village transport is important. Ox carts are expensive and scarce. Farmers generally use traditional sledges, pulled by two, four or six oxen.

On a provincial basis, the availability of draft animals is not a problem, but there are local shortages. Cattle and oxen are least common in the maize-growing Kaoma District. This area is considered by MoA to be of relatively high agricultural potential.

The farmers in Kaoma are more oriented to crop production than elsewhere in the Western Province. Kaoma district has relatively little grazing land, and MoA advises farmers to give supplements, such as crop residues and maize bran, to their working animals.

Oxen are commonly worked in teams of four, or even six. In most of the province, farmers train their oxen themselves and there is no need of ox-trainers. Standards of training are often low for animals that are only used occasionally for plowing, but animals that regularly pull sledges are generally well trained. In areas of introduction, such as Kaoma, training services may be required by farmers unfamiliar with animal traction.

It was reported that the river valleys south of Mongu, such as the Lui River Valley, have a high potential for rice production. MoA staff expect an expansion of the area used for rice production. Animal traction is expected to play an important role in this.

It was reported that the Forestry Department had carried out some investigations into the use of animal traction. Shallow plowing was found to have given better yields than deep plowing. This was possibly due to the resulting depth of manure placement. Cultivators were considered as an alternative to plows. Five cultivators were purchased for evaluation, but their quality was poor, and spares were not available. Plowing was found superior to tine tillage for suppression of weed growth.

The MoA Women's Extension Programme and the Peoples Participation Project have been involved in training women in ox-handling. Traditionally, women do not handle oxen. Most of the women who had been trained did not continue to work with oxen. Instead they assigned a male relative to plow



with the oxen. Women have more problems in obtaining a loan than men as they have less collateral. [The ADP-WP has other experience of the training women for animal traction, as mentioned below].

A provincial ADP steering committee has not been established. Some MoA officers consider that it would be superfluous since there are already other technical committees including a livestock development committee. One suggestion was to organize a ADP technical committee under the Provincial Crop and Livestock Committee, but there are no immediate plans for this.

MoA has several development projects that include work on animal traction issues in the Western Province. Most of them are supported by The Netherlands. They include the Western Province ADP Project, the Adaptive Research Planning Team, the Livestock Improvement Project and the Masese, Kalabo and Senanga Agricultural Projects.

Western Province ADP Project

The Western Province ADP Project (ADP-WP) of MoA started in 1989, with support from The Netherlands. The Project has an expatriate Technical Adviser, who is counterpart to the Provincial ADP Coordinator (the PAE). The ADP-WP aims to coordinate ADP activities in the province, and to strengthen ADP infrastructure at provincial and district levels.

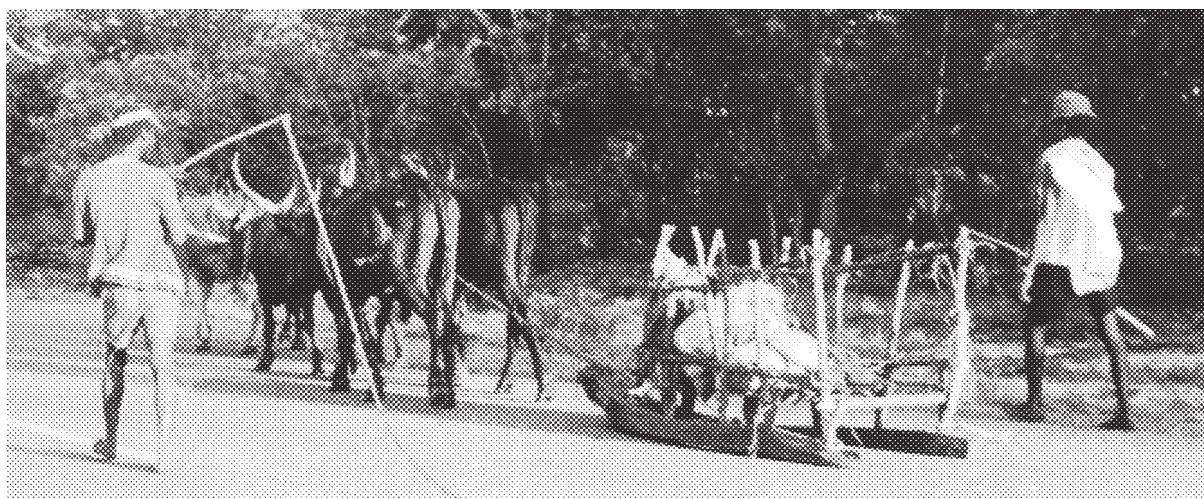
The training programme, which accounts for about two thirds of project activities, has been largely based on the earlier experiences of the Looma Oxen Supply and Training Centre. The ADP-WP has been attempting to carry out ADP training and extension functions in all districts. This has stretched its resources considerably.

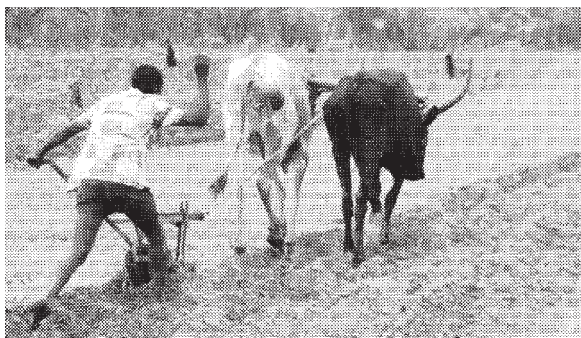
The project initially concentrated on residential training courses at Looma. These were designed for

small numbers of extension workers, farmers, carpenters and veterinary assistants from various districts. The courses covered ox-training, implement utilization and yoke-making. As attendance at courses was sometimes disappointing, greater emphasis has been placed on mobile training. About 20 mobile courses, demonstrations and field days were conducted during the 1989/90 season.

It was observed that extension staff in Mongu District who had been trained in animal traction were not effective in passing on their knowledge to farmers. Courses for contact farmers themselves were considered more effective. About 24% of farmers trained have been women farmers. A survey has been carried out to assess the impact of the training. This concluded that training was beneficial, particularly for those with easy access to oxen who could readily apply the skills taught. Women were worried by lack of basic knowledge and skills in handling animals and fixing yokes, and the courses gave them confidence in these areas. Single women appeared more likely to make use of practical skills in animal traction than married women (Hocking, 1991).

The ADP-WP has been involved in a number of other animal traction activities in the province. It has funded the animal traction revolving fund of KADICU, and assisted WPCU in obtaining oxen and implements for sale to farmers. The project commissioned a staff member of UNZA to undertake a study of blacksmiths in 1990. The project has provided funding for the two mobile ox hiring units that are based at Looma. ADP-WP has also cooperated with ADP-RDP and the Adaptive Research Planning Team in trials of animal traction equipment and techniques. Despite such liaison, the project reported that coordination of animal traction programmes in the province was difficult to achieve, since no formal or regular contacts exist between the





ADP-WP programme and various departments and institutions involved with animal traction.

Department of Veterinary Services

The Department of Veterinary and Tsetse Control Services (DVTCS) reported that disease was not a serious constraint to animal traction in the Western Province. Calf mortality could be high, but once animals had survived to the age when training for work could start, their chances of further survival was high. Trypanosomiasis was a constraint in some areas. The cattle population in the province was steadily increasing, and it was thought that it would stabilize at about one million.

A retail scheme for veterinary requisites such as tick grease and healing oil will be set up in collaboration with the WPCU. To keep the revolving fund operational, the drugs will be sold at replacement prices, and these will be frequently adjusted for inflation.

Animals exported from the Western Province (except Kaoma), had to be slaughtered within 24 hours, in order to stop the spread of contagious bovine pleuropneumonia (CBPP). This meant that the cattle trade was controlled by butchers, and it was difficult to establish a new trade in young oxen for use as work animals work.

The DVTCS is responsible for a livestock development project, funded by The Netherlands. This includes a Socio-Economic Analysis Team (SEAT). SEAT noted that cattle have many roles, and one of their main functions is as a bank. Women seldom handled animals. In some areas up to 30% of animals were owned by women, but they were generally kept in the kraal of a male relative. Women find it difficult to obtain credit for buying oxen and plows. Some farmers who had no animals would buy a plow, as it made it easier to borrow oxen. Socioeconomic studies relating to cattle ownership and use (including aspects of animal traction) have been

published by DVTCS, and these include two by Beerling (1986 and undated).

Looma Oxen Supply and Training Centre

The Looma Oxen Supply and Training Centre in Mongu District is a provincial MoA training centre for animal traction courses. It has been operating since 1982, under the auspices of a series of projects. It is currently funded by the ADP-WP. It conducts refresher courses for extension staff, veterinary assistants, contact farmers and cattle buyers.

Following the practice of the earlier Looma project, the Centre still has two small ox-hiring units. Although they achieve some income, they are not fully self-supporting. The argument for their retention has been that they have demonstrated techniques and levels of training. Traditional forms of ox-hiring are widespread in the area, but support may be given by ADP-WP to entrepreneurial farmers who want to start private ox-hiring units in Kalabo and Kaoma Districts.

The Looma centre developed a design of withers yoke in which the point of contact had been shaped into a curve. This yoke has been promoted, and carpenters have been trained to make it. Farmers are said to appreciate them, and small numbers have been sold by Looma and carpenters. However there is little evidence of wide diffusion.

Adaptive Research Planning Team

Since 1988 the Adaptive Research Planning Team (ARPT) has worked on animal traction topics in two areas; Senanga West and Kaoma District. ARPT is supported by the Royal Tropical Institute (KIT) of The Netherlands, and the team includes expatriates.

In Senanga West, the team found that about 90% of household use animal traction, mainly for plowing and sledge-pulling. As the ownership of cattle is very skewed, the majority of farmers borrow or hire oxen. About 25-30% of households were headed by women. These households generally had more difficulty in obtaining adequate draft power, since women generally owned fewer animals than men, and seldom worked with animals, themselves. ARPT considered that the efficiency of animal traction in Senanga West could best be improved by greater daily and monthly use of animals, working of animals as pairs rather than fours, better kraaling and earlier training of oxen (Vierstra, 1990).

In the wetland farming systems, ARPT found great variation in the ownership and use of oxen. In one flood plain area (Liagati) 50% of farmers had oxen and 35% had both plow and oxen. In one dambo area (Mumbwana) 5% of farmers owned oxen, and

10% of farmers owned plows. Male headed households were more likely to own oxen and plows than female headed households. Access to oxen was important for rice production, and this was thought to explain why 70% of male headed households produced rice in Litawa, in comparison with 30% of female headed households (Dicko and Heemskerk, 1990).

The farming systems of Kaoma District are generally based on maize cultivation. ARPT reported that oxen were the main power source, cultivating over 65% of cropped land in the "system" (small scale commercial farmers with maize-based crop production). However, only 25% of farmers owned animals. Oxen-using farmers could plant 2-3 ha of maize, but only 0.6-0.75 ha if they cultivated by hand (Muwamba, 1989). Shortage of animals were serious and resulted in high hiring fees and late planting for many hirers. The ARPT had tried to introduce a jab planter, but this proved inappropriate (Muwamba, 1990).

Trials were carried out with Lenco and Northland plows. The Lenco plows were found to be too heavy for most farming systems, but they could be used for dry season plowing (Vierstra, 1990; Muwamba, 1990). Design and manufacturing faults were noted with both plow types. Farmers preferred the Northland plows. The larger size of the Lenco plow, made it unsuitable for the traditional system of hand-seeding every three furrows (Muwamba, 1990). ARPT noted that at least 90% of farmers removed the hake from the Northland plows, but it advised them not to do so.

ARPT has carried out various on-station and on-farm "research" studies on draft animal management, plowing practices, work output, yoking and supplementary feeding of oxen. Comparisons were made of the effect on work output of different numbers of animals plowing in a field at the same time (Dicko and Mwandira, 1989). If two teams of animals were plowing in a field, this appeared to stimulate work output (a competition effect of the animals or their handlers). However, if one team was significantly weaker than the other, the stronger team reduced its work rate to that of the weaker team. If more than two teams worked at the same time, work output per team decreased (presumably an effect of congestion).

Another ARPT trial attempted to assess the working abilities of oxen, cows and donkeys: apparently this demonstrated that oxen are stronger than donkeys, and oxen stronger than cows. ARPT has initiated a supplementary feeding trial in Kaoma District. One trial demonstrated that oxen receiving supplementary rations grew better than those that did not (but the



growth of the unsupplemented animals was found to be satisfactory the year of the trials). ARPT recommended that more training was required in selection, training, cattle management and yoking. ARPT is hoping to find a means to improve planting depth of maize following animal-drawn plowing.

Land and Water Management Project

The Land and Water Management Project (LWMP) has identified the Lui River Valley as being of high potential for rice production. Farmers use oxen for rice cultivation, but have difficulties in obtaining implements, spares and animals. LWMP considers present production is limited by poor marketing facilities and insufficient animal draft power. A development initiative has been proposed that would improve the marketing infrastructure, and assist farmers to obtain oxen and plows (MoA, 1991).

Masese Agricultural Project

The Masese Agricultural Project, supported by SNV of The Netherlands, is a small project trying to stimulate development in Sesheke, in the southern part of the Western Province. Soils are poor, yields are low, and profitability is marginal. Most farmers use animal traction. There are four main types of users: owner, sharers, borrowers and hirers. Sledge transport is widespread, but farmers seldom make more than one trip per week with their sledges. Carts are rare as few farmers could afford them, and the local tracks are sandy and narrow. Animals tend to be poorly trained.

The project has cooperated with ADP-RDP, Magoye, in the assessment of implements and carts. First impressions were that a simple, lightweight plow and a lightweight ridger would be an appropriate combination of implements.

Cooperative Union

The Western Province Cooperative Union (WPCU) has stocked plows in Mongu, but not ridgers, har-

rows and cultivators. Few spare parts have been available. The Union is afraid to tie up money for implements that may not be sold. At one time, projects in the Western Province linked loans to the provision of the Rumpstad/Lenco plows. Despite this, few of these plows were disseminated, as farmers judged them too heavy, and were concerned that spare parts were unavailable.

The WPCU Cattle Development Section is one of the 23 cattle buyers in Western Province. In total 23,931 animals were sold in 1989 (15,659 animals sold outside the province and 8272 slaughtered within the province). It was reported that the Section had about 10% of the market in 1989. It buys oxen for resale to farmers, and can buy 300-400 young oxen per year. If all cattle buyers differentiated between suitable work oxen and ordinary meat animals, it was estimated that 3000-4000 work oxen could be bought and sold annually.

KADICU

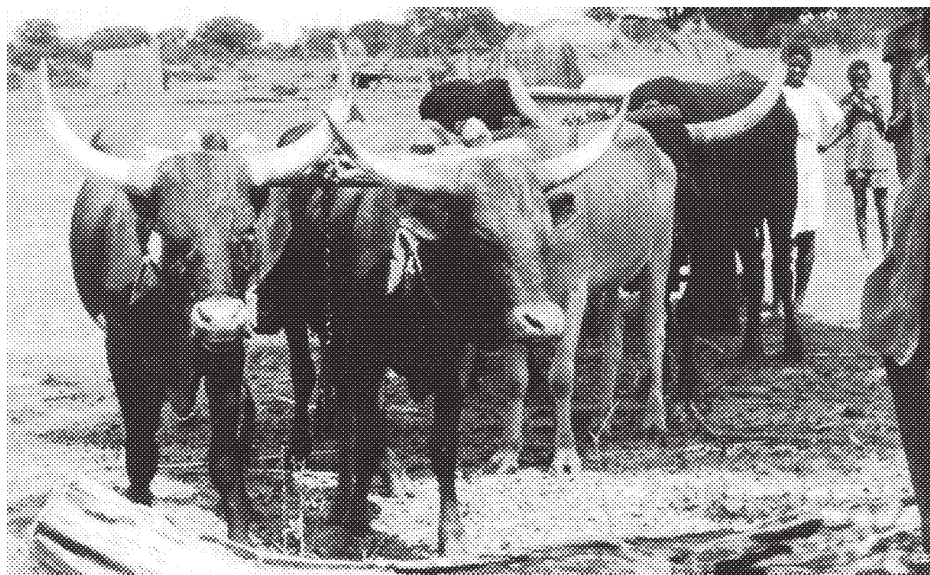
The Kaoma District Cooperative Union (KADICU) has established an animal traction revolving fund, with assistance from ADP-WP, supported by The Netherlands. It is designed to enable KADICU to purchase implements, spares and oxen for sale to farmers in the District. The revolving fund was created in December 1990 with an initial capital of K1.1 million. The fund is intended to allow the KADICU to purchase consignments of oxen from Mongu, and implements and spares from Lusaka and the Copperbelt. Decisions on what items to purchase are made by KADICU, in consultation with the DAE and ADP-WP. In order to make the fund sustainable, given the high level of inflation, implements and animals are due to be sold at replacement cost. Whether KADICU will be able to monitor

price movements and increase its own charges rapidly and regularly has yet to be determined.

Lima Bank and ZCF/FS

The Lima Bank at Mongu has been giving medium term loans for oxen and implements. The interest rate in late 1990 was 39%. Most loans are given to rice growers as they generally have some form of security for the loans. The supply of oxen has been a limiting factor and the WPCU Cattle Development Section has not been able to meet the demand. Repayment has been unsatisfactory because the production during last season was low and many loans have had to be rescheduled. Applications for loans for ox carts loans will be considered positively, however the carts themselves are in short supply.

It was reported that the ZCF/FS had no money for medium-term loans for animal traction in the Western Province.



Southern Province

Ministry of Agriculture

The Ministry of Agriculture staff reported that work oxen were widely used in the province. Although animal traction was well established, there was need to improve the:

- maintenance of animal-drawn implements;
- health and nutrition of the animals;
- training of oxen.

The most urgent need was to improve support to blacksmiths and village artisans. There were problems with animal health, insufficient veterinary supplies and the cost of dipping. Animal nutrition was poor due to over-grazing and lack of conservation of fodder. The traditional system of training and yoking differed from that recommended by the Palabana Animal Draft Power training course, and so should be improved (Chikwanda, 1990).

Four extension workers had recently been trained in animal traction at Palabana. MoA staff thought that oxen trainers were desirable to improve the standards of animal traction. The figure of two per district, as recommended in the 1985 Investment Plan, still seemed appropriate (Chikwanda, 1990). A detailed proposal to support animal traction in the

province within the context of a mixed farming project had been prepared for the consideration of The Netherlands aid programme (Anon, undated). It had not been accepted.

There was currently no donor-support for the provincial MoA staff to carry out activities relating to animal traction. Transport and resources were severely limited. Lack of transport and inputs had been cited as the reason for not surveying ox-trainers and farm implements in use 1988 (MoA-SP, 1988). The same reasons were given for the inability of the MoA staff to complete the 1990 animal traction survey on schedule.

A provincial Animal Draft Power steering committee had been established and had met twice to assign specific tasks. People had seemed interested and motivated, but there has been no report circulated or follow-up. There were some suggestions of inadequate information flow between the various organizations involved in animal traction at district, provincial and national level.

MoA had been involved in surveys relating to artisans and staff reported that there were 320 blacksmiths, 350 carpenters and 25 welders in the province. These artisans had no external support and mainly used simple tools and scrap materials. This meant that the implement repair and maintenance service available to farmers was limited. Many plows were in need of repair. The wheels on the plows from Zimbabwe wore rapidly. MoA is hoping to start a blacksmith training and support programme.

Department of Veterinary and Tsetse Control Services

The PVO reported that the cattle population had been increasing at 1% per year, but, since 1987 there had been a decline in cattle population. The decline was more marked in the traditional sector that accounts for 78% of the provincial herd. The major problem had been the tick-borne "corridor disease". The treatment for this is very expensive, and work on a form of vaccine is still being undertaken. The disease can be controlled by dipping. As most mortality occurs in January and February, weekly dipping is recommended from November to March.

Until 1986, dipping was free and many farmers dipped their animals. In 1987, a dipping fee of K0.50 per animal was introduced. Although farmers



complained to this charge, they continued dipping the animals. When the fee rose to K1.00 in 1988, then K5.00 in 1989, farmers felt that it was too expensive to continue dipping and many stopped. One problem is that cattle in herds may be owned by several people, and some may be lent. It may be difficult for herders to disperse cash on behalf of other peoples' cattle.

For most other diseases, vaccines were available, and these were being administered with support from the EC. Resources to the veterinary department were considered to be a limiting factor, particularly as animal population in the province was so large.

Animal traction survey

In 1989, a survey of animal traction in the Southern Province was organized by the national Animal Draft Power Coordinator Project. This involved questioning 224 farming households, 52 extension workers and 51 artisans in six of the districts of the province (Livingstone was excluded). The report (Tembo and Rajeswaran, 1989) provided some data relating to work animals and implements owned. While it would be unwise to extrapolate from these survey figures to the whole province, the survey did provide some examples of animal traction use in the Southern Province. The survey authors estimated that about three quarters of the 180,000 cultivated hectares in the province were plowed by oxen (Tembo and Rajeswaran, 1989).

It was estimated that in the years 1986, 1987 and 1988 the numbers of plows entering the province were 4,400, 2,500 and 4,400 respectively. In addition there were smaller numbers of ridgers (50, 25, 103), cultivators (15, 122, 210), harrows (10, 6, 812) and planters (0, 2, 0). The authors considered this was well below the market demand (Tembo and Rajeswaran, 1989).

Of the surveyed farmers, 90% owned work oxen and 27% reported hiring in oxen, while 6% reported hiring tractors. About 90% of farmers owned a plow, 53% a cultivator, 48% a harrow, 20% a ridger, 7% a seeder and 45% an ox cart. Ownership of plows was high in all districts, but for other equipment it was lowest in Gwembe and highest in Mazabuka (where 93% of farmers surveyed had an ox cart).

The survey found the average cultivated area in the districts was 7-10 ha, that 81% of farmers surveyed owned cattle (ranging from 62% in Choma to 91% in Kaloma and Namwala). Of the farmers surveyed, 63% used dips and 20% used sprays to control ticks. Only 10% of farmers provided supplementary feed, and all these were associated with the Small Scale Dairy Development Project which encouraged the use of a maize bran, molasses and cotton seed sup-

plement (Tembo and Rajeswaran, 1989). [In quoting the findings of this survey, the authors of this current report would like to stress that the sample size was small and the household selection procedure was not randomized. Thus while the statistics are of interest, they do not necessarily represent an accurate assessment of the animal traction in the province as a whole.]

Donkey survey

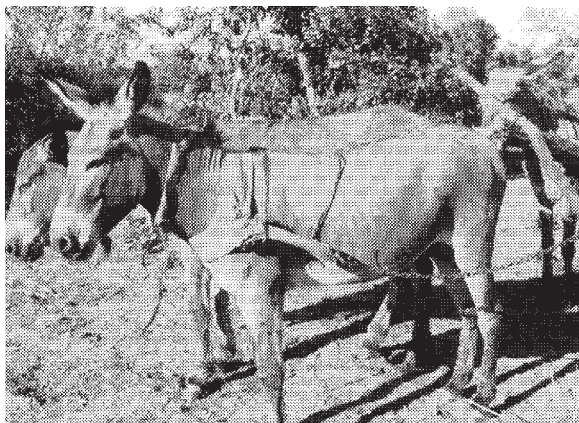
A survey on the use of donkeys in Gwembe South was carried out by the Gossner Mission in association with the national Animal Draft Power Coordinator Project of the Ministry of Agriculture. The survey (Luig and Chimimba, 1989) involved the questioning of 40 randomly-selected farmers in three areas where donkeys were widely used.

All farmers questioned owned donkeys, and some had owned donkeys prior to 1960. There was an average of 3.7 donkeys per household, and all households owned work oxen as well (average 5.1 oxen). It appeared that the donkey population was declining (the farmers reported owning a total of 230 in 1987, but only 148 in 1989). The birthrate (10% a year, births relative to total population) had not kept pace with the deaths. Most deaths were caused by other farmers who had found the donkeys in their fields. Therefore, 95% of the donkeys were herded (mainly by children) and only 30% were allowed to free-range even in the dry season. They were generally herded with the farmers' cattle. Most farmers reported castrating all males except one breeding jack, but they also frequently used males from other farmers for breeding (Luig and Chimimba, 1989).

Farmers considered the breeding performance of donkeys to be similar to that of cattle. About half reported that donkeys foaled every year, and half every two years. Farmers reported few management problems or sickness: the main problem was simply herding the animals when they were not being used.

Donkeys were mainly used as pack animals and travelled long distances to market towns. Almost all (38 out of 40) farmers reported travelling with their donkeys to Kabanga, about 65 km away. Three farmers reported travelling to Livingstone, a return trip of over 500 km. One farmer reported bringing a plow back from Livingstone on his donkey. Loads were generally about 50 kg per donkey (two 25 kg bags of mealie meal; three 15 kg tins of maize; one 50 kg bag of fertilizer or salt). Young donkeys only carried half an adult load. All farmers reported that donkeys were used to carry sick people, but none were ridden otherwise.

One quarter of farmers (10 out of 40) used donkeys for plowing, four farmers used them for pulling logs



and three used them for cultivating. Oxen yokes were used for harnessing donkeys for plowing, cultivating and carting. Almost all farmers were aware that some other farmers used donkeys for cultivating or pulling carts. Most did not do so themselves because they had oxen, because they did not have enough donkeys, or because they did not have a suitable cart or harness. Most farmers would have liked to have purchased donkey carts and donkey harnesses. Donkeys were hired out to transport goods, with most fees being K10-K20 per trip, even for far-away places such as Kabanga. Most donkeys were obtained by bartering, and few farmers knew the cash value of a donkey. Most farmers considered donkeys were superior to oxen in ease of training and handling, feeding and resistance to disease; their main problem was that they were more difficult to herd (Luig and Chimimba, 1989).

SPCMU and credit institutions

The Southern Province Cooperative Marketing Union (SPCMU) is responsible for maize marketing. Maize marketing has been a major logistical problem and the Logistic Planning Unit is helping SPCMU to develop effective strategies for future marketing arrangements. In late 1990, there was still grain left from the 87/88 and 88/89 seasons in some depots. Farmers had been paid for this, and according to the Union, most farmers had been paid for the 1990 harvest. [A demonstration by irate farmers during the time of the mission suggested not all had received their money.]

The Southern Province has 80 major depots and some satellite depots. There was growing interest in the potential to use ox carts to bring maize to the depots. Under one system in operation, farmers registered with the union were paid K15 per bag of maize transported from the satellite depots to the

main depots. This would generally be a distance of 7 km. However the satellite depots are due to be closed, and farmers will now be expected to bring maize to the main depots in future. The price of maize will be adjusted to compensate for this, so that ox carts, pick-ups and tractor-trailers delivering maize will receive the same transport cost per bag.

It is envisaged that 8-12 ox carts will be needed to collect maize at each of the 80 depots, so that a major investment in ox carts is envisaged. ZCF Commercial Services has been allocated K4,000,000 to assist cart manufacture, the money coming from Australian aid, channelled through LPU. In 1990 there had been difficulties in obtaining sufficient numbers of carts of acceptable quality from local manufacturers, and little of the money had been spent. The carts will be sold to farmers on credit (Herbig, 1991).

It has also been proposed that at each main depot there should be a workshop run by the primary society. This should be capable of making carts, maintaining carts and plows, and repairing punctures. It might also be appropriate to build a dip tank by each depot. The establishment of these might be supported by SPCMU and the Logistic Planning Unit.

The General Manager of SPCMU stressed the importance of animal traction in the province. Two thirds of the maize in the province was grown using draft animals. Animal health was a major problem now, and the imposition of high dipping fees had made the situation worse. The union was supporting animal traction through loans and the provision of equipment. The farmers preferred plows from Zimbabwe as they were better and cheaper than locally-produced plows. Plows from Malawi were also good. Northland Engineering had made efforts to improve its plows, and had visited the Union on several occasions. Nevertheless its plows were expensive. The Lenco (Rumtstad) plow had been found too heavy. In the future, SPCMU hoped to develop animal traction support centres at its depots, and would be actively encouraging the transport of maize in ox carts.

Some loan packages are available through the SPCMU, using funds provided by ZCF/FS. These packages usually involved the purchase of oxen, plow and trek chain. Lima Bank is reported to have had a programme targeted at benefiting 832 small-scale farmers. In 1988, Lima Bank provided K 209,840 in loans for 207 items of animal traction equipment. In the 1988/89 season Zambia National Commercial Bank provided loans totalling K319,000 to 68 farmers for oxenization. This represented

about 7% of the general purpose loans to small scale farmers in that year.

Integrated Farm Mechanization Development Project

The Integrated Farm Mechanization Project of the SCMU is funded by a grant from the Italian aid programme. It started in 1989 and aims to increase agricultural production through assisting the mechanization of smallholder and emergent farmers.

The project proposal (Motocultura, undated) envisaged the initial importation of Italian two-wheel tractors and Italian animal drawn equipment. The 8,500 animal traction plows and 2,000 ridgers were valued at just over US\$1,000,000 (US\$1,500,000 for initial supply of all animal traction equipment). These were to be distributed to farmers in the Southern province, with back-up provided by Italian Technical Cooperation Staff. Lightweight animal-drawn implements would be selected for use with the local N'Dama cattle. [N'Dama are a dwarf West African breed that do not exist in Zambia]. In the second year of the project as study was planned to assess the demand for animal traction implements and local manufacturing capabilities.

In 1988, the Agricultural Engineering Section of the Department of Agriculture had criticized the project document, pointing out that it had no bearing on the national strategies for mechanization and animal draft power. The project did not appear to take account of other Zambian and aid-donor supported initiatives in this field. Furthermore the project appeared back-to-front, starting with major importation of untested equipment, and following this with studies on what was required (Sindazi, 1988).

Despite the disquiet expressed, the project went ahead as planned. The project imported 8500 Italian plows and 2000 ridger bodies. These are of three different makes (Otma, Nardi and Biagioli). The ridger bodies can be fitted to the plow beam. The plows all weigh about 29 kg, which is light compared with the Safim type plow. These plows will be offered on credit. Since the implements came as a gift, project staff consider that their pricing is entirely arbitrary. In the project document, the plows had been costed at US\$115. At the end of 1990 they were priced at K1275 (about one quarter of their cost, and about one half the price of locally-available plows).

After they had arrived, samples of the plows and ridgers were sent to Magoye for testing. The Nardi and the Biagioli failed the initial on-station test, but the Otma passed. There was some optimism that the ridger would be useful for secondary tillage. By late 1990, few Italian plows had been sold, and they had

not been thoroughly evaluated by farmers. There was some evidence that plow beams were not strong enough for local conditions, and they became badly distorted if they struck obstructions in the soil, such as roots.

The project had also imported 210 Italian two-wheel tractors, complete with implement packages including seeders, hammer mills and trailer carts. These would be sold to farmers for K147,000, with generous credit terms, repayable over a five-year period.

Neither the Italian technical assistance staff, nor the local counterparts, were aware of any pre-project feasibility studies to determine whether the Italian plows and two-wheel tractors were likely to be appropriate in the local farming systems. Apparently the plows had been used "successfully" somewhere in West Africa (possibly Guinea). Project staff were not optimistic about the suitability of the implements supplied.

Implement supply

The major supplier of implements in the province is the Southern Province Cooperative Marketing Union (SPCMU). This union has depots in all districts. It stocks plows, harrows, ridgers and cultivators. SPCMU deals in both locally-manufactured and imported items. Local plows are usually from Northland. A very few plows were bought from Lenco, but the Rumpstad/Lenco plow is yet to be well-established in the province. The imported plows and cultivators are mainly from Zimbabwe. As noted above, there has recently been a very large consignment of 8500 Italian plows through the Integrated Farm Mechanization Development Project.

ZATCO is a private cooperative that has existed since 1927. It has retail outlets in four districts in the Southern Province. It sells animal-drawn implements, which it generally buys from Zimplow in Zimbabwe. These plows have a good reputation for design, quality and price and they are delivered rapidly by rail, often within one week of a letter of credit being issued. In 1989/90, ZATCO imported 1200 plows, 3000 harrows and 5-10 tonnes of spares such as plow wheels, axles, shares, nuts and bolts. ZATCO would order more (2000-3000), but it does not have sufficient capital to meet the Kwacha cost of the foreign exchange. ZATCO had sold about 40 Zimplow double-furrow plows to emergent farmers. The ZATCO officer considered the Northland plow was not popular and was more expensive than the Zimplow, particularly if the price of spares was considered. The Rumpstad/Lenco plow was considered too heavy.

Manufacturers

Private workshops in Mazabuka, Monze and Choma produce ox carts. Most carts are based on parts from scrapped cars and pick-ups. Choma Coach Builders is one such workshop building steel framed ox carts with axles from old vehicles. Another small workshop, Choma Carpentry shop, made 12 ox carts in 1989, and 19 ox carts in 1990. SKF axles were used for a time, but they became too expensive for the price-sensitive farmers. The workshop has therefore reverted to axles from car breakers. The managers of Choma Carpentry shop and Choma coach builders both reported that demand for their ox carts was highly dependent on the success of the harvest and the payments farmers received.

Kaleya Engineering in Mazabuka was created to service Nakambala Sugar Estates in Mazabuka. The workshop has started some repair and maintenance services for the implements of local farmers and it has made some animal-drawn harrows.

Farm visits

One large-scale commercial farmer (Mr. Beckett of Momba Farm, Choma) was using 80 oxen (40 pairs) for on-farm haulage. During peak periods 60 oxen would be working on the farm each day, in shifts. Most pulled two-wheel carts, but some pulled four wheel trailers. Oxen also delivered milk into Choma each day. The use of ox carts was considered more economical and efficient than using a pick-up. Oxen were not now employed for plowing. In the past, eight pairs of oxen had been assigned to plow a field. They would work four pairs at a time, in shifts, with four simple mouldboard plows. The daily productivity of such ox teams was equivalent to, or slightly greater than, the productivity of tractor pulling a three-furrow plow. This farmer was interested in the possibility of using ox-drawn mowers.

Another large-scale farmer near Choma (Mr. Danckwerts) keeps 20-24 oxen to pull his five 4-wheel carts. These are used every day of the year, each cart moving about one tonne of firewood distance of about 10 km. The carts sometimes carry two tonnes, and occasionally as much as five tonnes. Usually one pair of oxen pulls a cart, but with very heavy loads or on sloping ground another pair may help. He did not plow with oxen, although one of his neighbours had just plowed 5 ha of tobacco using oxen. He had recently started to use oxen for tied-ridging. His tractor-pulled ridge-tiers omitted every fourth row. He therefore tied-ridged these missing rows, using an ox-pulled rotating, acentric ridge-tier that he had made himself from an old tractor-pulled version. The operation was effective and had been used on 60 ha of tobacco. He also



used oxen for raking hay. He was interested in the possibilities of animal-drawn herbicide applicators.

Oxen were observed plowing a 5 ha field on a large-scale commercial farm in Kalamo District. Three employees, each with a plow pulled by a pair of animals, plowed around large blocks together. Another employee (a woman) dropped hybrid maize seed behind the last plowman, so that every third furrow was planted.

One farmer near Livingstone was observed using a locally-made two wheel cart made from a Landrover axle. It was pulled by four donkeys fitted with breastband harnesses. This technology, and the farmer, had come from Zimbabwe. The owner earned most of his living from transport. He could earn K900 a day, as the cart could hold 30 bags of charcoal, and he was paid K30 per bag, for distances up to 20 km. He had plowed with two and with four donkeys, but thought such a practice was only common in Zimbabwe.

Another farmer near Magoye was using a two-wheel cart made from an old pick-up. This was pulled by two donkeys, fitted with a withers yoke, like those used with oxen. The system of harnessing looked uncomfortable and inefficient, but had apparently been used effectively almost every day for at least two years.

Magoye Regional Research Station

Work on the testing and development of animal-drawn implements has been undertaken at Magoye Regional Research Station for about twenty-five years. The early work of the Farm Machinery Research Unit (FMRU) was reviewed by Cullen (1988). Cullen reported that many prototype animal traction implements and an ox cart had been developed during the early 1970s by the Intermediate Technology Development Group (ITDG). However,

the impact of the programme had been limited by lack of Zambian counterparts, weak extension and the short duration of the project. There had been few animal traction research and development activities undertaken at Magoye from 1973 to 1986, during which time the position of full-time research engineer was vacant. Some collaborative implement development had been undertaken during 1979-1980, when staff of Magoye had helped Northland Engineering to develop a range of locally-manufactured animal-drawn implements (Cullen, 1988).

The FMRU started to receive technical assistance from the British Overseas Development Administration (ODA) in 1986, with a programme of work that emphasized tractor-based mechanization. The complementary Animal Draft Power Research and Development Project (ADP-RDP), also based at Magoye Regional Research Station, started work in 1987.

Animal Draft Power Research and Development Project

The Animal Draft Power Research and Development Project (ADP-RDP), supported by The Netherlands, is a national project, based at Magoye. Its objective is to promote and support the introduction and local-manufacture of an increased range of animal-drawn implements. These should be of appropriate designs and suitable quality for small-scale and medium-scale farmers. The project also aims to support the development and introduction of improved tillage systems.

To achieve this, its main activities are:

- formulation and implementation of standard testing procedures and the testing of animal-drawn equipment;
- on-station and on-farm tillage systems research;
- on-farm tillage systems demonstrations;
- implement development;
- operation of an animal traction demonstration farm at Magoye (IMAG, 1987).

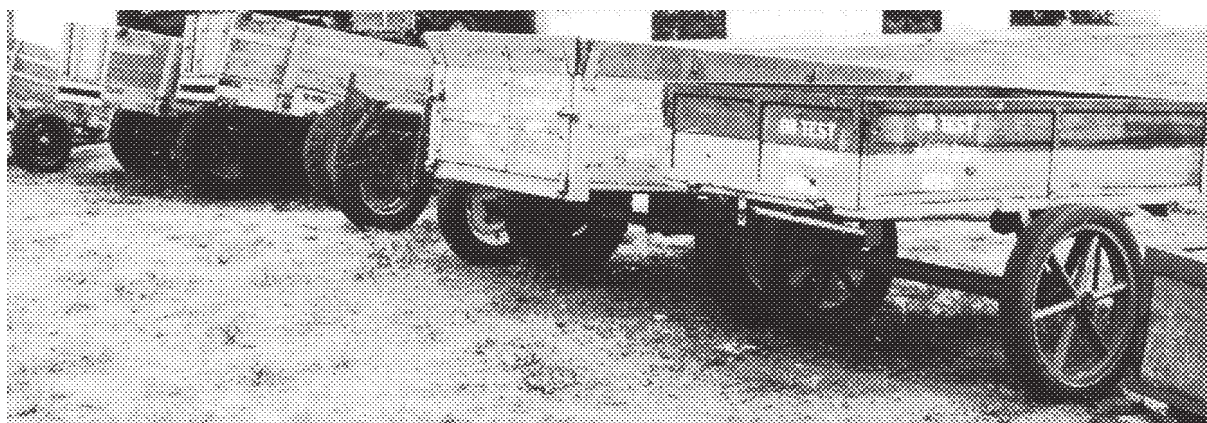
The project has developed Zambian standards for the testing of ox-drawn plows and ox carts and these have been approved by the Zambian Bureau of Standards (ZBS, 1990a and 1990b).

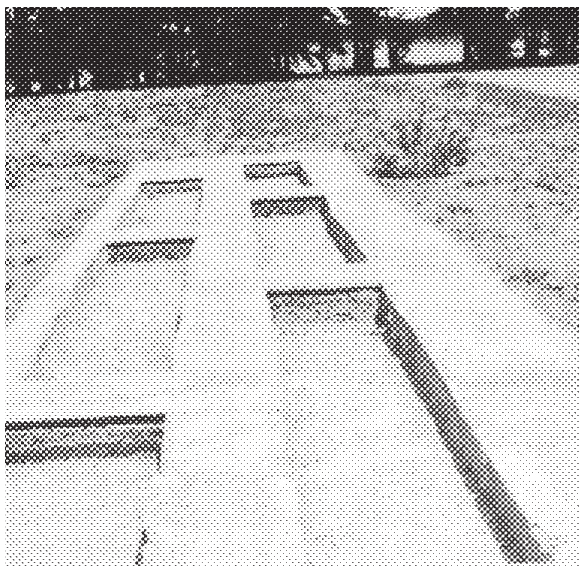
Ox cart tests

The project has tested several ox carts, both on-station and on-farm. To facilitate standardized on-station strength tests, a concrete test track has been made at Magoye. The on-farm testing took place for a minimum of six months in different ecological zones. A group of farmers was arranged in a rotation schedule, and after four weeks, they passed on their cart and received one of a different design. Details were recorded of cart breakdowns and farmer reaction.

The results of tests on 19 designs of ox carts have recently been published (Dogger, 1990). Seven of the carts passed the on-station tests, but only one passed the on-farm testing. This was the cart made by Lenco using imported Italian axles and rims. It was also the most expensive cart. Several carts using the SKF axle passed the on-station tests, but the axles did not generally survive the on-farm tests. It was reported that the wooden block bearings used in the TDAU carts can work very well, provided they are accurately made and fitted. However, the precision required for constructing such axles requires more skill and equipment than is usually available in rural workshops. Thus good wooden bearing blocks are relatively expensive to produce, and poor ones, though cheap, rapidly give problems. Although farmers like the idea of puncture-proof wheels, they generally found pneumatic tyres best.

It appeared that the best solution for ox carts in Zambia, would be a cart based on a high quality axle, such as that supplied by Lenco. A suitable cart should have a cheaper body than that currently sup-





plied by Lenco. Carts based on old car axles (as already widely used) might also be of good quality. Such carts are limited by the shortage of appropriate axles.

Tests of plows

The ADP-RDP has also tested several plows both on-station and on farms, and has carried out on-station comparative trials (Dogger and Meijer, 1989; Meijer et al, 1990). One lesson from these is that on-station testing for technical performance (e.g. plowing quality, draft, wear and tear) is not sufficient. Farmers judge plows on a variety of criteria, including colour, shape and weight and they do not necessarily opt for that which is technically superior.

A good example of multiple criteria for plow quality relates to the first Rumpstad/Lenco plow. Although it had a weak hake, in terms of other technical specifications and on-station performance it was the best ox-drawn plow the project had tested. Yet farmers had firmly rejected it because it was considered "too heavy". It was physically heavier than the other plows. If it were adjusted correctly it could give a large cut requiring a very "heavy" draft (1626 N for 438 cm² specific area compared with 536 N for 97 cm² for a worn "Safim" type plow). Although the actual draft was high (as perceived by the animals) the specific draft (draft force relative to size of cut, a measure of efficiency) was low for the Rumpstad/Lenco plow (Dogger and Meijer, 1989). In one trial, in three different soil types, the average draft of the Rumpstad/Lenco plow was 943 Newtons, with a specific area (cut) of 360 cm². This compared

quite favourably with 928 N for a specific area of 290 cm² for the Northland plow.

In the same trials, the Zimplow had a lower draft for a comparable area (859 N for 350 cm²). Based on technical criteria and farmer acceptance, this does appear to be the best plow overall at present. It is very popular with farmers.

The Gameco plow had the heaviest draft of the plows tested, due to its abrupt mouldboard shape. The Northland plow had some defects (notably with the wheel bearing) and the problems were mainly attributable to poor standardization and inadequate quality control at the factory. The overall performance of the Northland plow was considered to be "fair".

Comparison of worn and new plows

During tillage trials, it was found that a Rumpstad/Lenco plow adjusted to plow deeply (requiring a high force) controlled weeds better than worn or shallowly adjusted plows, and led to higher yields (Dogger and Meijer, 1989). However when this trial was repeated the following year, the worn plow performed better. One possible explanation for the different results between the years, was that in the first year, the soil was drier, so the worn plow had difficulty in penetrating. For the present, the somewhat surprising conclusion is that there is little detectable difference in total time of operation and crop yield between plows that are worn and those that are new, nor between badly-adjusted and well-adjusted plows. This may explain why farmers seem so tolerant of plows that seem (to agricultural engineers) to be performing badly.

Case for compulsory testing

ADP-RDP staff felt that testing should be made compulsory. Marketing of implements should not be allowed before the implement has passed the necessary tests. This should be applied to both locally-manufactured and imported implements. This would protect farmers from buying unsuitable implements and save manufacturers from making implements the farmers did not want. The problem is that manufacturers and aid donors do not appear willing, or patient enough to accept compulsory testing.

The present technical and farmer-acceptance tests could have prevented Rumpstad/Lenco from importing the first batch of heavy plows. The second Rumpstad/Lenco "Sandy 3" plow was submitted for testing and was found to have major design defects (Meijer et al, 1989), and so these were never marketed in Zambia. As a direct result of the ADP-RDP tests, the latest batch of Rumpstad/Lenco plows ("Sandy 4") have been given stronger beams. However, Rumpstad also made other modifications to

the “Sandy 3” design. Thus the “Sandy 4”, which is now being marketed by Lenco, has not itself gone through the standard testing procedures.

Two of the three different makes of recently imported Italian plows had failed the first on-station tests. Several thousand of these plows, costing about US\$1,000,000, had already been imported for sale to farmers. Such an apparently unsatisfactory situation could have been prevented, if an initial batch of plows had been tested before such large-scale importation.

Ridgers, cultivators and seeders

Besides the plows and ox carts, the ADP-RDP was also working with cultivators, ridgers and planters. These have been tested in replicated on-station trials and multi-locational on-farm assessments. Provisional observations are as follows:

- Direct ridging can be as effective as an alternative to plowing. It is almost twice as fast, and has comparable draft requirements.
- Ridging and tied ridging can lead to effective soil and water management.
- Primary tine tillage is fast, but is less effective than plowing for weed control.
- Ridgers and plows can both be used for weeding. The use of a plow is more time consuming. The efficiency of tine weeders depends greatly on soil conditions.
- No acceptable alternative to hand-metered, third row planting, nor to the locally-available planter, has been found.

ADP-RDP considers ridgers as most promising implements for both primary tillage and weed control.

In one trial ridgers were superior to three designs of cultivator in controlling weeds (Dogger and Meijer, 1989). ADP-RDP believes that ridgers will play an increasingly important role in soil and water management practices in Zambia, and is assessing the advantages and disadvantages of the various ridgers available in Zambia.

Other ADP-RDP activities

The project has a pair of donkeys for research purposes. In comparison with oxen, donkeys play a very small role in Zambia at present. Nevertheless there is increasing interest in the potential for donkeys in Zambia and in most countries in the region.

The project has also been involved in the evaluation of an animal-powered mill, similar to the ones developed in West Africa. The first test results showed that there are still technical problems to be solved before they can be recommended for introduction to the rural communities. The output of the mill is not considered high enough and it varies greatly with the moisture content of the grain. Feasibility trials are being carried out by a GATE/GTZ regional project to find out the socioeconomic acceptability by rural communities.

The ADP-RDP envisages continuing its programme of on-station tillage trials, but it will not continue with its demonstration farm at Magoye. It will be carrying out on-farm testing of implements and ox carts in Southern, Central, North Western and Western Provinces, in cooperation with local farmers and MoA staff. It will continue to liaise with implement manufacturers and participate in field days and agricultural shows.

Central Province

Ministry of Agriculture

Ministry of Agriculture staff reported that there were great differences between the districts of the Central Province in regard to the status of animal traction. The people and the farming systems differed markedly, as did the patterns of cattle availability and disease. Some tribal groups were used to owning cattle and had employed oxen for generations, while in some areas cattle were rarely seen. As a result of this diversity, ways of promoting animal traction varied between the different districts.

The 1990/91 animal traction questionnaire survey, undertaken by MoA, suggested that 21,500 plows were in use, and another 6400 were need of repair. There were 9300 carts in use (plus 3400 in need of repair) and 10,900 sledges. The survey estimated there were 9200 harrows, 6000 cultivators, 5400 ridgers and 1300 planters in use.

The survey suggested there were about 41,000 trained oxen in use, out of a total of 55,000 oxen. The 1989 cattle census had reported there were 100,000 "oxen and tollies" in the smallholder sector in province. The large difference between the estimated 55,000 oxen and the census figure of 100,000 "oxen and tollies" may (possibly) be attributable to the somewhat unclear definitions of what exactly are oxen, tollies and steers. The estimate of 41,000 oxen in use accords well with estimates of plows owned and also with one MoA guestimate that about one third of all steers in the traditional sector are used for work. The animal traction survey did not specifically record the number of female animals used for work, although it has been observed that cows are increasingly being employed.

Most work oxen are found in Kabwe and Mumbwa, with only about 1000 oxen in use in Serenje. The provincial census figures imply that there are many untrained steers available, and so the supply of work animals should not be a constraint for the province as a whole. Nevertheless, the uneven distribution of cattle means that there are some areas (such as Serenje) where few steers are available.

Recent MoA ox-training initiatives have been concentrated in Mkushi and Serenje in the east, where animal traction was being introduced. In 1990, there were two MoA ox trainers in Mkushi, and four in Serenje. The ox trainers usually spent one month in a village, training both farmers and their animals. In 1988 in Serenje District, 100 pairs of oxen had been trained. It was thought that this level of training

would be sustainable in 1989 and 1990. There were reported to be shortages of cattle in both Mkushi and Serenje districts. There was one ox supply centre based in Mkushi, run by ZADL. A supply centre for oxen had been established in Serenje District in the mid-1980s by the IRDP, which existed then. It had subsequently been handed over to the District Council. Herd productivity had fallen, and output had become minimal.

In Kabwe and Mumbwa Districts, animal traction is well established and farmers train their own animals for plowing, weeding and transportation. In these areas MoA staff considered that the maintenance of implements and the supply of spare parts was a constraint. Very few artisans are capable of making spares for ox drawn implements. Mumbwa district has five active farmer/blacksmiths, trained under an FAO-supported scheme. They only operate as blacksmiths during the dry season.

Major disease constraints exist within the province. Trypanosomiasis is a threat, particularly in the west and the east of the province. Prophylaxis twice a year with Samorin (costing about K30 a dose) can be effective. The European Community has been supporting such prophylactic treatment. Corridor disease has hit the central areas of the province, leading to high mortality in some herds that had not been practising dipping or spraying.

Maize Development Project

The former Maize Development Project had been supported by the European Community (EC). It had implemented a credit programme to help farmers to purchase oxen. This credit scheme had been implemented through Barclays Bank, with financial backing provided by the EC. The credit scheme was started in 1985 and had a target of 500 loans to be issued by 1987. Repayment figures were reported to be good, being 98% in 1986, and 92% in 1987. The programme was intended to be run on a sustainable, commercial basis, with a commercial bank giving loans at normal interest rates, with donor funds only used for initial capital and security.

In some ways the project had been successful, with 500 pairs of oxen having been placed. However, only about 300 of these were still in use a few years later. The rest had been sold, consumed or stolen, or had died. The demand for meat in the province was such that farmers short of cash were tempted to sell their animals to butchers. If an animal became sick,

there was a tendency to slaughter it immediately, to ensure there was a return on the investment.

As there was a significant tsetse challenge, there had been a campaign to provide Samorin vaccinations twice yearly. In one campaign, the project had vaccinated about 10,000 cattle. In a comparable scheme, the veterinary department had vaccinated about 550 cattle. Corridor disease threatened cattle in the area, but oxen-using farmers had successfully used sprays to prevent death.

The project had undertaken some testing and development work with animal-drawn implements, and had made a forecarriage plow with two wheels to give stability. The work did not reach the stage of manufacture or farmer adoption.

Smallholder Development Project

The Smallholder Development Project, with financial and technical support from the European Community, follows the Maize Development Project. It is also attempting to promote animal traction, but hopes to learn from the previous project. It will provide loans for implements and carts, rather than animals. As farmers will have to provide their own animals, it is thought they will be less likely to sell or slaughter them. In the first year, about 200 loan packages are envisaged. The prevailing high rates of interest and inflation are considered to make the work of the project more difficult.

Implement supply

Implements are normally supplied by the Central Province Cooperative Marketing Union (CPCMU) and by some small dealers. The supply of ox drawn implements is reported to have improved greatly in the past five years. The province receives both imported and locally manufactured implements. Supplies are best along the line of rail. The demand for spare parts is far higher than the limited supply.

Manufacturers

There are no major manufacturers of ox drawn implements or spare parts in the province. Small numbers of ox carts, made from old vehicles, are fabricated by artisans and small workshops in several places.

In some locations, notably in Mumbwa District, artisans manufacture spares such as plow shares, land-sides and tines for harrows. An FAO/UNDP-assisted village workshop pilot project had originally established 25 workshops. Artisans had been trained, and had received loans to purchase tools. Only seven workshops were still thought to be in operation.

COMET (Copper Mines Enterprise Trust) is assisting artisans in a variety of ventures. With technical advice from Intermediate Technology Consultants of the UK, it is planning to start manufacturing ox carts. It had recently imported two carts (of long-standing Zambian/Zimbabwean design) from the firm of FarmKart in UK. It was hoped to sell the carts through established organizations like the co-operatives.

Farm visits

One farmer visited in Kabwe Rural District was plowing with four animals, one of which was a female. He did not feel that it was unusual to use female animals, although most farmers would use oxen if they were readily available. His young oxen had only recently been trained. They had developed yoke sores, possibly caused by the ends of the metal rods that passed either side of the animals' necks. The sores had been treated with tick grease. The farmer reported that he, and his neighbours, had lost animals from corridor disease. He now sprayed his animals weekly, using a cotton sprayer. Obtaining dip chemical from the veterinary department was not always easy, and so he tended to buy from a chemist. However at K5000 for a 5-litre drum, he found the cost of the dip expensive. This farmer hired out his oxen and his cart. Last season he carried 100 bags of his own maize, and 400 bags for neighbours. His cart, based on the axle of an old Landrover, could carry 15 bags. During the main transport season he would do two trips a day, and at K20 per bag, he could earn K600 per day.

Another farmer in the same district also used one female animal in a team of four. He did not have a cart, as he could not afford one. He did however hire out his sledge. At the time of encounter, four animals were dragging his sledge loaded with crates of tomatoes, which a woman was planning to sell at a roadside market.

Eastern Province

Ministry of Agriculture, Chipata

In Eastern Province, the MoA oxenization programme started in 1975 in Chipata District, within the framework of the Intensive Development Zone Programme. The province had a large cattle population that were little used for draft purposes. Later, the Integrated Rural Development Programme extended oxenization to all the “plateau” districts in the province. Until 1985, this programme was carried out in conjunction with the MoA Animal Husbandry Section. From 1985 to 1987 the Agricultural Engineering took over animal traction duties. In November 1987, it was felt that enough farmers were competent in ox-training to make oxenization sustainable. Oxen training was phased out. The full-time ox trainers were laid off, and then contracted to conduct special mobile courses on ox-training and the adjustment and maintenance of ox-drawn implements. The Agricultural Engineering Section continues to conduct mobile courses, and there were seven of these between July 1989 to June 1990.

Considerable attention has been given to the training of artisans in the province, and several blacksmith support workshops have been established. Lack of raw materials and technical tools have constrained blacksmiths. This has improved recently through the FAO-sponsored blacksmith programme. The MoA Agricultural Engineering Section is closely involved in the coordination of the Katopola Agricultural Engineering Centre.

The cattle population of the Eastern Province was estimated at 270,000, in 1989. There is no overall shortage of steers, but some areas, such as Chama District, are reported to have insufficient oxen. East Coast Fever is found throughout the province, except for some parts of Petauke District bordering Katete District. Movement of animals into Petauke is therefore restricted. Communal diptanks have been established, but the present fee of K5 per animal has discouraged farmers from dipping their animals. Standard vaccinations are said to be carried out on cattle between the age of three months and one year in Chipata, Chandiza, Katete and Lundazi Districts. Trypanosomiasis is found in all parts of Eastern Province except in some parts in Chadiza. The Veterinary Department is attempting to control the tsetse fly vector with impregnated traps. Cattle in the greatest areas of risk are also inoculated “Samorin”.

The Animal Husbandry Section conducted a survey of farmers in cattle development areas, including Mwase, near the Malawi border (Simukali, 1989). The survey of 47 households in Mwase indicated that 96% of the farmers used animal traction. Between them they owned 89 spans of oxen (total of 206 animals), 78 ridgers, 45 plows, 27 carts, 25 sledges, 2 harrows and one cultivator. The great importance of ridgers is noteworthy, and the small numbers of harrows, seeders and cultivators is probably related to this. Despite the widespread use of animal traction, farmers generally cited the production of milk, meat and manure as being their main reasons for owning cattle (Simukali, 1989).

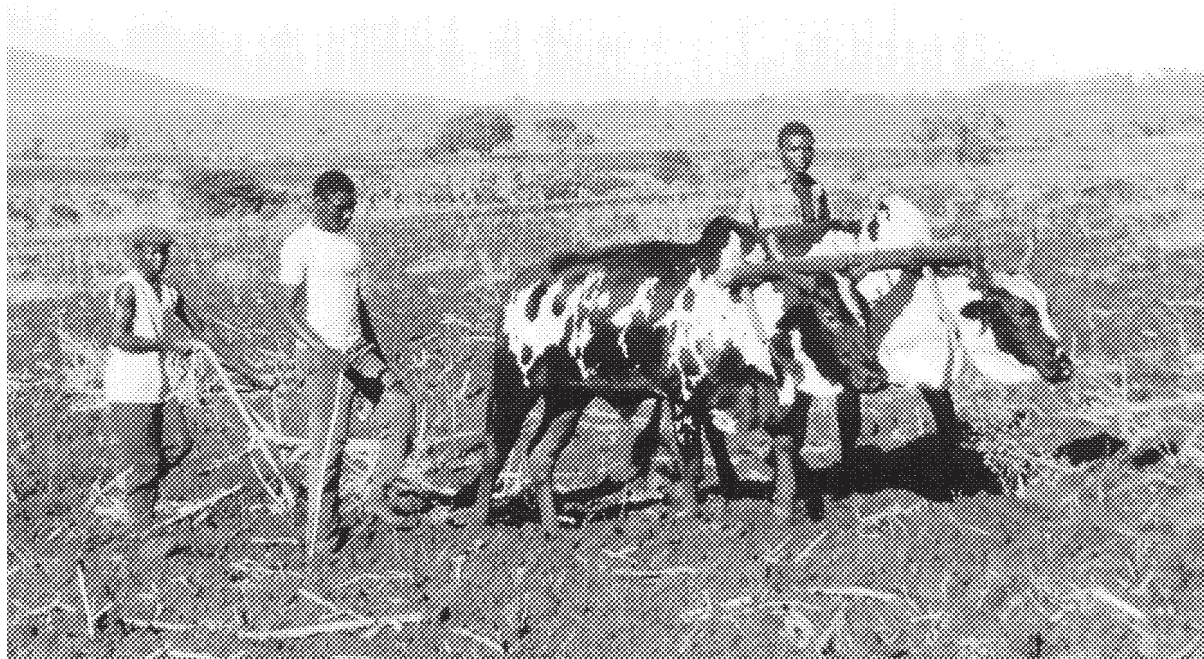
Adaptive Research Planning Team

The Eastern Province Adaptive Research Planning Team (ARPT) carried out some basic implement testing in 1986/7, in collaboration with the Msekocika Project (ARPT-EP, 1987). This compared plows and toolbars supplied by Agrimal (Malawi) and Bulawayo Steel (Zimbabwe), as well as by Northland and Lenco (Zambia). The plows of Bulawayo Steel, Agrimal and Northland were all of Safim-type design, but quality differed. The Zimbabwe plow was best and the Northland plow poorest. The marketing manager of Northland had visited the team in 1986 and assured them that implement quality was being improved. The Lenco plow gave problems with its hake and it was considered heavy. However, its wheel was good and large, the steel was good quality and its potential working rate was high. Having a wider cut, three-row planting of maize with the Lenco plow resulted in excessive inter-row spacing, and so alternate row planting was necessary. ARPT considered that all implements should be made available. They concluded that the most suitable implement overall was the Agrimal toolbar, with plow body and ridger (ARPT-EP, 1987).

Agricultural Mechanization Project

The Agricultural Mechanization Project was established with support from FAO. It provides a tractor hire service to cooperative societies. Farmers who ask for early plowing, before the rains, receive a discount. If the rains are late, demand for tractor services becomes excessive; even ox-using farmers try to hire tractors in these circumstances to improve their timeliness.

The plowing charges were intended to allow the project to be sustainable and commercially viable. In



practice, income has covered only the running costs of the service, and replacement of equipment has been impossible. Inflation has been a contributory factor, and insufficient allowance for this was made in the accounting system. In 1990, the cost of plowing with a 70 Kw tractor and a three-disc plow was raised from K267 to K1000 per hour. The Project staff believe that the tractor hire charges are now realistic. They do not think that the further development of oxenization in the Eastern Province will be threatened by subsidized tractor services.

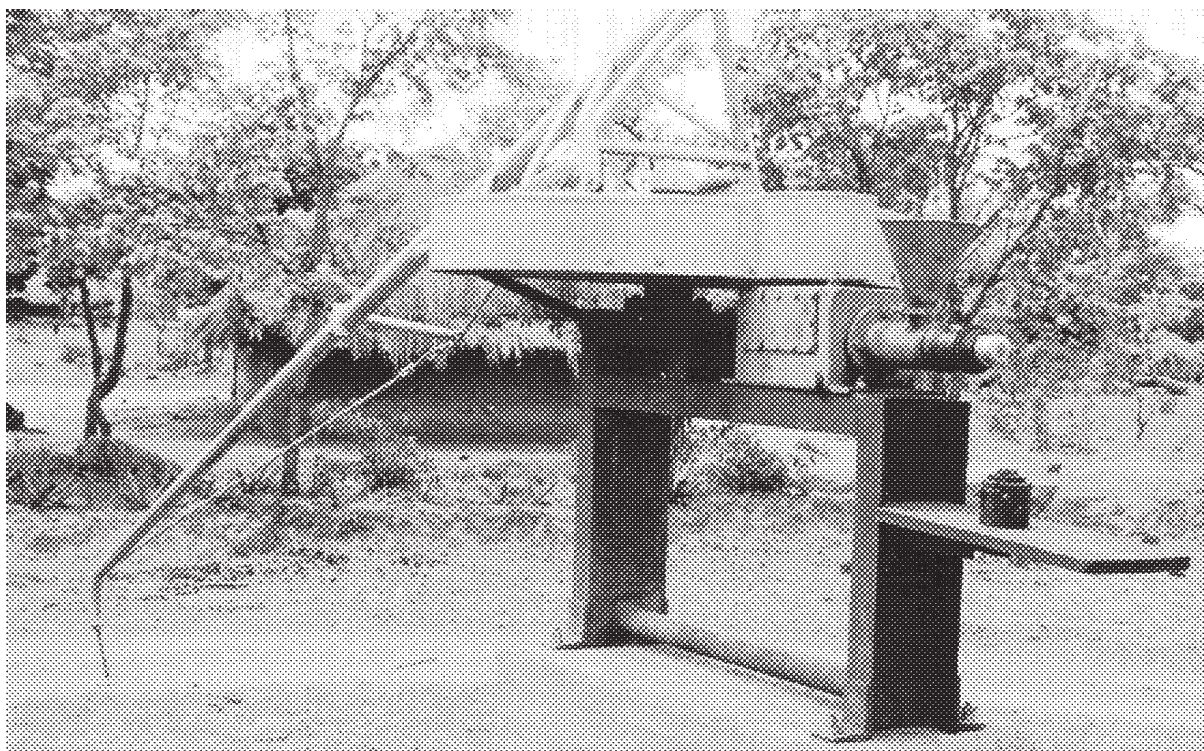
The blacksmithing programme of the Agricultural Mechanization Project is meant to assist smallholder farmers in repairing their implements. It was observed that many animal-drawn implements were abandoned, because there were no repair facilities and no spare parts. In establishing a blacksmith programme, the Agricultural Mechanization Project tried to learn from the experience of a similar FAO-supported blacksmith programme in Central Province. In the Central Province programme village artisans were trained and equipped, but many quickly migrated to urban areas where they could earn more money with their skills and equipment. Village workshops had been set up too close to each other, and they they had therefore saturated the local market.

The blacksmith programme in Eastern Province has been associated with the cooperative movement. The candidates for the blacksmith courses have been members of Primary Cooperative Societies who select their candidates. The final selection is done by

the blacksmith training instructors. The village workshops sell their products to the Primary Cooperative Societies. If the market is saturated, they sell their produce on to the district and provincial cooperative societies. The supply of steel and coal is decentralized. There are stores in Petauke, Katete and Chandiza and another is planned in Lundazi. The steel and coal are handled by the cooperatives in collaboration with the District Agricultural Engineers.

Out of the 60 artisans who were trained between 1986 and 1990, only six have failed and had their tools repossessed. These were following a retraining course offered by the project. The trained artisans are visited once a month. Some items of the tool kit, such as the tongs, are made during the training course. Other are imported and sold on credit. The training courses concentrate on the maintenance and repair of ox-drawn implements and the manufacturing of spare parts. It was reported that there was need for refresher courses for blacksmiths as design criteria for ox-drawn implements and basic setting of implements were given insufficient attention in the past.

Village workshops have also been involved in ox cart manufacturing; they make the cart bodies and the project provides the axles and the wheels. The ox carts are bought and sold by the cooperatives. The limiting factor in ox cart production is the availability of axles and tyres.



The project has also assisted other projects, including one in Senanga West, in training blacksmiths. In-service training courses for District Agricultural Engineers have been held in collaboration with the Agricultural Engineering Section.

Katopola Centre

Katopola Agricultural Engineering Centre (KAEC) near Chipata provides services relating to vocational training and rural structures. It has, for many years, received support from SIDA. The Vocational Training Section offers courses on the making of farm implements, blacksmithing and rural technology for women. It also offers in-service training courses in carpentry and blacksmithing for District Agricultural Engineers.

KAEC aims to train school leavers and upgrade rural artisans in blacksmithing, carpentry and tinsmithing. The centre caters for both male and female participants. The farm implements course is reported to be a woodwork course of six months. During the final three months the participants are taught how to make wooden farm implements, including ox carts, push-carts and wheel barrows. This course had been offered since the early 1980s. The mission was informed that **none** of the participants trained in recent years was actually making any of the implements, carts and wheel barrows they had been trained to make. KAEC staff were also unaware of any farmers

actually using the ox carts with wooden wheels bearings that had been promoted for many years. Although this was a source of discouragement, no decision had been taken to change to a different cart design. Trainees were still been shown how to make the wooden-wheeled cart. The manufacture of other wooden animal-drawn implements, such as wooden harrows, had been stopped.

The blacksmith course concentrates on manufacturing hand tools, sets of blacksmith tools and blowers, and the repair of ox-drawn implements. The trained participants make their own tools during the course, and have to look for raw materials from scrap. It was reported that in 1989/90 15 participants were trained. Although the KAEC had not followed up all trainees, they believed that about 11 were active, while four were not. Recently it was agreed that all blacksmiths could buy steel from the Cooperative Union, although Katopola graduates who are not members of the Primary Societies are expected to pay cash.

Village Oriented Development

Village Oriented Development Programme (VODP), of the Diocese of Chipata, is a rural development programme focusing on social organization and training. Supported with Austrian aid, it works in three areas of the Eastern Province, Msekhe (600 km²), Magodi (300 km²) and Katete

(100 km²). In these districts, traditional village social structures are considered predominant and stable (Wenger and Rauch, 1990). The work of VODP involves the organization of village youth groups, with training in agriculture and basic skills in village training centres. When the trainees, male and female, become self-employed farmers and craftsmen, VODP provides refresher courses. Since the start of the programme, 15 years ago, the achievements have included:

- 14 village centres for training young people;
- 440 young villagers been trained in agriculture, carpentry and/or blacksmithing;
- 450 ox carts produced by VODP members.
- within the project areas, oxen are used to a higher standard, for more purposes, and are also handled by women.

The programme installed three ox-powered oil presses. The oil presses are used by women groups, each group having one pair of oxen. They pay a fee of K300 per day for using the press. It was reported an animal-driven grinding mill was installed, with assistance from the GATE project. This had had problems with the tyre and the grinding stone. One women's group was waiting for the installation of another animal-driven grinding mill. All women's groups were making their own ox carts and used them for marketing their products in Chipata. Efforts to manufacture axles locally had not been successful, and so the ox carts were now fitted with axles imported from Austria. The Msekhocika centre had a four-wheel ox cart for transport to and from Chipata. This was considered more affordable and sustainable than a pickup.

Luangwa IRDP

The Luangwa Integrated Rural Development Project (LIRDP), based at Chipata, was started in 1988, with support from NORAD. It is concerned with agriculture, wild life, women's participation and infrastructure development. LIRDP operates in Luangwa Valley area, which is heavily infested with tsetse flies. Wild animals are common in the area, and the project hopes to promote agricultural production systems that are compatible with the long term conservation of wildlife. The project is collaborating with the Department of Veterinary and Tsetse Control Services

(DVTCS) to reduce tsetse infestation. Tsetse traps have been set up in Msoro as a pilot area.

The project, working with the Department of Agriculture, is introducing the use of work oxen. By the end of 1990, 60 oxen had been bought by the project. Half of these will be used for research purposes under the DVTCSA, and the rest will be given on credit to farmers. The package of a pair of oxen with a plow and ridger is being made available with medium-term loans of K30,000. Short term, seasonal loans are also available for provision of seeds and fertilizers. LIRDP will supply the drugs required to maintain the oxen free-of-charge until August 1992. From August 1992 to August 1993 the project expects to meet 50% of the cost prophylaxis. If the pilot oxenization project is successful, LIRDP anticipates assisting farmers to set up small cattle breeding herds.

Cart manufacturers

Daba Enterprises, Chipata, is a small company that makes a range of products including ox carts. These are based on old car axles and have wooden bodies. If axles are hard to find in Chipata, the proprietor travels to Malawi to find some, or he buys them from SKF, Kitwe. Ox cart price ranged from K15,000 to K25,000 depending on the cost of the axle and wheels. Production in 1990 was estimated to be just over 50 units. Production was limited by the availability of axles and wheels, and the ability of farmers to afford the carts.

The small firm Studio Five had made some ox carts in the past. It found that old axles were increasingly difficult to obtain, and the price of all inputs were rising. Farmers did not seem able to pay higher prices for carts, and so it was no longer emphasizing this aspect of its business.

Implement supply

Implement supply in Chipata was reported to be good, with both the cooperative union and private suppliers holding stocks of plows. The range of plows included some made by local blacksmiths and others from Northland Agriculture. Agrimal plows from Malawi were also reported available. A reasonable range of spare parts made by artisans were available through the cooperatives.

Lusaka Province

Ministry of Agriculture, Lusaka Province

Staff of the Ministry of Agriculture had prepared a report reviewing animal traction in the province from 1985 to 1990 (Sichembe, 1990). An earlier MoA report had also reviewed the status of animal traction and extension work (Chisanga, 1988). These reports both noted that while animal traction is commonly employed in Lusaka Province, it is not used by the majority of farmers. There has not been a major extension programme, and the present utilization and distribution of animal traction is mainly a result of informal diffusion and farmers' own efforts. Historically smallholder farmers copied animal traction techniques that were used on the large-scale farms. Some animal traction promotional work was undertaken by the MoA's Palabana Dairy Training Institute, and by the NGO Kasisi Agricultural Training Project.

Serious promotion of oxenization by the MoA started in 1988, and from 1988-1990 about sixty farmers participated in ox-training courses. Nevertheless, considering the total target population, the MoA extension service acknowledges that, to date, its effect on animal traction development has been marginal. MoA considers that farmers have great interest in using oxen, but the expansion animal traction is hampered by lack of credit, lack of clear extension and, in some areas, shortages of steers.

The provincial MoA headquarters finds itself somewhat overshadowed by the national headquarters. Provincial staff are sometimes called to help at headquarters. The provincial offices are not well known, and so visitors from the province may go directly to the national ministry for information on animal traction. The provincial office has few vehicles and mobility is a constraint for staff. In 1990, ZADL offered to supply the province with 100 weaner steers, but due to lack of transport, staff were unable to identify recipient farmers, and the animals were not distributed.

MoA reported that ox-drawn implements were generally readily available in Lusaka, at the Lusaka Co-operative Union and in private stores. However, implements are less obtainable in the outlying districts.

Most ox carts in the province are made by small workshops using axles from old vehicles. Efforts have been made by several organizations to introduce cheaper ox carts that use wooden bearings and wooden wheels. The acceptance of such carts by farmers has been very low and few private work-

shops have started to produce this type of cart. Some ox carts, with wooden wheels and bearings, have been made by the blacksmith workshop at Mwembeshi. These do not appear very durable, and those of a comparable design made at Kasisi seemed better. It was felt that there were more broken ox carts in the Province than operational ones, and so the role of rural workshops in repairing ox carts and implements should increase. The MoA is trying to improve the supply of raw materials to allow rural workshops to manufacture and repair ox-drawn implements and carts. Submissions have been made to ZCF Commercial Services for steel to be imported under the SIDA-assisted steel importation scheme.

Trypanosomiasis is a problem for work oxen in some areas, notably Luangwa. Tick-borne diseases, including corridor disease, appear to be increasingly prevalent, and cause the deaths of many work animals. Dipping facilities are available, but not all farmers are in easy reach of dips. Even where dips exist, few farmers dip their animals regularly. In 1990, the number of recorded dips was about 62,000, an average of 1.5 dips per year per head of the traditional cattle population. Farmers in the province (and elsewhere) complain about the price of dipping. Dipped and non-dipped animals often mix when grazing. The veterinary department considers that this lack of stock control, combined with difficulties in implementing compulsory dipping, is hampering the control tick-borne diseases.

Ministry of Agriculture, Headquarters

The Ministry of Agriculture Headquarters in Lusaka includes the Department of Agriculture, the Department of Veterinary and Tsetse Control Services and the Planning Division. The two sections of the Department of Agriculture most concerned with animal traction at a national level are the Agricultural Engineering Section (AES) and the Animal Husbandry Section. There is reportedly much cooperation between these sections: both are members of the Animal Draft Power subcommittee of the National Livestock Steering Committee. Both sections have technical staff in the provinces, and animal draft power programmes in the provinces are coordinated either by an agricultural engineer or by an animal husbandry officer, depending on the local staffing situation. Both sections report that they are understaffed (relative to staff establishment) in Ministry headquarters and in some provinces.



Following the 1985 Animal Draft Power Investment Plan, the Agricultural Engineering Section was assigned major responsibilities for the coordination of the national animal traction programme. The national Animal Draft Power Coordinator programme, supported by The Netherlands, operates within the AES in Ministry Headquarters. Two other national animal draft power projects supported by The Netherlands, the Magoye ADP-RDP and the Palabana ADP-TP, are also technically responsible to the AES. The staffing level of the AES at national headquarters has been consistently below that envisaged in the national animal draft power investment plan. Only recently, has a full-time counterpart been allocated to the expatriate in the Animal Draft Power Coordinator Project.

Palabana Animal Draft Power Training Project

The Palabana Animal Draft Power Training Project (ADP-TP) is located within the Palabana Dairy Training Institute of the Ministry of Agriculture. The project aims to establish a national training centre that will provide in-service training in animal traction technologies. Few staff in the MoA extension service, or in NGOs and development projects, have ever had practical training in this important field.

The Dutch-funded project was planned to start in 1987, and finally became operational in 1989. It is staffed by a team of five specialist instructors (two expatriates), including a socioeconomist. In its first year, emphasis was placed on establishing the infrastructure of classrooms, stores and training farm. The infrastructure and training facilities were completed in late 1990, and the official opening was held in early 1991. The animal traction training centre has ten hectares of arable land available for practicals and demonstrations. An irrigation system has

been installed so that at all times of the year trainees will be able to plow, plant and weed crops. The project has acquired a wide range of implements from different countries for demonstration purposes.

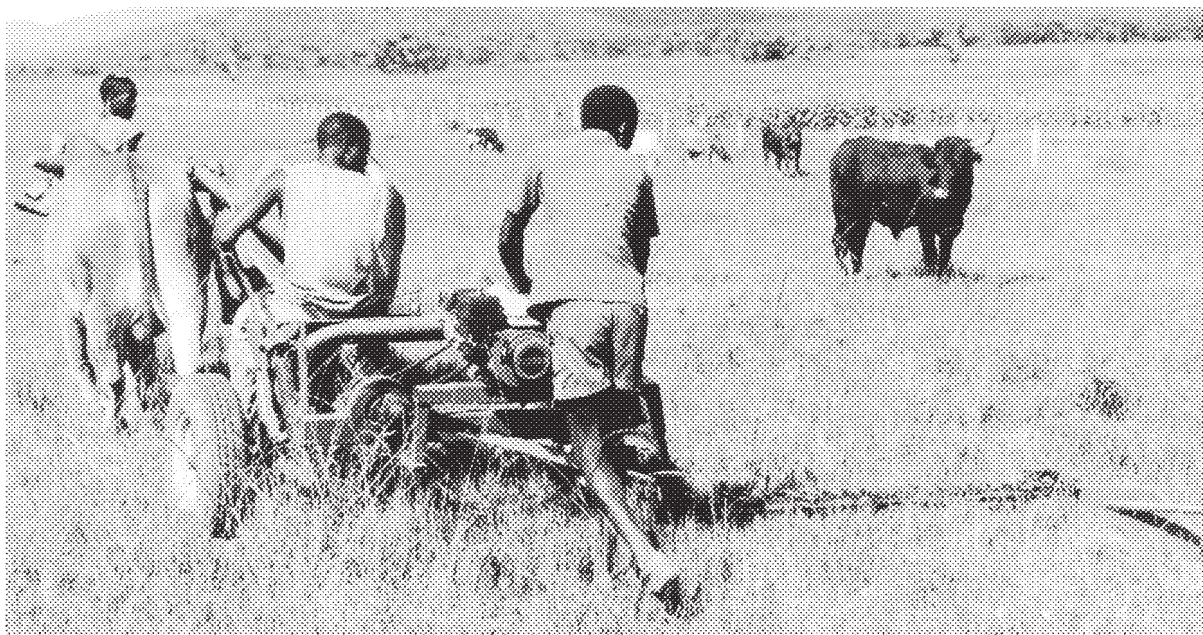
The first intake of trainees was in July 1990. It is planned to hold five highly-practical in-service courses a year, each of 4-5 weeks and each catering for 20 trainees. In addition, each year there are planned to be up to four courses of 1-2 weeks. These will cover special topics or will be targeted at specific professional groups (policy makers, credit agents). Staff will also undertake follow-up activities in the districts, to gather feedback and ascertain future needs, and may assist in courses at farmer training centres. In the first instance, much use was made of training materials developed in Zimbabwe, but work has started on the development of new training manuals.

ADP-TP held a national seminar on animal traction in April 1991, to discuss training priorities. The proceedings of this are being published (Bwalya et al, 1991).

Animal Draft Power Coordinator Project

The Animal Draft Power Coordinator Project (ADP-CP) is a national project, supported by The Netherlands, that started in March 1987. It is based within the Agricultural Engineering Section of the Department of Agriculture headquarters in Lusaka. The 1985 Animal Draft Power investment plan had envisaged that the MoA Agricultural Engineering Section would have a specialist in animal traction, as well as a rural production engineer and a training and extension specialist. These latter positions were not filled.

The ADP-CP is intended to provide the country with:



- Advice, strategies and priorities for animal traction development in the country.
- Improved coordination and liaison between the animal traction research, development and extension programmes.
- Problem identification for animal traction programmes in the provinces.
- Establishment of a national Animal Draft Power Steering Committee.

The project has been implemented by one Dutch expatriate, working within the MoA Agricultural Engineering Section. Until October 1990, he was working without a full-time counterpart. The project helped establish the planned national ADP steering committee, which was formed as a sub-committee of the National Livestock Development Committee.

The project has assisted the establishment of the two other national animal traction projects; the ADP-RDP at Magoye, and the ADP-TP at Palabana. It has also prepared project proposals for the:

- manufacturing of ox-drawn implements at Lenco;
- manufacturing of ox-cart axles at SKF (Zambia) Ltd (MoA, 1988).
- Northern Province Animal Draft Power Development Programme (MoA, 1990).

In 1988, the project organized a national workshop on "Prospects and constraints of animal draft power related tillage research and implement development". The proceedings of this meeting have yet to be published. The project has prepared some extension materials on ox-drawn plows and ox plowing competitions (Dibbits, 1987a, 1987b, 1989).

The project has participated in several meetings of provincial ADP Steering Committees. Plowing competitions have been supported, and provided with prizes. In Southern Province, the project supported surveys of animal traction (Tembo and Rajeswaran, 1990) and donkey use (Luig and Chimbamba, 1989). Agricultural colleges and agricultural engineering sections in the provinces have been provided with demonstration samples of Rumpstad/Lenco plows and Looma yokes. Second hand Landrover tyres and rims have been imported, and supplied to organizations producing ox carts.

The project considered that its links with the extension services have been much stronger its links with research organizations. An important exception to this generalization has been the close contacts between the ADP-CP and the ADP-RDP, Magoye. [During the mission, it was confirmed that most MoA staff and development projects contacted were well aware of the activities of the ADP-CP: many had participated in project activities or received practical assistance.]

Prior to the establishment of the Palabana animal traction training centre, the project organized and sponsored animal traction training at the Agricultural Extension Training Centre (AETC) in Harare. Eighteen staff of Palabana, Magoye, Looma, agricultural colleges and the district MoA offices attended two-month training course at AETC. Zambians were sponsored to attend animal traction workshops in Senegal and Scotland, and to visit animal traction programmes in Botswana and Niger.

The project participated in a regional workshop held in Zimbabwe in 1991, at which the Animal Traction Network for Eastern and Southern Africa was launched. The project has since agreed to act as a secretariat for this network, which will hold its first major workshop in Lusaka in 1992.

SIDA Agricultural Engineering Project

SIDA has been supporting animal traction through its assistance to the national and provincial Agricultural Engineering Sections (AES). The national AES has been responsible for the project, and the Animal Draft Power Coordinator has overseen local disbursements relating to animal traction.

This SIDA project funded the production and publication of an attractive animal traction training manual (MoA, 1989). Most of the text and diagrams were taken directly from the extension manuals of the AETC, Harare. By early 1991, this manual had not been widely distributed. [Few organizations contacted during the mission had copies or even knew of its existence. Several training institutions and provincial MoA staff had complained of lack of training materials. The lack of diffusion of the manual may be partly explained by the resentment expressed by some agricultural engineers within AES. These felt that the manual had effectively plagiarized Zimbabwe training materials, and some locally-produced documents, without giving sufficient acknowledgement.]

Animal powered technology project

The Animal Powered Technology Project is a regional project, based in Lusaka, that is promoting and studying the introduction of animal-powered grinding mills. It is sponsored by the German Appropriate Technology Exchange (GATE), a division of GTZ, and is implemented by a German consultancy firm. It has worked with other organizations to introduce and evaluate animal-powered maize grinding mills. Among the mills installed for evaluation are those at Msekhocika (Eastern Province), Kasisi Mission (Lusaka Province) and Magoye (Southern Province). The mills are mounted on a rotating beam, and are powered from a friction wheel that runs on a small circular wall. One or two animals walk round in circles, pulling the mill around the wall, and in the process, maize is ground at the rate of up to 20 kg per hour. The project would like such mills to be installed in many rural areas, to relieve the drudgery of women. The technology is innovative, and the design has been modified several times to try to overcome specific problems, such as tyre wear and low output. The present milling rate is considered rather low. Assuming the technical problems can be overcome, the units should be able to

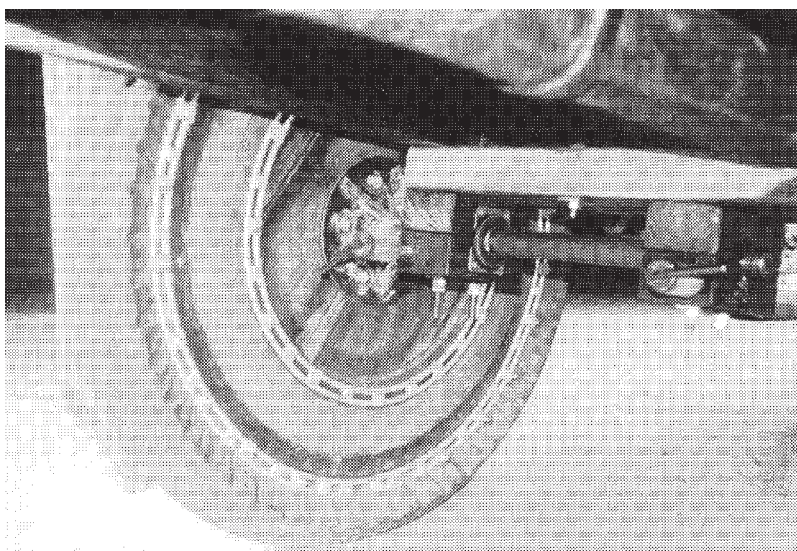
cope with the milling requirements of small villages. This may require group ownership, which has social and economic implications that are still being assessed (Löffler, 1991).

Technology Development Advisory Unit

The Technology Development Advisory Unit (TDAU) is an independent organization within the University of Zambia (UNZA), with its own Board of Directors chaired by the vice-chancellor. It works with a range of development-orientated technologies, including milling, oil pressing and rural transport. It is expected to become financially self-supporting within four years, through contract work for aid agencies and private companies. In recent years it has carried out paid work for several aid agencies, including GATE, USAID, NORAD and AGROTEC. It has also cooperated in research, developing and testing with several other organizations within Zambia, including the Kasisi Mission. Although TDAU has produced some original prototypes in the past, it now aims to build mainly on existing experience. It therefore envisages obtaining proven machines or prototypes from other countries, testing them under Zambian conditions, modifying them as necessary, and assisting Zambian manufacturers to take over production.

For many years, TDAU has been working on the developments of ox carts. These have generally had wooden bearings and wooden wheels. Its latest development is an ox cart with wooden block bearings and large diameter wheels fitted with a non-puncture "flexiwheel" tyre. This is made from an old truck tyre that is squeezed and clamped so that the tread and walls produce a narrow air-filled space around a wooden wheel of smaller diameter. It has many characteristics similar to a pneumatic tyre. It is puncture-proof as the shape of the tyre is not dependant on the pressure of the trapped air. The shape and strength depends on the tensions in the walls as the tyre is firmly bolted onto the wheel.

The latest prototype cart, with flexiwheels, has been tested on-station, and TDAU consider it is now ready for diffusion. A NORAD project has purchased six carts with these wheels for testing. A course for entrepreneurs on how to make the wheels and bearings will be held in 1991. The starting entrepreneurs will be provided with jigs. The jigs are expected to cost K300,000 per entrepreneur. TDAU has requested support from the Ministry of Agriculture and some donor organizations for this programme. TDAU is selling this prototype ox cart for K40,000, which includes an element for development costs and high quality timber. In rural areas this could be reduced to K25,000.



TDAU considers its designs have been successful, and that some individual carts have been in use for seven years. TDAU also acknowledges that uptake of its carts has been low. One of its carts passed an on-station test at Magoye. This later failed an on-farm test. Both the flexityre and the wooden bearings worked well, with little wear. However the bearing blocks loosened and split and farmers complained that the cart and wheels were very heavy (Dogger, 1990).

TDAU has also been involved in the testing and modification of an animal-powered mill in collaboration with the GATE/GTZ initiative. It estimates that an output of flour of about 50 kg per hour would be needed to justify such a mill commercially. Output has not yet reached this level.

TDAU was contracted by the regional AGROTEC project to submit details of some prototypes that could be usefully developed. One of these was an animal-powered mill.

Department of Agricultural Engineering UNZA

The Department of Agriculture Engineering of the University of Zambia (UNZA) considers animal draft power as one of several power sources (such as motor, wind, solar, water and human). There is no special emphasis on animal power or small-scale mechanization. The University owns no draft animals, and students are not exposed to animal traction during normal practicals. The Department owns one ox plow, but it has not been used in practicals. In recent years, students have been to Palabana Dairy Training Centre for one residential week of practicals, and this has included work on animal traction.

In the 1985 animal draft power investment plan (MoA, 1985), it had been envisaged that someone

from UNZA would specialize in animal draft power. However, the Department of Agricultural Engineering has been seriously under-staffed, and so all existing staff have been over-loaded with teaching duties. The Department therefore could not justify giving particular attention to animal traction issues. Staff time, rather than finance, has been the critical constraint. The department staff felt they could quite easily obtain funds to undertake specific animal traction work (for example, from the ADP Coordinator Project).

The staff of the department had been impressed by the level of publicity relating to animal traction. The subject was widely talked about in the provinces. They did wonder, however, whether actual progress was as good as the publicity. From their perspectives, there had not been much technological change over recent years. The students were more willing to treat the subject seriously than they were a few years ago, but they would probably object to a full course being given on the topic. There were no student texts on animal traction, and the staff had few resource books on this subject. Naturally the staff and students would welcome the provision of these.

Kasisi Agricultural Training Centre

The Kasisi Agricultural Training Centre is a small "appropriate technology" development centre, established by the Kasisi catholic mission in 1982. It started developing animal-drawn implements and carts in the early 1980s. They developed a series of ox carts that have earned the slightly cruel nickname "Flintstone", after the stone-age cartoon characters. The design of these has been constantly evolving, but most have had wood block bearings and solid wooden wheels covered with tyre rubber. Small numbers of such carts have been in use around Kasisi for several years. The one cart failed rigorous

on-station and on-farm tests carried out by ADP-RDP Magoye (one set of wheels disintegrated and the bearings wore excessively). The centre makes about one complete ox cart in three weeks.

The centre has also developed and tested their own groundnut lifter, tine plow, yokes and harnesses. The centre has cooperated with several other institutions, including the University of Zambia/TDAU. It worked with the University of Warwick in the testing of a prototype animal-powered rope engine (which disintegrated when the ox was uncooperative). It is helping to evaluate a prototype animal-powered maize mill, installed under a GTZ/GATE project.

Although one of the key figures in the development of the centre left Zambia in 1990, the centre intends to continue its development, production and training work. Its activities will continue on a modest scale, constrained by staff time, resources and materials.

ZCF, Commercial Services Division

The Commercial Services Division of Zambia Cooperative Federation Ltd (ZCF) took over the operations of the National Agricultural Marketing Board (NAMBOARD) in 1988/89. Although ZCF-CS is widely perceived as a parastatal organization, technically it is a private company owned by farmers.

The work of the division involves trading in locally manufactured items and imported goods, and it is expected to at least cover its costs. It buys implements, from local or foreign suppliers, and sells these to the provincial cooperative unions. These in turn supply the district cooperatives which supply the primary cooperative societies. Unfortunately, the system has tended to break down, as provincial societies have become virtually insolvent due to inflation and the high costs of collecting and purchasing maize.

As the provincial unions are under financial pressure, ZCF-CS no longer supplies implements to them on credit. Since the provincial cooperative unions have little cash available, plow orders placed with ZCF-CS have fallen markedly, and many provincial warehouses are empty of animal-drawn implements. In order to make supplies available in the provinces, ZCF-CS may open (or reopen) provincial wholesale warehouses. They will also sell directly to the districts and to private traders and dealers.

ZCF-CS has imported animal-drawn implements following international tenders financed through IFAD and the World Bank. Under present policy guidelines, local manufacturers are always given priority over imported goods, provided they are not more than 20% more expensive. In 1988/89 it ordered the following implements:

Implements ordered by ZCF-CSD (1988/89)

Implement	Numbers
Plows	3000
Ridgers	50
Cultivators	600
Harrows	650
Planters	100
Trek	3000
chains	
Ox carts	100

Source: ZCF-CS quoted by Sindazi (1990)

The 3000 mouldboard plows came from Zimbabwe. These are popular with the farmers, and the cooperative unions generally prefer to purchase these. A further 3000 plows were on order (in early 1991) from Tata of India. Although it is too early to judge the consignment that is due to arrive, implements from India have generally been considered to be of

inferior quality. Lenco plows had been unpopular, and were described as “too heavy”. In the past, ZCF-CS had not taken into account test results of ADP-RDP Magoye, but intended to do so in future. It would not import plows if sufficient implements of appropriate quality and quantity were available. It had recently withdrawn an international tender for plows.

ZCF-CS sees the main problems with animal traction implements to be cash-flow. It had the capital to purchase large numbers of implements, but there was not enough cash in the system to allow these to be distributed to the regions and purchased by farmers. Ideally cash should be injected through credit to farmers. They could then place orders through the local cooperative unions, who in turn could order from ZCF-CS stocks.

The SIDA steel procurement project

ZCF-CS has been responsible for administering a steel importation scheme to assist local manufacturers of ox-drawn implements. This has been funded by the Swedish International Development Authority (SIDA). Steel is not locally produced in Zambia and foreign exchange to import it has been scarce. Therefore, in 1989, SIDA agreed to provide seven million Swedish Kroner (over one million US dollars) for the procurement of steel on behalf of local manufacturers of animal-drawn implements and carts. SIDA made it a condition of the project that none of the steel was to come from South Africa. The Zambian government agreed to allow steel and materials intended for agricultural inputs to be imported free of duty. ZCF-CS was allocated a 20% commission for its role in procurement and project administration.

By October 1990, about 1100 tonnes of steel had been imported under the project, as shown in the table. The largest beneficiary has been Northland Agriculture. Its 1038 tonnes is equivalent to the weight of about 25,000 plows. Support to blacksmith groups has been small, mainly due to organizational constraints, but assistance for these is hoped to increase.

Most of the steel was imported in 1989/90, and came in the form of bars, plates, rods and tubes. Some welding rods and nuts and bolts were included, as were the following ready manufactured items:

- 2000 plows (as components) for Lenco;
- 2000 bearings and components for stub axles for SKF;
- 120 cultivator wheels for MDM Agricultural Division.

Under the project, manufacturers were expected to pay for the steel retrospectively in local currency, at a favourable rate of exchange (US\$ 1 = K 26). This

should have allowed the establishment of a revolving fund with a value of K 30.9 million (equivalent at the time to about US\$ 1.2 million). By March 1991, the smaller importers had paid their bills but the two largest importers, Northland and Lenco, had made only token payments, with K 22 million outstanding (Jonsson, Maipose and Mansson, 1991). Even if all bills were paid rapidly, the late payment and devaluation of the Kwacha will have effectively halved the value of the revolving fund. An evaluation report concluded that, despite the administrative problems, the project had achieved many of its objectives and that the national supply of animal traction implements had been assisted (Jonsson, Maipose and Mansson, 1991).

Lusaka Engineering Company (Lenco)

Lenco is a large manufacturing company, partly owned by Italian companies, and partly by the Zambian Government. It specializes in making the bodies of buses, as well as smaller steel products like filing cabinets and tubular furniture. It is manufacturing a range of animal-drawn implements in collaboration with the firm of Rumpstad, of The Netherlands, with the financial support from the government of The Netherlands (DGIS). It also sells steel ox carts made from components supplied from Italy.

The history of the implement project dates from 1983, when plows were scarce in Zambia, and criticisms were being made of the quality of the plows produced by Northland. Palabana Dairy Training Institute imported two plows from Rumpstad for testing. The Department of Agricultural Engineering of the University of Zambia tested the plow and reported that it performed well. Ten more plows were imported in 1984 for testing at the Magoye Farm Machinery Research Unit (FMRU) and at Looma, in the Western Province. The plow was reported to have passed the test of the FMRU. The plows tested at Looma had bent, and it was suggested that stronger beams were required for Zambian conditions.

In 1984, Rumpstad contacted Lenco to discuss cooperation in the assembly and manufacture of animal-drawn implements in Zambia. It was agreed that 50 plows would be supplied in the first instance for market assessment, and components for 4,450 plows would be sent for local assembly, together with a few production machines. These were supplied by Rumpstad in late 1985, having been paid for by the Dutch aid programme (DGIS). Marketing of the plows commenced in 1986.

Sales of the first consignment of Rumpstad/Lenco plows were very slow. About the time of first local assembly, the market situation was altered by the importation of 14,000 Zimbabwean plows, of a popular and inexpensive design. Furthermore, Lenco's ex-factory price was higher than that of the competition. Initial marketing was not very rigorous, and the factory depended mainly on orders placed in Lusaka by projects and the cooperative unions. It also became increasingly clear that farmers found the plow too heavy, and generally preferred the Northland/Zimplow types.

As a result of these factors, in late 1990, Lenco still had a stock of 350 plows from the 1985 importation. Other plows from this importation remained in the stores of various cooperative unions. As Lenco has since acquired large stocks of a lighter plow, Lenco intends to scrap the remaining "heavy" plows, and will use the steel and components for different purposes.

Not long after the initial importation of Rumpstad plows, it was proposed that Lenco should be supported by the Netherlands aid programme to move to full local production (Jansen and Dibbits, 1986). A new project proposal was prepared in 1988 (MoA, 1988). Some concerns about the financial viability of the project delayed project approval, but in 1990 Rumpstad was contracted to establish a production line for ox-drawn implements. The project involved the supply of machines, jigs and materials, and the provision of a full-time production engineer for a three-year period. The machines and the production engineer from Rumpstad arrived in 1990, and the production line was in operation in early 1991. In due course, Lenco will be expected to pay in local currency for the machinery and materials supplied.

Large scale production did not start immediately, Lenco still had large stocks of plows. Most of these had come in a consignment of 2000 plows (of a new, lighter design) which had been imported from Rumpstad in 1989/90 under the SIDA steel support programme. Sales for these had been slow, and, in early 1991, Lenco resorted to selling them at below their cost price in order to reduce stocks and capture a market share. [Lenco could afford to do this as it had not paid the full cost of this consignment].

Rumpstad had received feedback that its original plow was considered too heavy. It therefore produced a modified plow that was lighter. The Magoye ADP-RDP purchased samples from Rumpstad for testing. The plow failed its initial test at Magoye because its beam was too weak. Other more minor modifications were also suggested (ADP-RDP, 1990).

Rumpstad therefore supplied stronger beams in the consignment purchased under the SIDA steel importation programme. Rumpstad also made some other changes, some following ARP-RDP recommendations and others for production reasons. The latest version, which will be locally manufactured by Lenco, was being tested by Magoye in 1990/91, and has also been released for sale. At the time of the review mission, it was too early to know whether the new plow would be well-received by farmers, but the staff of Rumpstad were confident that it would.

During interviews with the mission, the staff of Lenco were only able to report the technical opinions of Rumpstad and Magoye, since no one at Lenco was familiar with the technical aspects of plow design and use. The Rumpstad production engineer had no comparably-qualified counterpart, and plans to recruit a Zambian agricultural engineer have yet to be implemented.

Lenco has also imported some Rumpstad multipurpose toolbars, seeders, ridgers and cultivators for assembly and testing. Under the three-year support programme, the local production of these was envisaged. However, most of these implements have not been fully tested or evaluated in Zambia, and Lenco is unlikely to commence the large-scale manufacture of these in the near future. The Rumpstad ridger body has been tested by ADP-RDP Magoye, and reaction has been quite favourable. The Rumpstad engineer has developed a system whereby ridger bodies can be bolted to the Lenco plow beam, and Lenco ridger bodies are likely to be available for the 1991/92 season.

Lenco has been selling small numbers of steel carts, that use pneumatic tyres and roller bearings. These have passed on-station and on-farm tests arranged by Magoye ADP-RDP, and have been well-received in various projects. Sales have been low due to its high cost (K60,000 in December 1990), limited marketing effort and the high cost of transporting fully-manufactured carts to the provinces. Lenco reported that it has large numbers of axles and hubs to manufacture further carts, and the Dutch production engineer has developed a cheaper cart design (K30,000 in March 1991). This may be sold in kit form, to reduce transport costs.

Lenco reported that it had gained relatively little from the first phase of the Dutch-supported project, as sales had been slow and it could not sell the plows at a profitable price. However Lenco is hoping that the investment of the second phase will pay off. It will have the capacity to make at least 10,000 plows a year, and would like to be able to

capture a market of at least 5000 plows a year. This level of production would represent only 5% of Lenco's annual turnover, and so the company is not dependant on the success of the project. Lenco's recent sales figures are provided in the table below.

Gameco

Gameco is a medium-sized, privately-owned workshop located in the industrial area of Lusaka. It started fabricating plows in 1984, based on second-hand plow beams bought in the provinces. In 1988, it had increased its annual production to 1000 plows. The implements were not produced on a jigged production line, and were somewhat variable in both design and quality. The company then started to import plow beams from South Africa. Between 1989 and 1990 it imported about 6000 plow beams. It continues to fabricate handles, shares and bodies from available materials. Its wheels are made from pipe section. It intends to improve its quality and standardization when all its machines are in operation. It anticipates building a new workshop with partial line production in 1991. It has made a few cultivators, harrows, ridgers and ox carts, but has not been impressed by the market potential for these.

With Swedish assistance, Gameco has invested in workshop machinery, both new and second hand, to enhance its capacity and to improve the uniformity of its work. Equipment is purchased in Sweden with payment subsequently being made in Kwacha under favourable conditions. Under the Swedish scheme, Gameco receives some technical advice from the large, Swedish-based, multinational, agricultural implement manufacturer, Overüm. Overüm is also providing technical support to the SIDA-backed Agro-Alfa implement workshop in Mozambique. There have been contacts between Agro-Alfa and Gameco, and, in future, Gameco expects to purchase plow beams from Agro-Alfa, and benefit from their experience.

Gameco's production has been limited by the availability of raw materials, restrictions on foreign exchange, and market saturation. The small size of the company, and the lack of an agricultural engineer may also have restricted production and product diversification. The company has an active marketing strategy, that allows it to keep low stocks. It seeks out firm orders from ZCF-CS and from retailers in

the Southern, Central, Lusaka and Eastern provinces and then manufacture batches of implements to specific delivery dates. A few implements have been made for casual purchasers.

Gameco gave the impression of being a growing company, with a dynamic manager interested in expanding its share of the implement market in Zambia. It is also actively investigating exporting to other countries in the region. The following table is based on Gameco's estimates of its past and projected production.

ZCF Transport and Engineering

The Transport and Engineering Division of Zambia Cooperative Federation Limited (ZCF-TED) transports produce and goods throughout the country. Most of its activities are based on heavy trucks. In 1990, the division became interested in the potential for ox carts. It manufactured 15 carts for ZATCO in Choma, using SKF bearings. The size and the national status of ZCF-TED are such that it could become a major supplier of carts, if it saw the market potential. However it has only recently started production, and it is too early to say whether it will expand and sustain its interest in this sector.

AFE Limited, Lusaka

AFE is a parastatal agricultural machinery dealer, selling a wide range of agricultural implements and equipment. In 1988 it started to stock ox plows. It decided to import them from Zimbabwe, as it understood that Zimbabwe plows were of good quality and were preferred to locally manufactured ones. AFE's importation of these implements since 1988 is as follows:

The 1990 order arrived at the end of 1990, and major sales are not expected before the 1991 buying season (June to November). The animal-drawn implements have normally been sold out by the end of the year. The exception was that 123 cultivators from the 1989 importation remained unsold in November 1990. The level of future importation of the various implements will depend on past sales and perceived market demand.

Another private importer/dealer selling ox plows from Zimbabwe is the hardware company E. W. Tarry Ltd. of Lusaka.

Animal traction in Zambia: status, progress and trends 1991

Report prepared by

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Appendices

1. References and bibliography
2. List of persons contacted
3. Addresses of organizations involved with animal traction

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(in chronological order of first encounter)

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Mr. Kees van Baar, Third Secretary, Royal Netherlands Embassy, Lusaka
Mr. H. B. Mwase, General Manager, Lenco Ltd.

Friday 16 November

Mr. Grieve Z. Sibale, General Manager Commercial Services Division, Zambia Cooperative Federation Ltd, Lusaka
Mr. A. M. H. Muyovwe, Gameco, Lusaka
Dr. Alex M. C. Lemmens, Head of Assessment and Extension Unit, Technology Development and Advisory Unit (TDAU), University of Zambia
Dr. Naifi G. Musonda, Head of Dept. Agricultural Engineering, University of Zambia
Dr. Nicholas Kwendakwema, Lecturer in Agricultural Engineering, University of Zambia
Mr. Herman van Slooten, Project Coordinator, Palabana Animal Draught Training Centre (ADTC)
Mr. Martin Bwalya, Agricultural Engineering Training Officer, Palabana ADTC
Mr. Jacques de Graaf, Socioeconomics Training Officer, Palabana ADTC
Mr. Paul P. Jackavula, Agricultural Engineering Instructor, Palabana ADTC
Mr. Sitali Kalakuka, Agricultural Engineering Instructor, Palabana ADTC
Mr. Edson Y. S. Phiri, Extension Worker, Petauke (training at Palabana)
Ms. Sylvia. C. Chilufya, Extension Worker, Chipata North (training at Palabana)
Mr. Enoch Chileshe, Extension Worker, Kasama (training at Palabana)
Mr. Aaron Tembo, Extension Worker, Katete (training at Palabana)
Mr. B. S. Witola, Extension Worker, Isoka (training at Palabana)
Mr. Henry Kaoma, Extension Worker, Kasama (training at Palabana)

Sunday 18 November

Mr. D. S. Musakanya, Principal, Zambia College of Agriculture, Mpika
M. M. Maipambe, Instructor ADP, Zambia College of Agriculture, Mpika
Father Anton Oostveen, Chilubula Mission, Kasama

Monday 19 November

Mr. Bror Karlson, Provincial Agricultural Engineer, Kasama
Mrs. M. K. Lombe, Animal Draught Power Coordinator, Kasama
Mr. H. L. Moomba, PAO, Northern Province
Mr. Japhet V. Musukwa, Provincial Animal Husbandry Officer, NP

Mr. Gershom Mwansa, Animal Husbandry Officer, ETSP Kasama

Mr. Albert Makondo, Senior Veterinary Assistant, Kasama
Mrs. M. G. Katongo, Executive Officer, Veterinary Office, Kasama
Mr. D. Mumbi, Animal Husbandry Officer, IRDP Kasama
Mr. T. Linqvist, Coordinator, IRDP Kasama
Mr. Egil Nestande, Project Coordinator, Village Agricultural Programme (VAP), Kasama
Mr. Richard Gillett, Project Coordinator, Rice Development Project, Kasama
Mr. C. Mandon, Assistant Commercial Manager, ZCU, Kasama
Mr. Nangwale, oxen-using farmer, Kasama Settlement Scheme, Kasama
Mr. Kabwe, oxen-using farmer, Kasama Settlement Scheme, Kasama
Mr. Chilufya, oxen-using farmer, Kasama Settlement Scheme, Kasama

Tuesday 20 November

Mr. Nsenduluka, Oxen farmer, Chinkanga Village, Mporokoso, Northern Province
Mr. Mwansa, Chairman, Tubalange Multipurpose Cooperative Society, Laishi Village, Luingu, Northern Province
Mr. E. C. Kalaba, Acting P.A.O. Luapula, Mansa
Mr. Fresco Mumbi, Provincial Agricultural Engineer, Mansa
Mr. C. M. Sinkala, Provincial Animal Husbandry Officer, Mansa
Mr. A. Mutali, District Agricultural Engineer, Mansa
Dr. G. Haangoma, Provincial Veterinary Officer, Mansa
Mr. D. Masabo, Dairy Assistant, Mansa Rural Dairy, Mansa
Mr. J. Kapyra, Credit Manager, Luapula Cooperative Union Ltd, Mansa
Major Chalwe, oxen-using farmer, near Mansa
Mr. Dan Dahlin, Cattle Development Adviser, Luapula Rural Development Programme, Mansa

Wednesday 21 November

Mr. Rolando Silva, Adaptive Research Planning Team (ARPT), Mansa
Mr. Stanislaus Lubumbe, Livestock Officer, ARPT, Mansa
Mr. Mark Mulenga, Extension Training/Research Extension Officer, ARPT, Mansa
Mr. Peter Luzuwa, oxen-using farmer, Luzuwa Farm, Mansa District
Mr. Anthony Poloki, oxen-using farmer, Sanje Farm, Mansa District
Mr. Fred Kawele, oxen-using farmer, Chibalashi Middle Farm, Mansa District
Calobantu brothers, Calobantu Blacksmith Workshop, near Mansa

Mr. A. N. K. Seketeni, Branch Manager, Lima Bank, Mansa

Mr. John Chiwoka, Project Officer, Lima Bank, Mansa

Thursday 22 November

Mr. Stanley Muntanga, Managing Director, Northland Agricultural Ltd, Ndola

Mr. K. H. K. Goma, Production Engineer, Northland Agricultural Ltd, Ndola

Mr. A. G. Ngoma, Provincial Agricultural Officer, Copperbelt, Ndola

Mr. E. Munganama, Provincial Agricultural Engineer, Copperbelt, Ndola

Mr. E. Choongo, Animal Husbandry Officer, Ndola

Mr. Keith Owen, Agricultural Inputs and Credit Specialist, Smallholder Development Project, Copperbelt

Mr. Peter Stone, Project Coordinator, Smallholder Development Project, Copperbelt

Mrs. Efesa Sengela, oxen-using farmer, Ntwaleni Village, Mpongwe, Ndola Rural District

Mr. Boniface Wari, oxen-using farmer, Kitaba Village, Mpongwe, Ndola Rural District

Mr. Dan Kakunka, oxen-using farmer, Mpongwe, Ndola Rural District

Mr. Sanston Chikotana, oxen-using farmer, Chikotana Farm, Mpongwe, Ndola Rural District

Mrs. Ruth Mutolobale, oxen-using farmer, nr. Mpongwe, Ndola Rural District

Friday 23 November

Mr. C. Tembo, Provincial Animal Husbandry Officer and Deputy P.A.O., NWP

Mr. Mukuka, Provincial Agricultural Engineer, North Western Province

Dr. Jesse Kundaali, Provincial Veterinary Officer, NWP, Solwezi

Mr. B. Munalua, Coordinator, IFAD Programme, North Western Province

Mr. Kajoba, District Manager, North Western Cooperative Union, Solwezi

Mr. Musa, Credit Manager, NWCUC, Solwezi District

Mr. P. J. Sakala, oxen-using farmer, Kazoko Farm, Musamberlombe, Kasembe District

Mr. Nkalamo, District Agricultural Officer, Kabompo

Mr. Henry van der Lande, Management Adviser, Zambezi Cooperative Union, Zambezi

Mrs. Mieke van Grinsven, Management Adviser, Zambezi Workshop, Muzama Crafts Ltd, Zambezi

Saturday 24 November

Mr. Washeni, oxen-using farmer, Sagelenge Village, Kabompo District

Mr. Kenneth Litwai, oxen-using farmer, Samununga Village, Kabompo District

Mr. Justin Lumaya, oxen-using farmer, Mbwela Village, Kabompo District

Mr. John S. Kang'ombi, Chikata Village, Kabompo District

Mr. Tini Ruiten, Technical Adviser, Muzama Crafts Ltd, Manyinga

Mr. A. L. Lufuma, IRDP Coordinator, North Western Province

Dr. Ludwig Siege, Programme Advisor, IRDP North Western Province

Sunday 25 November

Mr. H. G. Kamphuis, Advisor, Animal Draught Power Programme, Western Province

Dr. Rob C. de Rooij, Provincial Veterinary Officer, Mongu

Monday 26 November

Mr. Paul M. Maimbo, Provincial Agricultural Officer, Mongu

Mr. C. Kapalasha, Provincial Agricultural Engineer and ADP Coordinator, Mongu

Mr. A. H. Sitima, Animal Husbandry Officer, Mongu

Ms. Mary Masona, Women Extension Coordinator, Mongu

Ms. Lydia M. S. Ndulu, PPP Coordinator, Mongu

Mr. W. A. R. Lauzens, Cattle Development Adviser, Western Province Cooperative Union, Mongu

Willem C. S. Heemskerk, Deputy Coordinator ARPT-WP

Mrs. Dicko, Livestock Specialist, ARPT-WP

Dr. Pheru Singh, Sorghum and Millet Programme, Western Province

Ms. Carin Vijfhuizen, Rural Sociologist, Livestock Development Project, WP

Branch Manager, Lima Bank, Mongu

Tuesday 27 November

Mr. Harm de Vries, Cattle Husbandry Specialist, Masese Agricultural Project

Ms. Wilma Slobbe, Crop Husbandry Specialist, Masese ADP

Mr. Lengwe, Coordinator, Masese ADP

Mr. Mulega, Assistant Coordinator, Masese ADP

Mr. Moses Silinganiso, donkey-using farmer, Nakatindi, Livingstone

Wednesday 28 November

Oxen-using employees of Muzunga Farm, Kalamo District

Mr. J. N. Chikwanda, District Agricultural Engineer (ag. PAE), Choma

Mr. B. Mzumara, Provincial Animal Husbandry Officer, Choma

Mr. N. R. Tebulu, Field Inspector, Logisitic Planning Unit, SPCMU, Choma

Mr. Marco Girelli, Agronomist, Integrated Farm Mechanization Development Project, SPCMU, Choma

Mr. Jairus P. Kambowe, Coordinator, Integrated Farm Mechanization Development Project, SPCMU, Choma

Mr. A. Makani, Buying Officer, Zatco, Choma

Dr. Satwant Singh, Provincial Veterinary Officer, Choma

Mr. T. M. Simutowe, Provincial Livestock Officer, Choma

Coach Builders, ox cart workshop, Choma

Mr. Paul Mswana, Choma Carpentry Workshop, Choma

Mr. Bruce Danckwerts, oxen-using commercial farmer, New Venture Farm, Choma

Thursday 29 November

Mr. Mike Beckett, oxen-using commercial farmer, Momba Farm, Choma

Mr. T. M. Mudaala, General Manager, Southern Province Cooperative Marketing Union, Choma

Friday 30 November

Mr. George Kampekete, oxen-using farmer, Kampekete Village, Chiwambe-Kabwe Rural

Mr. Ronald Simuyi, Provincial Agricultural Engineer, Kabwe

Mr. Stanny Lavu Tembo, Provincial Animal Husbandry Officer, Kabwe

Mr. Aaron Mkandawire, District Agricultural Engineer, Kabwe North

Mr. Moffat J. Phiri, District Agricultural Engineer, Serenje

Dr. M. L. Vyas, Provincial Veterinary Officer, Kabwe

Mr. W. Traugott Hartmann, Animal Traction Specialist, Smallholder Development Project, Kabwe

Mr. Clement Longa, Regional Enterprise Adviser, Copper Mines Enterprise Trust (COMET), Kabwe

Mr. Nicholas Sherwood, Training Officer, COMET, Kabwe

Mr. Golden Dowanga, oxen-using farmer, Shaputa, Chibombo, Kabwe Rural

Saturday 1 December

Ms. Maria Tekülve, Planning, Monitoring and Extension Officer, NW-IRD

Sunday 2 December

Mrs. A. Marikano, oxen-using farmer, Chalimbana Village, Lusaka Rural

Mr. Lungu, oxen-using farmer, Masangano Village, Nyimba District

Mr. Phiri, oxen-using farmer, Dick Village, Petauke District

Monday 3 December

Mr. Mashati Tembo, oxen-using farmer, Lunkunswe Farm, Chipata

Mr. John Kaenga, Provincial Agricultural Engineer, Chipata

Mr. Paul B. Thole, Team Leader, FAO Agricultural Mechanization Development Project (AMDP), Chipata

Mr. Danny Nyoka, Head, Blacksmith Section, FAO-AMDP, Chipata

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Ms. Sabine Meyer, Training Officer (Woodwork), Katopola AEC, Chipata

Mr. Thomas Banda, Mutowe School leavers Project, Chipata

Mr. John Nyoni, Chairman, Msokhocika Projects, Chipata

Ms. Christine Takatsch, Msokhocika Projects, Chipata

Mr. D. Banda, Managing Director, Daba Enterprises Ltd, Chipata

Mr. George Mbewe, Managing Director, Studio 6, Chipata

Tuesday 4 December

Mr. Willem B. Hoogmoed, Tillage specialist, Magoye RRS and Wageningen Agricultural University

Wednesday 5 December

Mr. Fred Chisanga, Natural Resources Development College, Lusaka

Mr. Henry Sichembe, Provincial Agricultural Engineer, Lusaka

Mr. Mubanga Mushimba, Provincial Farm Management Officer, Lusaka

Mr. Raymond M. Muzumbwe, Provincial Animal Husbandry Officer, Lusaka

Thursday 6 December

Mr. Willem Lublinkhof, oxen-using commercial farmer, Kafue

Mr. Chitah, Officer-in-Charge, Regional Research Station (RSS), Magoye

Mr. Roelof A. Meijer, Agricultural Engineer, RRS, Magoye

Mr. B. Chanda, Agricultural Engineer, RRS, Magoye

Mr. Piet A. Stevens, Agricultural Engineer, RRS, Magoye

Monday 10 December

Mr. Thomas Selänniemi, Finnish Volunteer Service, Mansa

January and February 1991

Mr. Trevor Cayless, Attaché Aid and Development, British High Commission, Lusaka

Mr. E. Gunnar Ring, Rural Development Adviser, Delegation of the Commission of the European Communities, Lusaka

Mr. Peter Rhode, Head of Project Administration Service, GTZ, Lusaka

Mr. Erik Bergstrand, Senior Programme Officer, Development Cooperation Office, Swedish Embassy, Lusaka

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Ms. S. I. Toro, Embassy of Finland, Lusaka

Mr. F. Mangano, Italian Embassy, Lusaka

Mr. Gerhard Ritter, Smallholder Development Project - Central Province, Kabwe

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