University of Fort Hare

FEEDING DRAUGHT CATTLE IN SEMI- ARID AREAS

DFID Livestock Production Programme

Final Technical Report Project R6609

June 1999

EXECUTIVE SUMMARY

The project developed and promoted recommendations on feeding and management practices for draught animals to improve their effectiveness in crop/livestock systems on smallholder farms. Feeding trials were undertaken on-station in South Africa to validate aspects of feeding standards for oxen used for work and identify strategies to enable farmers to match the energy needs of working oxen with the energy resources available. Participatory studies with farmers determined the use and management of draught animals and the feed available for them in small-scale farming systems in Eastern Cape Province and the constraints to development.

The knowledge gained from the on-farm work showed that draught animal power could play a major role in revitalising agriculture and rural development in Eastern Cape. This would improve food security and alleviate poverty in rural communities. Many rural communities now find themselves in the situation where income from pensions and outside employment is declining, but population is increasing as the unemployed return to their home areas. There was an increasing belief in the use of draught animal power in small-scale agriculture. The more general concerns identified by small-scale farmers were a shortage of the information that they needed, much of which is available, to improve their farming practices, problems with theft of livestock and encroachment of cattle on to crops, inaccessible support services particularly veterinary services, and the current communal land tenure system which many felt inhibited a personal sense of ownership of the agricultural resources and therefore their optimal use.

The on-station work tested some of the hypotheses associated with feeding standards produced for cattle. It provided some recommendations in the use of these feeding standards to predict energy requirements of working cattle in the field. Strategies to match energy resources to energy requirements of working cattle were also investigated. In small-scale agricultural systems energy for work can be provided satisfactorily from body stores in addition to energy in feed. Lean animals work just as well as those that are in good condition, provided cattle do not fall below a body condition score of 3 on a scale from 1 (emaciated) to 9 (obese). Supplementary feeds for working cattle need only be provided during work, although there is a small advantage in also providing then in the week before work starts. Feed resources on most small-scale farms in Eastern Cape are currently not sufficient to maintain large draught horses and these farmers should not be encouraged to do so.

A workshop was held at the end of the project. Farmers, extensionists, teachers, university lecturers, students, researchers, engineers and machinery distributors involved in various aspects of small-scale agriculture discussed the project findings, identified pathways for dissemination and follow-up proposals.

Front cover: Stanley Israel working his draught cattle in a feeding trial at the Research farm, Honeydale, University of Fort Hare, Eastern Cape.

BACKGROUND

Potential impact of animal power in Sub-Saharan Africa and problems addressed
Food shortages are estimated to affect one quarter of the population of sub-Saharan Africa (World bank, 1989). To overcome these shortages, to feed the growing population (reckoned to double over the next 20 years) and to reduce dependence on food imports, food production must be increased by 4% annually. Past studies indicate that it costs twice as much to prepare 1 ha of land with a tractor as it does using draught animal power (Morris, 1983) and tractors may even have a negative effect on crop production, with farmers overextending themselves in the areas ploughed, to the detriment of crop management (Panin, 1995). Hand labour can be the cheapest power source but the area of cultivation possible is low, about 2 ha. Tractor use is limited on small farms in sub-Saharan Africa and draught animal power is the only alternative to hand labour. Animal power is estimated to be the second most valuable output of livestock in sub-Saharan Africa and in developing areas of South Africa (FRD, 1995). For example in remote areas of South Africa it is estimated that 40-80% of families engaged in smallholder farming make some use of animal power (Starkey, 1995).

The benefits of improving draught animal power are measurable. In Zimbabwe on smallholder farms a clear relationship was shown at the household level between the number of draught animals per farmer and the area ploughed (CPU, 1988). Also in Zimbabwe Shumba (1986) reported a decrease in crop yield of about 10% for every week that planting was delayed and Metelerkamp (1987) emphasised the importance of timeliness of planting on maize and cotton yields. Maize planted 15 November yielded 3.9 t/ha whereas maize planted 15 December yielded only 1.9 t/ha. Yields of cotton planted after 25 October declined steadily, with each week's delay in planting. By 6 December yields were half those of cotton planted on 25 October (Metelerkamp, 1987). The importance of timeliness of cultivation for food production is obvious. Unavailability of animals at the right time for farmers who have to hire draught animals also leads to lower yields as owners naturally meet their needs first, before hiring out their stock. Increasing the area ploughed may reduce the risks of crop failure or increase crop output, while timeliness in planting optimises yield. Animals can also be used in weeding to alleviate bottlenecks and reduce the workload of women. Thus improved use of draught animal power can improve the food security of the smallholder farmer.

The crop-livestock interaction is not confined to ploughing: the availability of manure as fertiliser is important, and improved household nutrition through milk consumption may indirectly increase the effective household labour supply (Barrett, 1989).

On smallholder farms there is a need to use animal and feed resources in an efficient, sustainable way in the production of food and cash crops, optimising human effort and minimising the negative impact on the environment. In many areas the quantity and often the quality of the grazing land is decreasing and farmers have trouble maintaining the number of animals that they require.

Research on feed requirements of draught oxen, mainly funded by DFID has resulted in the development of feeding standards to allow energy needs of working cattle to be predicted. Some of the hypotheses used to develop the standards need validating, and the predictions need to be tested in different situations. Farmers keeping draught animals need to consider the best ways of meeting their working animal's energy needs, whether it is through body reserves or supplementary feeding. If supplementary feeds such as crop residues and other cut-and-carry fodders are available, then farmers need to consider when it is most effective to give these to their working animals.

Local issues addressed within South Africa

In South Africa, problems of low productivity within the small-scale farming sector are compounded by a complex mixture of social, political, economic and environmental issues arising from the area's political past. For example an agricultural study in Transkei (Transkei Government, 1991) described the situation as follows: "Crop and livestock productivity are both low, with maize averaging less than 500 kg per ha and a livestock off-take of less than 5%, together with overgrazing and soil erosion". In Eastern Cape Province, recognised as one of the poorest Provinces in South Africa, more than half the rural households have no real interest or commitment to farming, but own livestock as an investment. Most rural households are not self-sufficient in food, and rely on off-farm income. The youth and able-bodied labour force of the rural areas are drawn away to urban centres leaving mainly pensioners, women and children at home. Agriculture is not now looked upon as a career option or income-generating activity, although it was very much so in the past. Now most families depend on pensions and remittances from relatives working elsewhere to buy food. However, these sources of income are decreasing as more unemployed people return to their home areas and pensioners die.

In order to improve food security in these areas agriculture needs to be revitalised and people encouraged into food crop production. At present crop production in the former homelands is not market orientated, with most food grown for home consumption. Currently people are willing to invest labour, but not capital in crop production. The arable allocations are very small, so farmers' individual requirements for power are not high. In this environment animal power, for producers who own livestock, would seem to be an attractive option. Despite the promotion of motorised forms of power for use in crop production and transport in South Africa, tractors remain an unaffordable and uneconomic technology for many farmers with small land holdings. An appraisal of animal power within South Africa in 1995 indicated that draught animal power was still used on smallholder farms (Starkey, 1995) despite it being perceived by many of the agricultural institutions in the country as being an outdated and impractical technology for agricultural production. A need was identified for more information on the use of animal power in smallholder communities within South Africa (Starkey, 1995), "so that effective research and development strategies could be devised."

The demand for the project

Apart from the obvious application of knowledge gained on (i) how to best to match feed resources to requirements for draught animal power in semi-arid areas, and (ii) the present role of draught animal power in smallholder agriculture in South Africa, more specifically the demand for the project came from two directions:

- From the DFID LPP, who identified a need to validate the feeding standards for draught animals that had been developed by CTVM mainly from DFID funding.
- A request from the Department of Agriculture in South Africa to CTVM, via the Animal Traction Centre at Fort Hare University for assistance in gathering information on the use of draught animals in Eastern Cape following the 1995 appraisal undertaken by the South African Network for Animal Traction (SANAT).

References

Barrett, J.C. 1989. Valuing animal draught in agropastoral farming systems in Zimbabwe. Workshop on Tillage, past and future, Institute of Agricultural Engineering, Hatcliffe, Harare, November 14 1989.

Central Planning Unit. 1988. Agricultural statistics 1988, Ministry of Lands, Agriculture and Rural Resettlement, Republic of Zimbabwe

Foundation for Research Development (FRD), 1995. Announcement of new programmes, Rep. of South Africa

Metelerkamp, H.R.R. 1987. Review of crop research relevant to the semi-arid areas of Zimbabwe. In: Proceedings of the AGRITEX Workshop on Cropping in the semi-arid areas of Zimbabwe, Harare, August 1987, pp 190-315

Morris, J. 1983, Smallholder mechanisation: man, animal or engine? *Outlook on Agriculture* 12, 28-33.

Panin, A 1995. Empirical evidence of mechanisation effects on smallholder crop production systems in Botswana. *Agricultural Systems* 47, 199-210.

Shumba, E.M. 1986. Yields of maize in the semi-arid regions of Zimbabwe. *Zimbabwean Agricultural Journal* 81, 91-94.

Starkey, P.H. (ed). 1995. *Animal Traction in South Africa: empowering rural communities.* Development Bank of Southern Africa, Halfway House, South Africa.159p. ISBN 1-874878-67-6.

Transkei Government 1991. *Transkei Agricultural Development Study.* Rural Development Services. 355p

World Bank, 1989. Sub-Saharan Africa. From crisis to sustainable growth. A long-term perspective study. World Bank, Washington, DC, USA

PROJECT PURPOSE

To develop and promote recommendations on feeding practices for draught animals to improve their effectiveness in crop-livestock systems on smallholder farms. Feeding trials were undertaken on-station to validate some of the hypotheses used to develop feeding standards for oxen used for work, to test the predictions of energy requirement in different situations and to identify strategies to enable farmers to match the energy needs of working oxen in semi-arid areas with resources available. Participatory studies with farmers were undertaken on-farm to determine the use and management of draught animals, the feed available for them in Eastern Cape farming systems, and constraints to development. Investigations of constraints associated with the use of equids in addition to cattle were included largely at the request of farmers. At the end of the project a workshop was held with stakeholders to present and discuss findings, determine dissemination pathways and identify further activities needed to encourage and promote improved food security in the small-scale farming areas.

RESEARCH ACTIVITES

The papers included in Appendix One provide detailed descriptions of all the research activities that were conducted to achieve the outputs of the project. The facilities, equipment and techniques used to implement the project are included in these papers.

Special resources

Four special resources must be highlighted as the project could not have achieved so much without them:

- The presence and work of Mr Stanley Israel on the project. He joined CTVM as a PhD student, made possible with funding from NORAD, and took overall responsibility for day to day implementation of the on-station work, carrying out most of the actual work at Fort Hare Research Farm.
- The free loan from the Agricultural and Rural Development Research Institute (ARDRI) at the University of Fort Hare of a vehicle for use on the project. This enabled the work with local farmers to be undertaken.
- The MSc and Agriculture (Honours) students at UFH and CTVM who undertook some of the field survey activities during the course of the project: Mr N.T. Mzileni (Honours Agric and MSc), Mr L. Mapeyi (Honours Agric), Mr D. Taylor (MSc), Miss J Kneale (MSc). Mr Nimrod Mdledle the Middledrift extension officer also assisted in introductions to farmers and monitoring of participatory activities.
- The Animal Traction Centre's local promotion and training activities. These provided an immediate promotional pathway during the project to local farmers and extension officers. Project activities and preliminary findings were disseminated and also a direct feedback from farmers to the project staff was possible throughout the project.

Comparison of actual with proposed activities

Actual activities have followed proposed activities fairly closely. As the project evolved, more emphasis was placed on ways to match energy resources to energy requirements, than on actual energy balances and factors, which might contribute to differences in energy balance from predicted values. However the energy balances from all the on-station studies will be looked at in more detail during the further analysis of all the data collected in the on-station studies, by Mr Israel between June-November 1999, during completion of his PhD thesis.

Additional activities undertaken on the project concerned the investigations of constraints associated with the use of working equids in smallholder areas. These were included largely because emphasis at the Fort Hare Animal Traction Centre (ATC) seemed to be on the use of the large heavy horses favoured by commercial farmers, but the majority of smallholder farmers owned small lightly built animals, which seemed to be kept mainly for riding.

One of the major problems encountered was a fire in the Forage Shed at Fort Hare research farm which destroyed feed supplies and meant that one of the on-station feeding trials had to be re-started 6 weeks into the trial, following the purchase of replacement feed.

OUTPUTS

Recommended feeding strategies for work oxen appropriate to smallholder farmers conditions have been published and validated for promotion: Feeding Standards for Cattle used for Work by P.R. Lawrence and R.A. Pearson, CTVM, ISBN 0-907146-082.

Information on farming families' practices, perceptions and constraints in relation to draught animal husbandry and farm power was obtained. This knowledge is currently available as three technical reports from either Fort Hare Animal Traction Centre (ATC) or the Centre for Tropical Veterinary Medicine (CTVM), and as a paper in the journal *Development Southern Africa, 1999 volume 16, pages 319-333.* The database developed is also being used by the Agricultural and Rural Development Research Institute (ARDRI) to assist them in their work with rural communities.

General knowledge gained from the on-farm studies indicated:

- There is an increasing belief in the use of draught animal power in small-scale agriculture in South Africa.
- Draught animal power can play a major role in revitalising agriculture and rural development in Eastern Cape. Not only can it assist farming families in cash and food crop production, but support services such as implement repair, harness and yoke fabrication can provide jobs for other community members and animal power provides a means of local transport if sledges and carts are used.
- Small-scale farmers are not receiving the information that they need, much of which is available, to improve their farming practices.
- Major concerns include theft of livestock and encroachment of cattle on to crops, inaccessibity of support services particularly veterinary services, and a decline in the conditon of the veld in some areas reducing the traditional source of food for livestock within the area, including working animals.
- The current communal land tenure system inhibits a personal sense of ownership of the agricultural resources, and therefore their optimum use. It can discourage individuals, particularly young people from farming.

Information on strategies to meet the energy requirements of draught oxen using available feed resources, which can be applied not just in the Eastern Cape, but elsewhere in sub-Saharan Africa has been obtained. Three hypotheses behind the feeding standards for draught cattle were tested. In total four experiments were undertaken. The following recommendations for people using the feeding standards are made:

- The assumption in the feeding standards that animals in a team do equal amounts of work is valid for teams of two, but is not necessarily valid when animals work in a team of four. Comparison of actual with predicted energy balances of cattle working in teams of four, suggest that animals in these teams do not always do equal amounts of work.
- The hypothesis that net energy expended during work declines in a consistent and hence predictable way is valid during field work, but may not hold when cattle are carting loads on roads or tracks. In this case energy expenditure can increase as animals approach home, because some teams speed up, increasing their rate of work as they approach home.

- The assumption that the ability to work in cattle is dependent more on actual live weight than on the body condition is valid providing body condition is not extreme i.e provided the body condition score is within 3-7 on a scale from 1 (emaciated) to 9 (obese).
- Tropical cattle can be later maturing, and although of a suitable weight for work may still be growing. In this case predictions of energy requirements during work can underestimate actual needs, unless energy needs for growth are also taken into account. Hence age and maturity need to be assessed when predicting energy needs for work.

The following further recommendations as a result of the project work can be made to help farmers develop strategies to allocate feed resources to meet the feed requirements for work:

- Cattle subjected to a heavy work load are less selective when feeding than those which have spent less energy on work during the working day, and so are likely to obtain less nutrients from the food than those cattle which are more discriminating when selection is possible.
- A steady weight loss during work does eventually result in a reduced willingness to work. Only when live weight has fallen to a level at which the animals have difficulty generating the pull necessary to meet draught force required, does work rate fall off. Cattle losing weight during work perform as well as cattle maintaining or gaining weight until this happens - i.e. weight loss, which is often unavoidable during work is not necessarily deleterious to performance unless it is extreme.
- If body condition falls below 3 on a scale of 1-9 then cattle become too weak to work.
- When feed availability during work is plentiful, animals in lean body condition (score about 3) work as well as those in good body condition (body score 6).
- Given a fixed amount of feed (e.g lucerne + cob meal) to supplement a low quality forage (e.g bush hay) there is little difference to overall work performance whether half the supplement is given over several weeks before work with the rest being fed during the work period, or whether all the supplement is given during the working period. There is a small advantage in the first week of work in having fed before the onset of work, but this advantage disappears by the second week of work, hence both strategies are acceptable. More labour can be required for feeding if supplement is provided in the weeks before work and during work.
- Sunflower cake or cob meal (3.6 kg fresh weight/500 kg animal per day) and lucerne (3.0 kg/500 kg animal per day) enable animals doing an average day’s work to maintain or gain live weight when fed on maize stover. Lucerne was the cheapest option if feeds had to be purchase, but was not as easy or quick to feed as the cake or meal. Animals eating the sunflower cake gained the most weight during work.
- In Eastern Cape Province planting of barley, wheat or oats on crop land can provide a source of green fodder for draught cattle in the dry season, before the summer rains, at a time when grazing on the communal areas is poor.
- At present resources (food, finance and husbandry) on most smallholder farms are more suited to the maintenance of cattle, donkeys and small horses than the larger heavy horses, which originate from the commercial farming sector.

Other recommendations may result from the more detailed analysis of the results of the on-station work currently being undertaken using NORAD funding.

Information on the veld condition in one of the communally owned veld grazing areas is available as an Agricultural Honours Project dissertation from the ATC, Fort Hare. The information is being used by pasture scientists in their work to develop appropriate techniques to assess veld condition in communal areas and assist farmers in these areas in veld management.

Data collected on the project has added to the database relating to energy balance of draught animals in semi-arid production systems

DAP research capacity in South Africa has increased. Staff at the Animal Traction Centre have received training and equipment to allow them to record work performance in the field, students have been trained in PRA and survey techniques and at least two people should have obtained higher degrees by the end of 1999 in DAP subjects. Training and assistance were also given to staff to enable them to monitor implement performance on the ARC Institute of Agricultural Engineering (ILI/IMAG) implement trials in which ripper tines have been given to local draught animal farmers. Facilities to individually house and work draught animals are now available at the ATC. The project enabled links to be developed and strengthened between the University of Fort Hare (an historically black University) and the University of Pretoria (an historically white University) both of which had been studying draught animals in different parts of South Africa.

Agricultural extension staff working with small-scale farmers are more aware of the potential of draught animal power in small-scale farming activities, through the dissemination of information, including that from the project, by the ATC in information days and demonstrations at agricultural shows than at the start of the project.

CONTRIBUTION OF OUTPUTS

To the project goal

The information produced will enable those working with smallholder farmers to promote better use of draught animal power mainly through more effective management of feed resources within semi-arid smallholder farming systems. As a result it will meet the project goal of ‘Improving the performance of livestock, including draught animals, in crop livestock systems’. Better and more widespread use of draught animals enables small-scale farmers to produce more food than they would otherwise do manually, thus improving the food security and alleviating poverty within the community.

Promotion pathways and follow-up

A stakeholder workshop was held on 20-22 April 199 at Fort Hare University The workshop brought together many of the stakeholders who have an interest in improving the agricultural production of small-scale farmers in Eastern Cape and who see the use of draught animal power as a means to achieve this. From within South Africa participants in the workshop included: local small-scale farmers from within the Province; extension personnel from the Department of Agriculture and Land Affairs; Maxim Trading Enterprises (distributors of ZIMPLOW manufactured equipment); agricultural lecturers from the local high school (Pandulwazi), colleges (Fort Cox and Lovedale), the Border Technikon and the universities (Fort Hare and Pretoria). Researchers (agricultural

engineers, agricultural economists, agronomists, livestock and pasture scientists, sociologists and veterinarians) from universities and the ARC Institute of Agricultural Engineering (IAE/ILI) were present. Participants from Zimbabwe, the UK, Nigeria and a NGO (Vetaid) in Mozambique working with draught animal power also attended.
'Whisper translation' from English into Xhosa by two people bi-lingual in Xhosa and English (John Sneyd and Nimrod Mdledle) was provided continuously throughout the workshop presentations and discussions for those participants who were not fluent in English.

During the final discussion session, dissemination pathways were identified through which the results of the project will be made available:

Initial dissemination

- Through technical reports (available now) the workshop proceedings (available July 1999) and planned research papers (available 1999/2000). These will be distributed to the Universities, Technikons, and local high schools to be incorporated into their curricula and to the Department of Agriculture for incorporation into their extension materials. Some have already been circulated.
- The workshop proceedings will be sent to the Department of Agriculture and Land Affairs in Pretoria as well as in the Eastern Cape. These will be available in July 1999.
- An objective is to present some of the results of the project at the next ATNESA conference on draught animal power in South Africa in September 1999.
- The Animal Traction Centre will incorporate any extension messages coming from the project into its training curricula for farmers and extension officers and promote the messages at the agricultural shows they attend, after producing it in a suitable form.

Follow-up action needed to promote findings further

Realistically, additional finance is needed to enable the researchers on the project to link with the Department of Agriculture and Land Affairs to produce extension materials in a form suitable for local and regional distribution to farmers. Proposals have been sent in June 1999 to the FRD and two charitable trusts in South Africa asking for funding to enable the researchers on the project to get together with the Department of Agriculture to produce extension materials in a form suitable for local and regional distribution to farmers. DFIDs regional office (DFIDSA) was also approached, but further development and application of the project knowledge did not come under any of their current fields of interest, although they were willing to support any application made to British Council for funding for UK scientists to visit South Africa.

Follow-up researchable issues

The role of draught animal power in rural development in South Africa

The on-farm work showed that draught animal power can play a major role in revitalising agriculture and rural development in Eastern Cape, to alleviate poverty in these areas. Crop production is a risky business, particularly in the more arid areas, where the rainfall is generally both inadequate and highly variable. Crop yields are often low. These areas are better suited to extensive livestock farming. The chances of the application of draught animal power being successful in revitalising agriculture in

Eastern Cape lie initially in the part they can play in revitalisation of the small-scale irrigation schemes, many of which are under-producing through a shortage of power. In these schemes the effects of the vagaries of rainfall on crop yields are minimised and labour inputs have a greater chance of being rewarded. At the workshop it was recommended that a development/research project be undertaken between ATC, CTVM, SRI and the Department of Agriculture and Land Affairs to encourage the development of these irrigation schemes and the parallel application of animal power within the schemes. Major issues would include identification of the feed and animal power resources that would be needed to improve the productivity of these areas, through the production of food and forage crops during the year.

Publications

A list of publications, internal report available on request from CTVM or ATC, and other dissemination activities undertaken during the course of the project are given below:

Lawrence, P.R. and Pearson, R.A. 1999. *Feeding Standards for Cattle used for Work.* Centre for Tropical Veterinary Medicine, University of Edinburgh, Easter Bush, Roslin, Midlothian, EH25 9RG, ISBN 0 907146 082.

O'Neill, D.H. 1999. Draught animals. In: *CIGR Handbook of Agricultural Engineering, Vol II: Animal Production and Aquacultural Engineering* (ed E.H. Bartali). American Society of Agricultural Engineers, Michigan.

O'Neill, D.H., Sneyd, J., Mzileni, N.T., Mapeyi, L. the late Njekwa, M. and Israel, S. 1999. The use and management of draught animals by smallholder farmers in the former Ciskei and Transkei, Eastern Cape Province. *Development Southern Africa* 16, 319-333.

Pearson, R.A. 1996. Feeding strategies for cattle and buffalo used for work. *World Animal Review* 87, 45-55.

Pearson, R.A. 1998. Draught animals and their management – the future in rain-fed agriculture. *Annals of the Arid Zone* 37, 233-251.

Pearson, R.A. and Vall. E. 1998 Performance of draught animals in sub-Saharan Africa: a review. *Tropical Animal Health and Production* 30, 309-324.

Pearson, R.A., Dijkman, J.T., Krecek, R.C. and Wright, P. 1998. The effect of density and weight of load on the energy cost of carrying loads by donkeys and ponies. *Tropical Animal Health and Production* 30, 67-78.

Pearson, R.A., Wythe, S., Joubert, B., O'Neill, D.H. and Simalenga, T. (eds). *Management and Feeding of Animals for Work*. Proceedings of a Workshop at Fort Hare University, 20-22 April, 1999, CTVM Draught Animal Power Technical Report 4. Animal Traction Centre University of Fort Hare / Centre for Tropical Veterinary Medicine, University of Edinburgh, 161p, ISBN 0-907146-09-0 (in press).

Pearson, R.A., Zerbini, E. and Lawrence, P.R. 1999. Recent advances in research on draught animals. *Animal Science* 68, 1-17.

Powell, J.M. Pearson, R.A. and Hopkins, J.C. 1998. Impacts of livestock on crop production. In: *Food, lands and livelihoods – setting research agendas for Animal Science*. pp 53-66. Occasional Publication No 21, British Society of Animal Science.

Internal Reports:

O'Neill, D.H., Sneyd, J., Mzileni, N.T., Mapeyi, L., Israel, S. and the late Njekwa, M 1999. The management and use of draught animals by smallholder farmers in the former Ciskei and Transkei, Eastern Cape Province, South Africa. Centre for Tropical Veterinary Medicine Draught Animal Power Technical Report 1, CTVM, University of Edinburgh, Easter Bush, Roslin, Midlothian, EH25 9RG.17p.

Israel, I., Mzileni, N.T., Pearson, R.A. and O'Neill, D.H. 1999. Seasonal contributions of draught animals to activities in small-scale "emerging" farming in the Eastern Cape of South Africa. Centre for Tropical Veterinary Medicine Draught Animal Power Technical Report 2, CTVM, University of Edinburgh, Easter Bush, Roslin, Midlothian, EH25 9RG. 25p.

Taylor, D. 1999. The use of donkeys, horses and mules in the former Ciskei region of the Eastern Cape, South Africa. Centre for Tropical Veterinary Medicine Draught Animal Power Technical Report 3, CTVM, University of Edinburgh, Easter Bush, Roslin Midlothian, EH25 9RG. 44p.

Other dissemination of results

Joubert, A.B. D. 1997, Fort Hare Animal Traction Centre. Draught Animal News, 26, 2-3.

Israel, I. 1999 Matching feed energy resources to energy requirements of working cattle in semi-arid areas, PhD Thesis (in preparation).

Numerous farmers days at the Animal Traction Centre, University of Fort Hare where progress, dissemination of information on the project and preliminary results have been discussed with farmers directly and extension and development officers.

Dissemination through articles in the popular press - NUFARMER and FARMERS WEEKLY on several occasions during the project.

Dissemination through demonstrations/posters at Agricultural Shows given via the Animal Traction Centre's programme of promotion of DAP and draught animal management within South Africa.

Dissemination to students at the Universities of Edinburgh, Fort Hare and Pretoria in lectures on DAP, and to 18 people from sub-Saharan Africa on a DFID funded short course on DAP technology given jointly by the Universities of Edinburgh, Fort Hare and Pretoria in September 1998.

Dissemination via personal contacts within the ATNESA and SANAT networks and visitors to the Animal Traction Centre at Fort Hare, the Silsoe Research Institute, Bedford, UK and the Centre for Tropical Veterinary Medicine, Edinburgh, UK.

APPENDIX ONE

ACTIVITIES AND OUTPUTS

The project team with farmers and some of their produce grown using animal power

A survey of current use and management of draught animals by smallholder farmers in Eastern Cape

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ABSTRACT

A survey was undertaken on the use and management of draught animals in the Eastern Cape Province. Information was elicited through semi-structured interviews at 94 rural households, most of which owned livestock. Each household owned an average of 5.4 oxen, 8.3 cows and 1.0 horses. Animals were used for draught by 79% of the farmers; only 22% used cows for draught and only 12% used equids for draught. The commonest uses were weeding, cultivating, ploughing and harrowing. Horses were kept mainly for riding. Most farmers preferred animals to tractors for crop production tasks, but many farmers (74%) used tractors occasionally; only 18% had never used tractors. The preferred span size for ploughing was six animals and 38% of the farmers used spans of six. Supplementary feed was given to livestock by 50% of the farmers but only 4% fed working animals; the priority was for cows in milk (44%), for the economic return. The commonest feed supplements were homegrown maize stover and purchased lucerne. Most farmers (91%) believed that it is profitable to own draught animals but 97% were concerned about the risks of drought, theft and disease.

INTRODUCTION

A survey of 94 rural households was undertaken in 19 districts of the former Ciskei and Transkei in the Eastern Cape Province. Although a recent appraisal by Starkey (1995) indicated that draught animal power is widely used on smallholder farms, the practices adopted by smallholder farmers in South Africa, particularly with respect to their use of farm power, are poorly documented. The survey was undertaken to find out how smallholder farmers typically use and manage their draught animals, their attitudes to draught animal ownership and to gain some insight into their socio-economic circumstances.

Such information is better documented in some other southern African countries, notably Zambia and Zimbabwe, where draught animals play a major role in crop production. In these countries, the reported problems include a shortage of draught animal power, a lack of feed resources and a lack of suitable implements (e.g. see Barrett, O'Neill and Pearson, 1992). The survey findings facilitate comparison of the situations in South Africa and other countries in the region and can help promote the transfer and exchange of appropriate draught animal technology between these countries. The survey, therefore, is expected to contribute to the development of smallholder agriculture in the region through both the improvement of draught animal technology, by the identification of strategic research needs, and the targeted development and promotion of better farming practices.

METHODS

The survey was conducted between August and November 1996 in the districts of Ciskei and Transkei shown in Table 1. The households were selected by local extension officers for their willingness to participate and not specifically based on draught animal ownership. The survey team comprised two to four people for each visit; at least two of whom spoke fluent Xhosa, including the team leader who led the discussion. The information was elicited through semi-structured interviews in the form of wide-ranging discussions with the heads of the households (or a senior member in his or her absence) covering four main areas – demographic, socio-economic, animal and crop factors. The key lines pursued were membership and activities of the household, animal (particularly draught animal) ownership, the tasks for which the animals are used, how they are fed and other issues concerning husbandry in general.

Table 1: Districts surveyed

Ciskei (households 1 – 53)	**Transkei** (households 54 – 94)
Melani	Lady Frere
Ngwenya	Upper Ndonga
Debe Marela	Ngqweleni
Koloni	Maxelegweni
Peuleni	Butterworth
Upper Ncera	Gwegwe
Chamama	Xwili
Dishi	Centuli
	Nqunge
	Thuthura
	Qamata

The discussions were kept on the desired course by the help of a questionnaire, with which the survey team had fully familiarised themselves. This enabled them to develop interesting side issues, whilst ultimately being able to complete the discussion with all the major concerns addressed. The questionnaire contained 104 questions covering the four main areas given above, ranging from binary (e.g. 'yes/no') to numeric (e.g. how many cows do you own?) to open-ended (e.g. why do you use cows for work?). The 104 questions generated 181 answering situations, as some questions were subdivided (e.g. Q 43, on the preference of animals or tractor for draught work is associated with a separate response opportunity for each of 5 tasks – ploughing, harrowing etc). Each of the 181 answering situations had at least two options (as in the case of the binary) but usually many more than two for the numerical and open-ended questions. All the answering options were coded into integer format and analysed using a spreadsheet (Microsoft Excel, version 4.00).

RESULTS

Most of the results are presented in the form of histograms, with each column representing one farmer, or household. Two different formats of histogram have been used, selected according to the appropriateness of either identifying individual farmers or grouping together the farmers that are alike, based on the subject of the histogram. Thus, in the first case, the numbers on the horizontal axis are the farmer (household) identification codes and, in the second case, the numbers are simply the cumulative total (i.e. the numbers do not give the identity). The frequencies have been arranged in ascending order for ease of interpretation.

DEMOGRAPHIC

Household composition The heads of household were predominantly male (91%) and ranged in age from 20 to 94 years, but more than half were over 60 years (average 61.7 years). The average household size was 8 people, ranging from two to 18 people, with up to 13 children (in one of the households) attending school, whilst the average number of children was four. Many of the households (74%) had family members working away from home, the average being 2.2 and the maximum being nine. The eight women who headed households had an average age of 67 years (ranging from 51 to 85 years) and the household sizes varied from four to nine people, with between one and five people working away.

In most households the responsibility for managing and using draught animals is shared between men and women, with only 16% of households indicating that women did not help. Women are similarly involved in caring for crops, with only 14% of the households responding negatively to this question. In both cases, however, men did the bulk of the work. The main agricultural activities undertaken by women were found to be planting, weeding and leading animals but only 3% of the women ploughed. Perhaps surprisingly, these women were not from female-headed households although, in one of these households, the male head worked away on a monthly basis.

Children helped with draught animals in nearly all the households (95%). Although adults helped also, it was found in at least one district that farmers might delay their draught animal tasks until their children came out of school in the afternoon.

Animal ownership The numbers of large animals (namely cattle, horses and donkeys but excluding goats, sheep and poultry) owned by the households participating in the survey are shown in Figure 1. The ownership of cattle, sub-divided into oxen, bulls and cows is shown in Figure 2. Statistical details for the different types of cattle and equids for the participating households are given in Table 2.

Table 2: Ownership of large animals by households in the survey

	Oxen	Cows	Bulls	Horses	Donkeys	Mules
Total	508	779	30	96	16	3
Average/h'hold	5.4	8.3	0.3	1.0	0.17	0.08
Median	4	6	0	0	0	0
Mode	0	6	0	0	0	0

If the three cattle types are combined, the average cattle ownership per household is 14, with a median of 11 and a mode of 4. Only two farmers owned more than 50 cattle; one of these owned 150 of which 98 were cows, 50 were oxen and two were bulls.

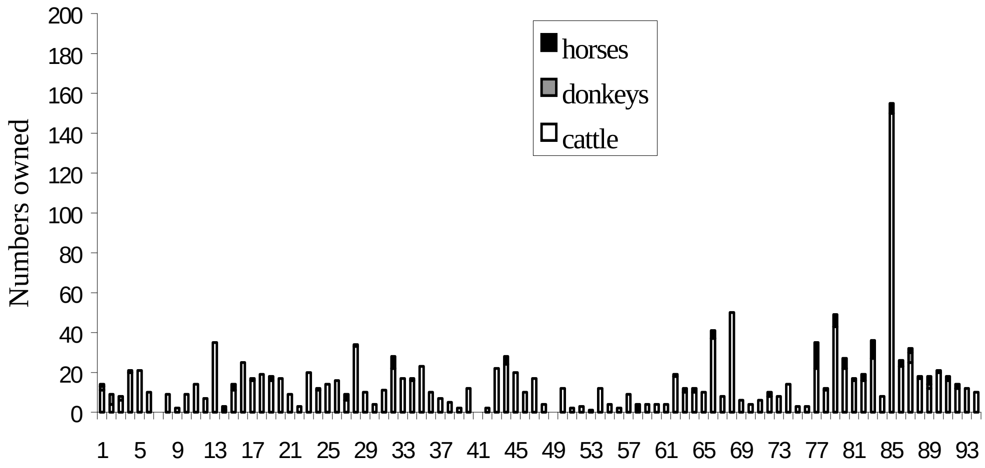

Figure 1: Cattle, donkeys and horses owned

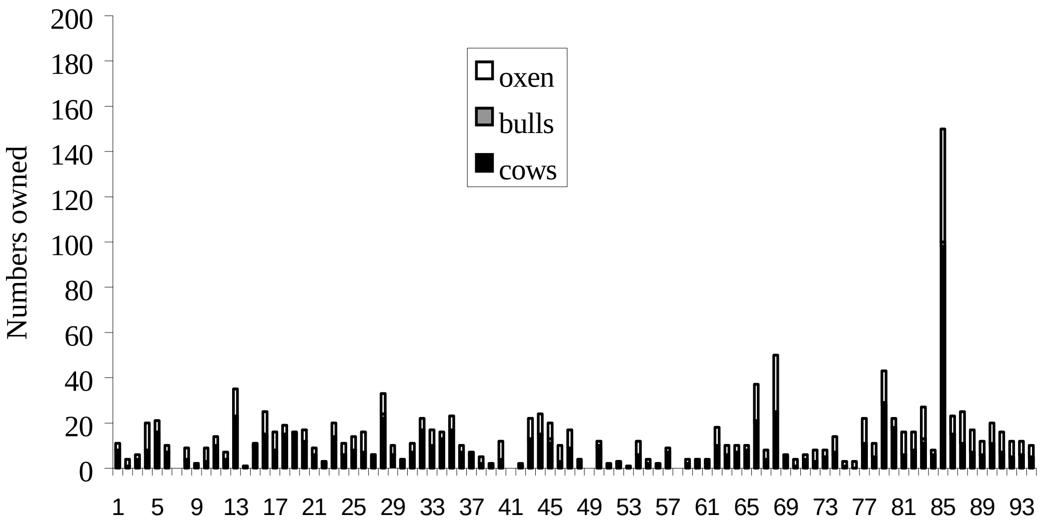

Figure 2: Cattle ownership

Horses were owned by 36% of the farmers (the maximum being 13) but donkeys were owned by only 5% of farmers (the maximum being 5). Only three mules were found, with one farmer owning two of them. This farmer also owned two horses but he was one of the few with no cattle. Most of the farmers (88%) owned goats, sheep or both in numbers ranging from just one to over 800 (combined). More than half the households (60%) owned pigs, the maximum being 16.

Land and crops The farming system is based on communal use of the land and more than half the farmers (62%) believed that they had enough land; only 22% said they did not have enough. It was not clear from the survey what areas the individual farmers cultivated for crop production, as they tended to respond in terms of the proportions of the total area available to the whole community for growing crops. More recent information (Israel *et al*., 1999) indicates that a typical household would crop two to four hectares.

The main crop grown by all farmers was maize. The most popular additional crops were beans and/or peas (91% of farmers), squashes (84% of farmers) and potatoes (68% of farmers).

All the farmers who provided information about crop care (91%) weeded their crops. Of these farmers, 91% (i.e. 78 farmers in total) used a combination of hand hoe and cultivator to perform this operation. Only one farmer used just a cultivator and only six farmers used simply hand hoes and no other equipment. One farmer used a combination of hand hoe and plough with the mouldboard removed (a practice which is probably more common elsewhere in southern Africa). No farmers reported the use of herbicides.

Only 2% of the farmers reported that their yields were unsatisfactory.

DRAUGHT ANIMALS

The majority of the farmers participating in the survey (79%) used animals for draught purposes. These comprise 67% using cattle and 12% using equids. The use of cows for draught purposes, usually to make up a span, was reported by 22% of the farmers. Horses were kept primarily for riding rather than for draught operations.

Ownership Very nearly all the farmers (97%) owned cattle, horses or donkeys and, of the cattle owners (i.e. 96%), only 16% owned just cows, with no oxen or bulls. Only one cattle owning household did not have cows, and farmers with inadequate oxen, either in the short term or the longer term, could (and generally would be prepared to) bring cows into their spans. Just over one third (36%) of farmers surveyed owned horses but only 12% used them for draught work**.**

Usage Information was elicited on the use of animals for (i) land preparation, (ii) crop care and (iii) transport. For the first two topics 90% of the farmers responded but only 61% provided information on transport. From these responses, the most common use for draught animals was weeding and cultivating (combined), reported by 77% of the farmers surveyed. The next most common use was ploughing and harrowing (combined) reported by 70% of the farmers surveyed. Only 11% of farmers reported that they did not weed or cultivate with draught animals and 15% reported that they did not plough or harrow with draught animals. More farmers owned sledges (63%) than carts (29%). Within the 61% of farmers using animals for carting, 55% of the farmers surveyed carted only fuel-wood, water or both. There was only one instance each of a farmer carting goods or people. A breakdown on the use of animal-drawn carts (by their users) is given in Figure 3.

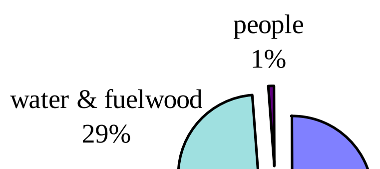

Figure 3: Carting by draught animals

The majority of farmers preferred using animals to tractors for their crop production operations. There was some variation on the degree of preference according to the operation, as shown in Figure 4.

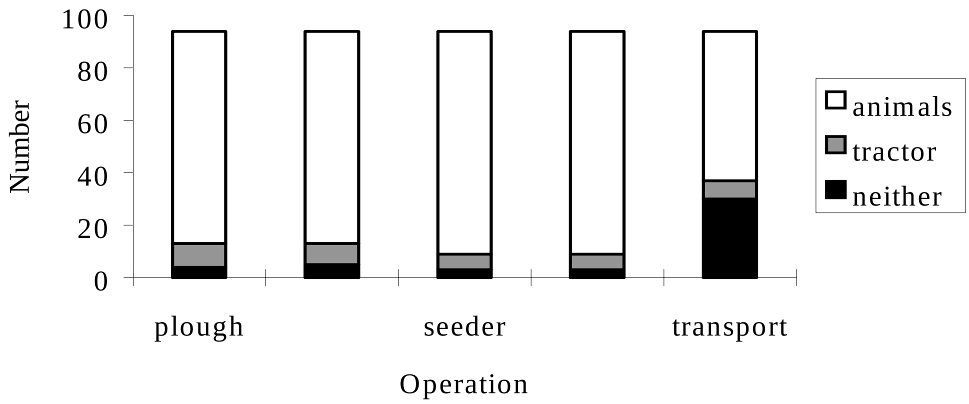

Figure 4: Preference for tractor or animals

Nevertheless, many farmers (74%) did use tractors occasionally and only 18% have never used a tractor (7% did not respond). The main reason for using a tractor was to open up new ground, an operation which is notoriously difficult because of its high draught force requirement.

Although only 22% of farmers surveyed reported using their cows for draught, 52% said they would be happy to do so. The two reasons given to span cows with oxen were to "fill in" (31%) and because they felt they did not have enough oxen. Three farmers used cows only, without spanning them with oxen. One farmer commented that he spanned whichever cattle were most conveniently available.
Insufficient oxen, particularly for ploughing, were reported by just over a third of the farmers (36%). The situation is shown in Figure 5, where farmers' preferences can be compared to what they actually do.

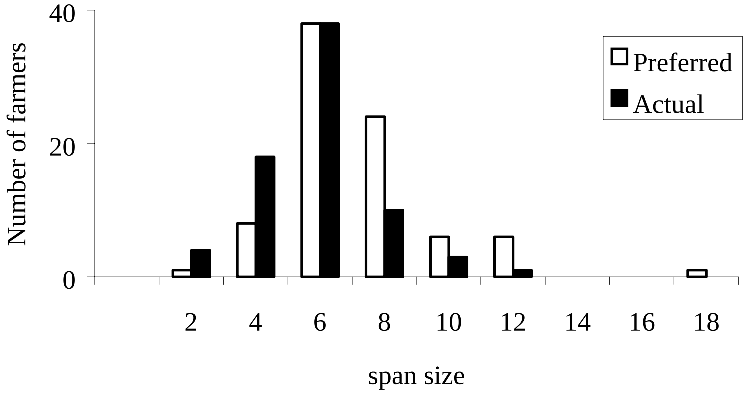

Figure 5: Span sizes for ploughing

The most popular span was six and this was used more than any other size. The second preference was for a span of eight, but this was realised by only ten farmers. Farmers' preferences for cultivating are less demanding than for ploughing, as there is a lower draught requirement. Except for one farmer who preferred a span of eight (and used a span of two), all the farmers who responded preferred and used spans of two.

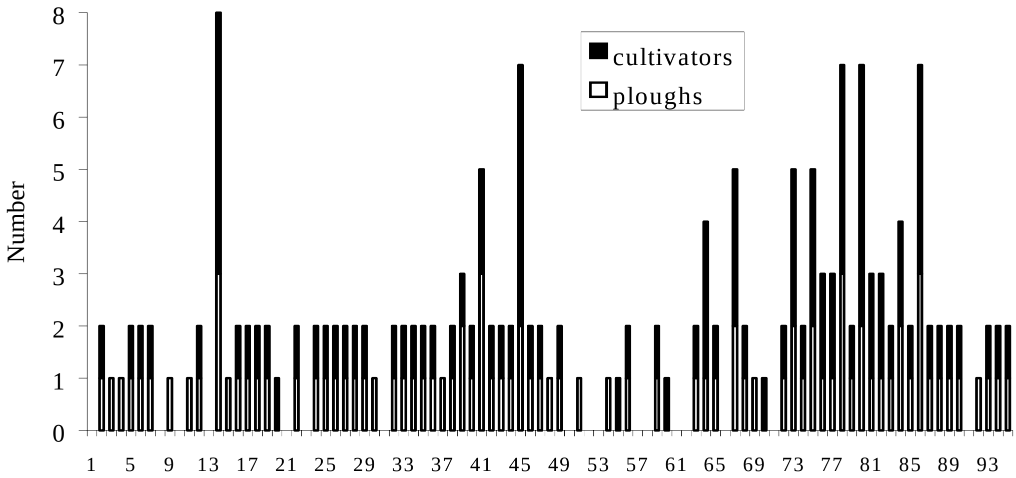

Figure 6: Ownership of ploughs and cultivators

Implements The most widely used animal-drawn implements were ploughs and cultivators (also called weeders) and more than half the farmers owned these (79% and 70% respectively). Harrows and planters (also called seeders) were less prevalent and owned by less than half the farmers (48% and 44% respectively). Some farmers owned more than one of each implement although some farmers had neither a plough nor a cultivator. Farmers with more than one plough all had cultivators. Details of the ownership of these implements are given in Figures 6 and 7. Several farmers did not specify how many implements they owned so, for the production of Figures 6 and 7, the default value was taken as one.

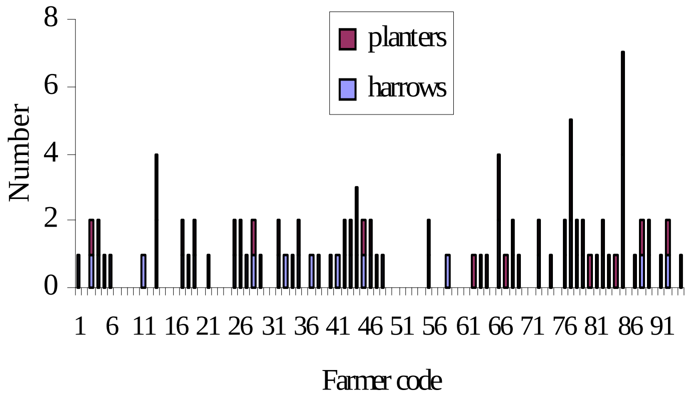

Figure 7: Ownership of harrows and planters

Some farmers reported that they had no need for certain implements: nine did not need a plough and eight did not need a cultivator, harrow or planter. One of the farmers who did not need his own plough owned at least one cultivator; the eight farmers who did not need a harrow or planter were the same. Farmers who needed implements were usually able to borrow.

LIVESTOCK-CROP INTERACTIONS

The main interactions were the use of livestock manure as fertiliser and the use of stover for animal feed. A small number of farmers (4% of those surveyed) also grew lucerne specifically as animal fodder. Figures 8 and 9 show the practices of the farmers regarding their use of fertiliser and crop residues respectively. In Figure 8, the label "none needed" refers to farmers growing crops on freshly opened land which was believed not to need fertiliser. As Figure 9 shows, the crop residues were used as either animal feed or fertiliser. Despite feed being the main use, if residues were sold, they were sold as fertiliser.

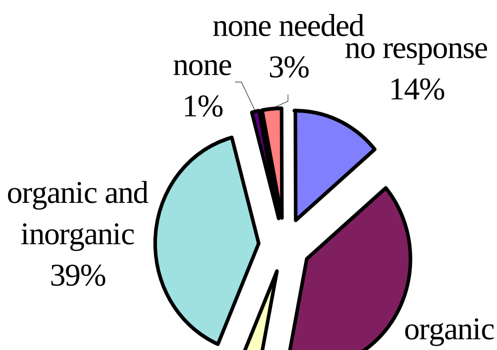

Figure 8: Fertiliser used

Figure 9: Uses for crop residues

NUTRITION

Very nearly all the farmers surveyed (98%) grazed their animals on communal natural pasture. The other two farmers hired adjacent farmland rather than use the communal land. In assessing the quality of the grazing, 30% reported that they considered it to be "very poor", whilst only 22% regarded it as "very good".

Half the farmers surveyed (50%) supplemented the grazing with other feedstuffs. As Figure 9 indicates, crop residues were widely used to supplement the grazing. Lucerne was used to a lesser extent and a few farmers (5%) fed dairy concentrate. The stover provided was usually home-grown whilst any lucerne given would probably be purchased, with only 4% of the farmers surveyed growing lucerne for their own use and 37% purchasing it.

Irrespective of whether they did provide supplementary feeding, 51% of the farmers surveyed responded that their priority would be for feeding cows with calves. Only 4%

responded that their priority would be for working animals. In response to what circumstances would justify supplementary feeding, 75% of the farmers said "when necessary", followed by 21% - "in drought periods". Livestock generally had reasonable access to water, with 34% of farmers having a supply on farm and 27% having water within 1 km.

ECONOMIC FACTORS

More than half the farmers (60%) reported that they had started their farming enterprises with earnings from previous employment. It would seem, therefore, that many, if not most, heads of household had not been "career" farmers but had moved into farming following termination of paid employment. Also, with being in the older stratum of the population, the heads of household are likely to have adult children and it would be reasonable to assume that they would make some sort of contribution either as labour or cash. Thus, it would be difficult to assess the economic viability of these small-scale farmers based on their agricultural activities alone.

The livestock side of these small crop-livestock enterprises is more valuable than the cropping side. In addition, the effort required of the household to produce a calf or a foal is substantially less than that to grow and harvest a crop of maize. An example of a small-scale farmer's (in this case a relatively wealthy one) cash flow for various crop and livestock items is shown in Figure 10 (see also Israel *et al.*, 1999). The relatively small transactions of up to about R300 relate to items such as the purchase of seed and the hire of labour or a tractor, and the larger ones relate to the sale of cattle. During this period, the farmer did not make any major equipment or livestock purchases.

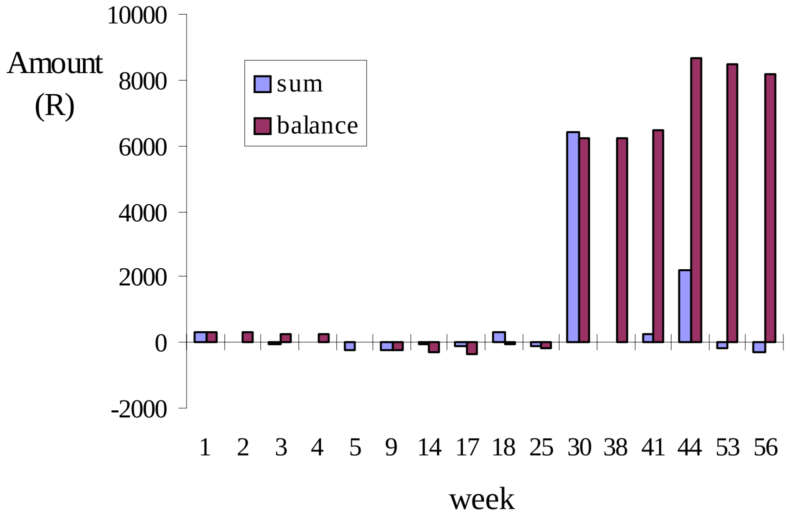

Figure 10: Cash transactions from agricultural activities

Draught animal power is generally more economically attractive than tractor power, with 31% of the farmers saying "*tractors are fast but costly and oxen save money*". Animals provide various benefits such as milk, meat, manure and skins, whilst tractors have expensive overheads such as fuel and maintenance. Furthermore, tractors do not procreate. Most of the farmers (88%) reported that they utilised all four of these outputs, but 10% of farmers said that manure was of no use to them.

FARMERS' OPINIONS

Most of the farmers (91%) believe it is profitable to own or use draught animals, the main reason being the low capital outlay. The various reasons with their different levels of support are given Figure 11.

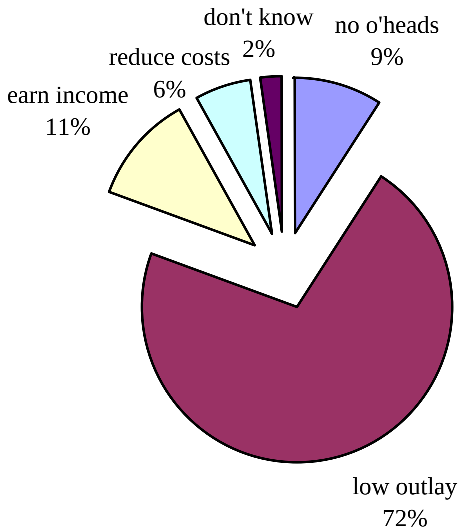

Figure 11: Reasons why draught animals are profitable

There was no conclusive response to whether draught or other animals commanded higher prices. The majority (57%) responded that they were less valuable and 32% that they were more valuable. There seems to be no market for animals trained for work so the cost is based on the meat value. If an animal is readily identified as having worked, there may be an expectation that the meat will be tough.

Most farmers (86%) believe that draught oxen should be of relatively small frame, typical of the indigenous and local mixed breeds. For the few farmers who did specify a breed, the Nguni was clear favourite for its "hardiness".

Almost all the farmers (94%) reported that they enjoyed the satisfaction of farming but perceived the greatest threats to their agricultural enterprises as drought (97%) and the combine risk of theft and disease (also 97%).

CONCLUSIONS

A survey of 94 rural households has provided information, which clarifies the current use and management of draught animals in the Eastern Cape. Useful information on the socio-economic circumstances of these households, typical of the Province, has also been collected. These should provide valuable guidance for future research and development to improve the productivity of crop-livestock farming systems in southern Africa.

The average size of household was eight people with, on average, two members working away from home. The heads of household were generally elderly with an average age of 61.7 years. All households except one owned livestock and all except four owned cattle. The average cattle ownership was 14 per household, including 5.4 oxen. Horses were owned by 36% of the farmers but only 6% owned donkeys and mules.

The farming system is based on communal use of the land for both cropping and grazing. More than half the farmers (62%) believed they had enough land to grow their crops, mainly - maize (all farmers), beans/peas (91% of farmers), squashes (84%), potatoes (68%). Only 2% felt that their yields were not satisfactory.

The majority of farmers (79%) used animals for draught operations. When they were short of oxen, 22% of farmers spanned cows, but 52% said they would be prepared to do so, if necessary. Horses were kept primarily for riding. The most common draught animal operations were weeding, cultivating, ploughing and harrowing, all undertaken by at least 70% of the farmers surveyed. However, many farmers (74%) used tractors occasionally, mainly for opening up new land. Draught animals were also used for transport (i.e. pulling sledges and carts). Most farmers preferred draught animals to tractors for all these tasks, but the preference was least widely expressed for transport. The use of animal-drawn carts was almost exclusively for fuel-wood and water (96%).

Just over a third of farmers (36%) reported that they had insufficient oxen for ploughing. The main preference was for a span of six (38% of farmers), but some farmers preferred fewer and some more, the second preference being for a span of eight (24%). Nevertheless more farmers ploughed with a span of six (38%) than any other size (e.g. 18% used spans of four). Smaller spans were generally preferred for cultivating. Most farmers owned ploughs (79%) and cultivators (70%), and some owned more than one of each.

Of the farmers who provided information on crop production, all weeded their crops and 96% used fertiliser, most commonly manure (46%) or a mixture of manure and inorganic fertiliser (45%). The crop residues were used primarily as animal fodder (85%) or as fertiliser. The more common practice was to leave stover in the field (36%) rather than to collect it (31%).

Almost all the farmers (98%) grazed their animals on communal natural pasture. Half the farmers (50%) supplemented grazing by feeding their crop residues and some farmers additionally provided lucerne (37% purchased, 4% homegrown). The priority for supplementary feeding was cows with calves; only 4% of the farmers indicated that working animals would be a priority.
More than half the farmers (60%) started their farming enterprises with income from previous employment. Livestock transactions have greater financial implications than crop production activities and the farmers regard draught animal power, in general, to be more economically attractive than tractor power. Most of the farmers (91%) believe it is profitable to own and use draught animals, the main reason given by 72% of the farmers, was the low capital outlay. Nevertheless, nearly all farmers (97%) were concerned about the risks of drought, disease and theft.

ACKNOWLEDGEMENTS

I would like to thank the farmers for their willing participation in the survey, and my many colleagues at the University of Fort Hare who have assisted with setting up and conducting the survey. Nevertheless, I am responsible for the accuracy of the analysis and the selection (from the very large database) of the information presented. Thanks are also due to DFID's Livestock Production Programme for funding the project (R6609) of which this survey was a part.

REFERENCES

Barrett, J.C., O'Neill, D.H. and Pearson, R.A. 1992. Strategic research needs relating to draught animal power: a diagnostic study in Zimbabwe. *Working Paper of the Draught Animal Working Group (DAWG),* ODA Livestock Production Programme, NRI, Chatham, 76p.

Israel, S.H., Mzileni, N.T., Pearson, R.A. and O'Neill, D.H. 1999. Seasonal contributions of draught animals to activities in small-scale "emerging" farming in the Eastern Cape of South Africa. *Centre for Tropical Veterinary Medicine, Draught Animal Power Technical Report 2*, Centre for Tropical Veterinary Medicine, University of Edinburgh, Easter Bush, Roslin, Midlothian, EH25 9RG, 25p.

Starkey, P.H., (ed). 1995. *Animal Traction in South Africa: empowering rural communities.* Development Bank of Southern Africa, Halfway House, South Africa, 159p. ISBN 1-874878-67-6.

Seasonal uses of draught animal power: a study with farmers in Esixekweni and Chamama

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ABSTRACT

Three farmers from Chamama, Amatole Basin and three farmers in Esixekweni, Debe Nek kept diaries recording the activities they undertook from July 1997 to October 1998.

The main crop grown was maize, with some vegetables grown as supplementary crops. Teams of four to six animals were generally used for ploughing, with teams of two usual for cultivation, planting, harvesting and transport. Cows were spanned together with oxen when the need arose. Working animals were kept and fed as the other cattle on the farms, with any preferential feeding usually given to the cows in milk. Peak times of use were influenced by the rainfall and coincided with land preparation and planting. Transport - of water (all year), manure (July to October), firewood (October to February), branches for kraals (as necessary) and building materials (intermittently) - was a regular use of draught cattle, using sledges at Chamama and carts at Esixekweni. Men and women worked together in carrying out farm activities, but men usually did most of the work, as women were involved in the domestic chores.

Livestock, particularly cattle, were the farmers' main resource. Tick-borne diseases were the main health problem in both areas. Dipping occurred only in Chamama (November to May). Most diseases were treated using local remedies due to the cost and difficulty of reaching veterinary advice and drugs. Implements were handed down through the families and spare parts were purchased when necessary during the year from Middledrift.

Apart from inaccessible veterinary services, the main concerns of farmers over the period were shortages of labour, encroachment of cattle on to crop land and local lawlessness, where crops may be stolen or vandalised. Farmers used their pensions to finance their agricultural activities, contributing to the belief that farming needs outside cash support.

INTRODUCTION

In view of the increasing belief in the use of animal power in small-scale farming in Eastern Cape, a study was undertaken to investigate, in detail, the seasonal patterns of management and use of animal power on co-operating farms in Amatole Basin and Debe Nek, Eastern Cape. The focus of the study was on "emerging farmers", those farmers who are developing their commercial activities and are generating cash flow through mixed farming. The aim of the study was to obtain a picture of the contribution that animal power makes on "emerging" farms in Eastern Cape throughout the year, rather than to gather statistical or detailed numerical information. A more detailed account of this study can be found in Israel *et al.* (1999).

METHODOLOGY

Two study areas were selected on the basis of their known use of draught animals for agriculture and their distance from Fort Hare University to ensure access throughout the year. The areas were Esixekweni in Debe Nek and Chamama in Amatole Basin, both of which are within Middledrift district in the Eastern Cape Province. Three farmers who keep and use working cattle were picked from each area to participate in the monitoring. Each farmer was given a diary and agreed to record in it all activities pertaining to farming, as well as draught animal use and management. Regular farm visits by one or two members of the research team were arranged every two weeks in order to support the farmers in their record keeping, transfer the information from the diaries and collect any additional information through personal observations around the households or farms. On these visits additional information was also collected through discussions with the farmers or other members of their families. The monitoring lasted sixteen months (July 1997 - October 1998, inclusive).

PARTICIPATING FARMERS

Three farmers - Mr Hamilton Gobodo, Mr Sipo Mapitiza and Mr Simon Salusalu - were from Chamama, and the other three - Mr Kwedana Dyantyi, Mr Benjamin Kedama and Mr Pitwell Ndarala were from Esixekweni. Before participating in the seasonal monitoring study, the farmers took part in informal interviews, similar to those in a wider survey of draught animal power owners in Eastern Cape (O'Neill *et al.*, 1999). During the individual interviews they each described their farming systems.

COMPARISON OF SITUATIONS AT CHAMAMA AND ESIXEKWENI

From the farmers' questionnaires, the situations at Chamama and Esixekweni were very similar. The biggest contrasts, particularly regarding the management of draught animals, were (a) the difference in feeding strategies, with the Chamama farmers leaving stover in the field and not mentioning extra rations for the draught animals, (b) the generally smaller (and more variable) span sizes at Esixekweni and (c) the absence of carts for transport at Chamama.

OBSERVATIONS

CROPS GROWN DURING THE YEAR AND PRODUCTS TRANSPORTED USING ANIMAL POWER

Two out of the six farmers, one in each location started their primary cultivation in May and June (Table 1), immediately after the maize harvest. This, they claimed, simplified the work because at that time the soil was still moist and therefore easy to work. They also noted that early ploughing of the soil reduced runoff, preserved more moisture within the soil and reduced soil erosion. It also helped to reduce weeds, since the latter were removed before their seeds had fully matured. Having done primary tillage early, secondary cultivation and harrowing became easier. The other farmers ploughed later in the year, influenced by rainfall pattern.

One farmer in Chamama had sown oats in March 1997 before the start of the monitoring period, for winter feed. He said he turned his livestock on to the oats for supplementary grazing in the winter months (May, June and July).

Table 1: Cropping calendar and related activities based on the period June 1997 to October 1998 on three farms in Chamama and three in Esixekweni, Eastern Cape Province, South Africa

	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Plough & Harrow					Primary Cult.	Primary Cult.	Primary Cult. Harrow	Primary Cult. Harrow	Primary[2] & Secondary Cult. Harrow	Secondary Cult. Harrow	Secondary Cult.[2] Harrow	Secondary Cult. & Harrow
Planting & Weeding	Peas Potatoes	Maize Potatoes	Oats[1]			Potatoes Peas	Pumpkins	Pumpkins	Pumpkins Maize Beans	Maize Beans Peas	Maize Beans Potatoes	Maize Beans Potatoes
Harvest		Pumpkins Potatoes	Maize	Maize Beans	Maize	Maize Peas		Potatoes	Peas Potatoes			Potatoes
Transport	Wood Water Branches Bricks	Wood Water	Wood Water Poles	Wood Water Sand	Water Poles	Water	Manure Water Wood[3] Branches	Manure Water Wood[3] Branches	Manure Water Branches	Manure Water Stone	Water	Water
Other Activity									Spread manure	Spread manure		

[1]Oats grown for winter grazing (Chamama); [2] One farmer used a tractor as well as oxen; [3]firewood for ceremony.

Table 1 shows that cattle were used for transport activities throughout the year. Water was the only commodity that required transport throughout the year. Transport of firewood occurred mainly between January and April (summer time) whereby enough was accumulated to supply the farm over the winter and early spring months. Manure was transported during late winter and spring (July - October), this preceded and to some extent overlapped with the main planting season for maize, pumpkins and beans. Transport of stover for animal feeding was not practised at Chamama. Crop residues were transported by two farmers at Esixekweni in April. While maize was planted in spring when enough rain had fallen, the planting of vegetables, particularly potatoes and peas was sometimes staggered, particularly when it was for home consumption. Harvesting depended on when the crop was sown. Maize was harvested green or dry depending on the farmers' preferences.

DRAUGHT ANIMAL USE

The three farmers in Esixekweni cropped a total of 11 ha whilst those in Chamama cropped a total of about 13 ha. The animals did some work almost every month, but were busiest (based on hours worked) between August and November in Esixekweni and later between November and January in Chamama. The difference in seasonal use for the two areas was due to the differences in the rainfall pattern during the year in the two areas. Due to the erratic rain showers in Chamama, the farmers had to replant maize up to three times within the same season and so continued to work their cattle in cropping activities until March 1998, long after farmers in Esixekweni had ceased using their cattle on the land (November 1997).

In Chamama, all farmers used six animals for ploughing, adding in cows to make up the number if necessary (two farmers) or borrowing from another (one farmer). In Esixekweni one farmer who only had two oxen, used them for all activities including ploughing and did not attempt to hire in others from outside. The other farmers in Esixekweni used 4-6 animals for ploughing, borrowing one span where necessary for ploughing. In Chamama one farmer would span eight of his animals when transporting materials or water long distances with his sledge. Harrowing by all farmers was usually done with only 2-4 cattle. Only a single pair of cattle was used when planting and weeding, except when planting was done on the same day as ploughing, when the size of the team was usually kept unchanged.

Field work started about 0700-0900 h in the morning and lasted until it was finished or until about 1400-1500 h. Where there was a labour shortage, farmers delayed their start to wait for assistance from boys after school.

DISTRIBUTION OF FARM LABOUR

The majority of farm or household activities that involved use of draught animals on the farms were done by males. Inadequacies in supply of labour for working the animals were rectified by making arrangements with those members of the community who did not have their own oxen so that they could assist in return for having their plots worked. Another arrangement was to schedule farm operations so that they took place in the afternoon with assistance from boys after they had returned from school. Girls returning from school did not help with the animals. At peak periods of farm activity, some farmers were forced to hire labour for activities that needed to be accomplished promptly. Examples include weeding following some rain after a prolonged dry period

(November/December, Chamama) and when the plants were too tall for working animals to pass through without causing damage (February). Further strategies to overcome the problem of labour inadequacy entailed the use of working animals in pairs for ease of working, so that only one operator was needed at a time. An added advantage of this arrangement which farmers spoke about was that if only two animals are worked at a time, all the oxen have time for grazing. One pair work while the others are grazing and then once the working pair show signs of getting tired, the others are spanned in their place, while they have time to graze. Female members of the household were allowed to work with animals, but in practice were engaged mostly in domestic chores. Sometimes they assisted in farm work, which did not involve working with animals, such as weeding between the rows and planting by hand.

RESOURCE MANAGEMENT

Farmers in the two study areas obtained income mainly from the sale of livestock and any farm products that were produced in excess of those they required for home consumption. This income added to the money they received from their monthly pensions. The main inputs that went into farming included costs for tractor hiring, purchase of seed, repair of animal traction equipment, costs for animal health care and in a few cases hiring of labour. More than three-quarters of the food produced on the farms was consumed by the household, and farmers all said that they met most of their domestic needs for food from farm production.

Maize stover is the only by-product from crops that is available in substantial quantities in Chamama and Esixekweni. After threshing, bean and pea crop residues were fed to livestock in the kraals in the evenings and were not stored. Two farmers in Esixekweni harvested the maize stover and stored it near their homesteads for winter feeding. These two farmers had crop land close to their homesteads. The other farmers left the stover standing on the field and grazed all their animals when the need arose. In the latter arrangement, oxen that were not inspanned were left to graze on the area that was yet to be ploughed, until their turn to work came. The farmers in Esixekweni who did transport stover did so on their carts. Farmers at Chamama even if they wanted to collect stover for animal feed said they could not because it was difficult on a sledge. One farmer in Chamama used oats that he had sown in March as a supplementary winter livestock feed. The animals were turned on to this crop periodically over the winter season.

All livestock in Esixekweni were always confined in kraals at night, but at Chamama only the goats were confined at night. Manure was transported by two farmers in the study period, one farmer at Esixekweni (using his cart) and one farmer at Chamama (using bags and his sledge). The manure was turned out in heaps at several points in the fields. Depending on the crop that was going to be established, manure was either spread manually all over the field from the piles before ploughing, or it was applied on specific points together with the seeds during planting (for example when planting pumpkins). Two reasons for not applying manure to the fields were the distance from the household to the field and because the farmer believed the land being cropped did not need it that year. The farmers believed that the soils were sufficiently fertile not to need an application of manure every year. It was general practice to manure once in three years, the main indicator of need being the performance of the previous crop. One farmer from Esixekweni, for example, who had crop land near his household, did not use manure this year because he believed the soil did not need it.

Farmers invested considerable effort in protecting their resources and assets. Kraal building and repairing was a regular activity and, before and after the cropping season, repairs to maintain the fences and gates around the plots. These activities involved considerable use of animal power for the transport of branches and poles (Table 1).

Livestock, particularly cattle, are the farmers' most significant resource and they exist as a reasonably liquid asset. Farmers selling cattle generally sold them for slaughter, not to other farmers for use as draught animals. Amongst these farmers over the monitoring period, replenishment of cattle was by the birth of calves. One farmer at Chamama who sold three of his cattle and slaughtered two for ceremonial purposes was provided with three male calves by his cows. Breeding is a natural, uncontrolled process with bulls serving the cows whilst they are grazing.

ANIMAL DISEASES AND HEALTH CARE

Tick-borne diseases presented the biggest health threat with the majority of reported incidences of sickness being locally diagnosed as Red-water (Babesiosis). Cases were reported by the farmers throughout the summer months (November to May). A few cases of Heart-water (Cowdriosis) were also reported in April and May.

Treatment of animals with sickness was mostly accomplished with local remedies (see Table 2). Expert advice was sought only when the local remedies seemed to fail. The main reason for this almost total reliance on local remedies was the costs involved in seeking expert advice. Money was needed to cover taxi fares for going back and forth from Chamama to Fort Cox College of Agriculture to obtain veterinary advice after reporting the case, and to purchase the medicine at Middledrift, as well as the payment required for the treatment. All these trips also take time. Another problem farmers reported was that the veterinarian may not arrive for several days after an animal is reported sick. Traditional remedies for several of the animal diseases that are endemic in the two areas were recorded by one farmer in Chamama (Table 2).

Internal parasites were also controlled with local concoctions, given whenever the farmer felt the need to do so. One farmer in Chamama treated his animals in September and November. In Chamama dipping for the control of ticks was done on a monthly basis, sometimes twice a month, during the summer months from November to May. Farmers contributed to the cost of buying acaricide because there was a heavy tick challenge. Despite dipping farmers reported tick borne diseases in their oxen, cows and in young animals ("isifo somqeku" - ephemeral fever) during these months, although they admitted that they did not always take all animals to the dip. In Esixekweni dipping was not recorded by the farmers, but one of the farmers attended two meetings in March 1997 to discuss repairs to the dip tank in his area. Other reasons given for not dipping were: a lower prevalence of ticks, the distance from the dip (about 6 km), a lack of water at times and an unwillingness of farmers to purchase acaricide. In the past it had been provided free by the Government.

One farmer in Chamama gave a twice yearly dose of a mixture of vinegar, sugar and water to prevent/control bovine TB (Table 2). In May the cattle were vaccinated with help from the Department of Agriculture for "unomkhonwana" (Black-quarter, *Clostridium chauvoei*) in combination with a vaccine against anthrax.

Table 2: Local remedies for common diseases as reported by one farmer in Chamama in the Amatole Basin, Eastern Cape Province in 1997/98

1. Treatment of tick borne diseases

(i). Ingredients: *Aloe ferox,* especially the dry parts at the base of the plant
Table salt
"Bloustan" (Copper sulphate)
Preparation: Cook the aloe leaves to boiling point, add salt and "bloustan" (about a knife point).

(ii). Ingredients: "Umdubu" leaves
"Imbethe" roots
"Bloustan" (Copper sulphate)
Preparation
The "umdubu" leaves are cooked together with "imbethe" roots and then "bloustan" is added

2. Treatment of Red water (Babesiosis)

Ingredients:
1 part "umbomuane" bark (*Elaeo dendron croceum*, saffron tree)
2 parts "umngwenya" bark (*Ekebergia capensis*)
3 parts "umgxam" bark (*Schotia afra*)
4 parts "umfinca-fincane" leaves (*Leonotis leonoris*, red dagga)
Preparation: Take and mix each of the ingredients above and pound them thoroughly on a stone to crush the bark. Transfer the mixture into a cooking pot, add 1 litre of water and bring to boiling point, boil for half an hour. When cool, separate the juice from the rest of the mixture and this is ready for use. Adult cattle are given one bottle (1 litre) of the mixture while younger animals are given half this dosage.

3. Treatment for* "Amathumba" *(lumpy skin disease)

Ingredients: Luke warm water and "uzifozonke" (potassium permanganate) and an injection of antibiotic

4. Treatment of injuries

Take "umadolwana womlambo" (*Chloris compressa* grass), crush it on a stone, squeeze the juice into the injury with a cloth. The residue can also be bandaged onto the wound and after a short time the injury heals.

5. Use of Vinegar sugar and water mix:

The farmer was unwilling to divulge the proportion of water to vinegar as he sold the mixtures locally:

(i). Treatment of worms "diarrhoea"
A mixture of water and vinegar with 500 ml of vinegar mixed with one and a half cups of sugar

(ii). Treatment for liverfluke (Fasciolosis)
350 ml of vinegar mixed with one and a half cups of sugar, the bottle was dosed to one large ox or cow and half a bottle was given to the calves.

(iii). Treatment for "umbolane" (Bovine tuberculosis)
Preparation: Pour 2 tea cups full of sugar into 750 ml of vinegar (one bottle) and mix them thoroughly. The whole mixture is sufficient for one adult ox (above 300 kg), use half of the mixture for younger animals.

One farmer from Chamama was concerned about poor veterinary services in his area. He therefore had meetings in April 1998 with other local farmers to discuss the formation of a farmers union. He reported some local farmer interest. The main aim was to organise a plan to take some young men to the training centres to learn how to treat animal diseases so that they could assist the whole community.

TRAINING OF DRAUGHT ANIMALS

One farmer from Chamama trained his two young oxen in June. He first worked them in a pair for one day, pulling a log in the field, then the next day spanned them with his four older experienced oxen to collect firewood using a sledge. Boys (usually his children) help the farmer train his animals. By the end of the month he was using them with the other oxen for ploughing. The farmers said they preferred to train their young animals alongside their older ones, when possible, even to the extent of borrowing oxen from others. But, if there were no experienced oxen available then they would train them on their own, usually using them for transport activities first (branches or firewood), before using them for land preparation and cultivation. The farmers breed their replacement oxen themselves. If they lose an animal, they said they would use a cow as a replacement in the span or borrow from others until their young animals are old enough to work. These farmers who were already using animal power never considered buying draught oxen from others, however they said that they would consider selling working oxen to farmers new to animal traction if the price was good.

ACQUISITION AND CARE OF EQUIPMENT

All farmers owned a plough, but not all owned a harrow and very few a planter. These had been handed down through the families. No farmers purchased new equipment in the 16-month study period. Repairs were carried out to a plough owned by one farmer at Chamama in May and a planter owned by one farmer in Esixekweni in November. The repairs were carried out at the Animal Traction Centre at Fort Hare. At Esixekweni a replacement ploughshare and heel were brought by one farmer in December and a ploughshare, heel and wheel were brought by another farmer. The three farmers in Chamama, which was hilly terrain, owned sledges, whereas the farmers in Esixekweni, in a less undulating area, with better road access, owned carts that they had made themselves. No records were made of any repairs to these during the study period.

Only one farmer in Chamama made yokes and skeis for use on his own oxen. All the other farmers relied on local craftsmen who specialised in making the equipment for sale. It was possible for some farmers in Chamama to fabricate their own equipment because they have a forest nearby making it easy for them to find a suitable wood for that purpose. Riems and strops used by the farmers had been made by the farmers themselves, but they did not record making any during the study period.

CULTURAL CONSIDERATIONS

Some farmers delayed their work in the fields, particularly the tasks that needed more people, until their children, especially boys, came home from school. These tasks usually involved the use and control of their draught animals. Other arrangements to overcome labour shortages could involve payment “in kind”, whereby a farmer would use labour provided by neighbours or other members of the family in return for him taking his animals to plough their fields.

There were also communal activities involving animals, such as dipping to protect the animals against disease, or farmers using their animals to help with a community project, such as building a church. Other community activities which would take precedence over agricultural activities were funerals and ceremonies in honour of the family's ancestors or for religious festivals (e.g. Easter). The latter can involve the slaughter of oxen.

A number of farmers used their pensions to finance (at least in part) their agricultural activities. Thus, it is difficult to assess the financial success, or sustainability of their farming enterprises. This contributes to the fairly widely held impression that farming is not a viable activity, thereby possibly deterring younger people from taking it up as a profession. Another possible deterrent was evident from the diary of one farmer who was becoming increasingly concerned about the growing lawlessness in society, particularly in his own neighbourhood, where his crops may be stolen or vandalised, sometimes by people allowing their animals into crops that had yet to be harvested. This is a serious sociological problem that needs to be addressed. Nevertheless, one farmer rented and cropped land that was superior to his own for growing crops. However, it is not clear how widespread this practice is.

DISCUSSION AND CONCLUSIONS

The crops grown, activities undertaken with draught animals and the management of the animals on the farms, as reported in the monthly record-keeping, agreed fairly well with the information obtained in the informal interviews conducted at the start of the project (see O'Neill *et al.*, 1999, and these Proceedings). The advantage of the monthly diary keeping by the farmers was that it enabled information to be obtained on the time of different activities on each farm and their frequency throughout the year. It also revealed the role that draught animals play in infrequent activities such as community repairs and building activities, which is not always apparent at informal interviews. The disadvantage of the monthly monitoring was that it relied on the farmers themselves to record the information, and therefore was influenced by when and what each farmer decided was worth recording. One farmer for example reported his animal health and treatments for disease in great detail, whereas another was more concerned with cropping activities. Nevertheless the farmers' efforts in keeping their diaries are commended.

Some anomalies between the diaries and the interviews were apparent. Farmers frequently harrowed with fewer oxen than they had said; probably because harrowing could be done satisfactorily with fewer animals, without compromising work output. Clearly, the numbers of animals owned by a farmer can change at any time due to a livestock death or a birth, so the head counts will vary, as may span sizes or the number of cows used for draught purposes. Some activities that farmers said they carried out were not recorded in the diaries nor observed by the research staff during the 16-month monitoring period. These activities centred on management of animal feed resources and may not have been thought by the farmers to be relevant to the management and use of their working animals, confirming, indirectly, the farmers' priorities for other livestock products rather than those associated with crop production. For example collection and transport of stover for animal feeding was reported only by two farmers and no mention was made of purchase of supplementary feeds by farmers at Esixekweni although they said that they regularly did this. Similarly one farmer at Chamama, who had sowed oats for winter grazing for his livestock before the start of the monitoring period, did not mention its use specifically for working animals. The use of cows for work was far more common than had been apparent when the farmers were initially interviewed. Farmers often spanned cows, even when oxen were available (in one case “the ones which were easiest to catch in the camps”) and thought nothing of doing so.

The division of labour was not so rigidly defined as it appeared in informal interview. The priorities for men were the agricultural tasks just as the priorities for women were the domestic tasks. People worked according to these priorities without men being precluded from the domestic tasks (e.g. they may fetch water), nor women from the agricultural tasks. The one exception was that women did not use the plough.

Labour shortages occurred from time to time, especially during periods of the greatest agricultural activity. This seems to be exacerbated by the high proportion of older people (more than 60 years old) engaged in agriculture. These shortages were overcome by neighbours working for each other, usually offering their services “in kind”, but sometimes for a share of the harvest or occasionally cash. The most serious shortage seemed to occur during land preparation, which is a male-dominated activity, and farmers delayed their work until boys (often their grandchildren) arrived home from school.

There was a reluctance for farmers to use veterinary services and most use local remedies for prevention and treatment of the common diseases. In the past, there was considerable support from the Government (for example dipping) but now that this has been withdrawn, the farmers feel that they can not afford the significant expense of summoning a veterinarian, paying for a consultation and paying for any necessary medicines. Farmers also expressed concern over the reduction in other Government services such as agricultural inputs (particularly seeds) and health care but had not taken any action.

The importance to farmers of livestock, rather than crops, is evident at both locations. The most significant indications are provided by (a) the sums of money involved (b) the preference to supplement the feed (where this is practised) to milk cows and to cows in calf, rather than working cattle which facilitate crop production and (c) the use of horses for riding or as status symbols rather than for draught work. A possible explanation may be that the toil and drudgery of crop production in often difficult soils and erratic rainfall for little economic gain is relatively unattractive compared to the extensive rearing of livestock, particularly cattle, with the associated cultural implications of dowries and ancestral ceremonies.

Despite the superficial differences in veterinary needs, both groups of farmers suffer from a lack of veterinary services, which could be met at an elementary level with modest local training inputs. It appears that some crop production activities are held back, particularly around primary tillage, with farmers waiting for boys to come home from school to start ploughing. Whilst it is gratifying that boys are not kept out of school, a re-appraisal of land preparation techniques might facilitate crop production. The hilly terrain around Chamama prevented the use of carts, which influenced the farmers in the way they used their crop residues (mainly maize stover), and caused one farmer to grow oats as a supplementary livestock feed. Carts, in use in Esixekweni enabled farmers to collect the stover more easily for storage and feeding in the dry periods. The encroachment on to crops by cattle and crop theft are difficult to overcome when not all farmers in the area consider crop production as important as that of livestock and not all members of the community see farming as an occupation worthy of undertaking. The erection of fences would help overcome this problem, but it is not unknown for the fences themselves to be stolen. That farmers use their pensions to finance their agricultural activities contributes to the fairly widely held belief that farming in the area needs outside cash support. This is something which farmers felt may deter young people from taking up farming. If the numbers of "emerging farmers" are to increase then the challenge is to find ways of attracting the younger members of the community into agricultural production.

This monitoring exercise has confirmed the importance of cattle to smallholder farmers in the Eastern Cape. Crop production relies heavily on livestock outputs, particularly draught power. The more successful emerging farmers are now complementing their animal power with tractor power for primary tillage operations. Although this initiative has been taken by the more elderly farmers, the selection of appropriate power sources for crop production tasks is a significant step forward, and may increase the incentives for younger people to take up farming. There seem to be bright prospects for younger, energetic people to run small-scale agricultural enterprises commercially, based on livestock and the judicious use of draught animal power.

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REFERENCES

Israel, S.H., Mzileni, N.T., Pearson, R.A. and O'Neill, D.H. 1999. Seasonal contributions of draught animals to activities in small-scale "emerging" farming in the Eastern Cape of South Africa. *Centre for Tropical Veterinary Medicine, Draught Animal Power Technical Report 2,* Centre for Tropical Veterinary Medicine, University of Edinburgh, Easter Bush, Roslin, Midlothian, EH25 9RG, UK.25p.

O'Neill, D. H., Sneyd, J., Mzileni, N. T., Mapeyi, L., the late Njekwa, M. and Israel, S. H. 1999. The use and management of draught animals by smallholder farmers in the former Ciskei and Transkei, Eastern Cape Province, South Africa. *Development Southern Africa* 16, 319-333

The use of donkeys, horses and mules on smallholder farms in Eastern Cape Province

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ABSTRACT

Two surveys, making use of informal interviews were carried out in the former Ciskei area (survey 1) and the Fish River and Grahamstown areas (survey 2). The first survey looked at equids. The second survey concentrated on the use of donkeys in a rural and an urban setting.

The results showed that many people prefer horses and donkeys to oxen because they thought they were easier to manage in small areas and require less labour. Animals rely on communal grazing to obtain most nutrients for work, and are hence affected by seasonal effects on pasture quality as well as stocking density. Some horses are also supplemented if working. Donkeys are generally left to fend for themselves. Shoeing and hoof care is minimal with few people having the knowledge or wish to interfere. Ticks, Babesiosis and Mange are the most frequently reported health problems other than work related injuries. Treatments are largely with local remedies as most veterinary services are out of reach geographically and financially for many equid owners in these communities.

In the rural communities, access to veterinary services is a key issue whereas in urban areas security against theft and abuse, and availability of grazing are seen as the major problems. A need was expressed for improved training of young people and children in draught animal management and care, and for local training in veterinary matters to improve local access to animal health care.

Equids still make a major contribution to the well being of many rural families. However poor harnesses, hitching and heavy carts and ploughs, poor veterinary services and limited feed resources all restrict the efficiency with which they can be employed. At present on-farm resources (food, finance, husbandry) on most smallholder farms are more suited to maintenance and use of donkeys and small horses than the larger heavy horses that originate from the commercial farms. Localised mule breeding seems to be an option worth considering in the future.

INTRODUCTION

Many horses, donkeys and some mules are found in South Africa and offer alternative sources of animal power to oxen. Large draught horses, such as Percherons, have been used on large commercial farms in the past, but there is little information available on their suitability or use, or that of other horses or mules in smallholder farming. Donkeys are found both in rural areas and on the urban fringe and tend to be used for transport, rather than agricultural activities. Neighbouring countries have seen donkeys being increasingly used for work, particularly in kitchen gardens. Droughts in recent times have reduced the availability of oxen, and farmers have had to look to donkey power to work the land (Pearson, Nengomasha and Krecek, 1995). The donkey is one of the cheapest sources of power and, being small, requires less resources to maintain it than other working animals. Donkeys have been identified as the most suitable draught animal for poorer communities in South Africa (Krecek, Starkey and Joubert, 1994). Despite the continued use of draught equids in South Africa, they have received relatively little attention from researchers. For this reason two investigations were carried out: Study 1 was undertaken in the Ciskei region and Study 2 was undertaken in the Mid-Fish River Zone and Grahamstown. More detailed accounts of the studies can be found in Taylor (1999) and Kneale (1996).

The objectives of the work were:

- To characterise the use, husbandry and health of equids in Eastern Cape Province.
- To identify key issues and constraints to the more efficient use of working equids in the areas surveyed, and discover local people's priorities.
- To make recommendations for education and extension on the use of equids.

CURRENT USE OF EQUIDS FOR WORK

Today about 180,000 horses and ponies are found in the former 'Bantustan' areas of South Africa. They are generally of a light build and range in height from about 13.2 hh (138 cm) to 15.2 hh (158 cm). Their use is quite localised but they are notably prevalent in the Eastern Cape Province, particularly in Transkei. About 150,000 donkeys are currently employed in the country (Starkey, Jaiyesimi-Njobe and Hanekom, 1995). A census conducted in 1992 indicated that there were 2,800 horses, donkeys and mules in the Ciskei. In Eastern Cape cattle are the main animals employed, it being less usual for horses to work. Some donkeys are used as pack animals and to drag wood (Starkey *et al.*, 1995). A survey in the former Transkei and Ciskei regions suggested that 67% of farmers used cattle for draught while only 11% used horses for work despite the fact that 36% kept horses (O'Neill *et al.*, 1999 and this Proceedings). It is unusual for relatively poor communities to keep so many horses not used for work.

An Eastern Cape farmers' delegation to a SANAT workshop in March 1996 identified a lack of suitable horses and mules for draught work as one of the major constraints to the adoption of draught animal power (Simalenga and Joubert, 1997). This would appear to suggest that more people would like to use equine draught animals but do not consider those already available to them to be particularly suitable.

MATERIALS AND METHODS

BACKGROUND TO THE STUDY AREAS

Points which are relevant when considering the use of draught animals in crop production activities:

- The youth and able-bodied labour force of the rural areas are drawn away to urban centres leaving mainly pensioners, women and children at home.
- Agriculture is not looked upon as a career option or income-generating activity, with most families depending on pensions and remittances from relatives working elsewhere.

- Mixed agriculture is practised with animal husbandry regarded as more important than crop production.
- Traditional crop production is not market orientated, with most food grown for home consumption, which means that people are willing to invest labour, but not capital in tillage.
- The land tenure system means that opportunities for expansion are limited and there is little incentive to invest in agriculture.
- The arable allocations are very small, so farmers' individual requirements for draught power are not high, and could be met by a pair of small horses.
- There is limited grazing available and the communal system of grazing means there is no incentive to improve the grazing area. Therefore if equids are kept, they should be used efficiently and, if possible, all year round.
- Tractor availability has been a problem with irrigation schemes. Horses and donkeys could be a viable alternative source of power in this situation.
- Crop residues could potentially be harvested for feeding draught animals including equids.

Points which are relevant when considering the use of draught animals in the urban fringe (Grahamstown area):

- The increase in population has meant low density sprawl and building has tended to extend over the former communal grazing areas on the edges of the town.
- Unemployment is high and there is considerable dependence on an informal economic sector.

SURVEY TECHNIQUES

Survey 1 The survey was conducted over a six-week period from July 2nd to August 12th 1998. The locations visited were Victoria East, Keiskammahoek, Peddie, Middledrift, Whittlesea, (Hewu), Seymour, Mdantsane and Zwelitsha. The extension officer through his contacts in the agricultural extension services arranged interviews.

The research team consisted of one of the authors (D. Taylor) and two local South Africans, one of whom was a local extension officer. These two team members were fluent speakers of the Xhosa language so interviews were conducted in Xhosa by one team member while another acted as translator and recorded the main findings. Semi-structured interviews were conducted. A check-list of questions and topics of interest was prepared and this was used to guide the interviews in a certain direction while allowing the flexibility for participants to talk about aspects of horse, mule and donkey care which seemed particularly significant to them. The checklist covered such topics as, the reasons for using equids, the roles performed, economic factors, husbandry and health. If animals, harnesses, carts and other equipment were present, they were examined.

Survey 2 The survey was conducted for four weeks from July 22nd to August 19th 1996. The locations visited were Ndwayana, including the Tyefu Irrigation Scheme, Ndlambe, Sheshugu and Glenmore in the Fish River area, and Grahamstown. Interviews were arranged with the assistance of the Agricultural and Rural Development Research

Institute (ARDRI), through their contacts in the agricultural extension services. In Grahamstown, interviews were arranged with the assistance of the Society for the Prevention of Cruelty to Animals (SPCA).

The research team in the villages, consisted of one of the authors (J. Kneale) and one or two South African Xhosa speakers, who were research assistants with ARDRI either based at ARDRI or in the villages. Interviews were conducted in Xhosa in Mid-Fish River. In Grahamstown, where many of the donkeys owners spoke English, a member of the SPCA participated in the team and English was usually spoken. Semi-structured interviews were conducted as in survey 1.

When donkeys were present, they were examined briefly. Age (according to Trawford and Crane, 1995) and sex were determined, live weight was estimated from girth and length measurements. Body condition score (according to Pearson and Ouassat, 1996) and general health were assessed. Use type and condition of harnesses, implements and carts were assessed when available.

RESULTS

SURVEY 1

Ten group meetings were held and 36 individual owners were interviewed. Of the latter, 20 owned donkeys, 12 owned horses, three used both horses and donkeys and one owned a mule. Out of the 20 donkey owners, three were female, while no women who owned horses or mules were interviewed. This is probably a reflection of the fact that horses are normally associated with men in Xhosa culture.

Equids, particularly donkeys, were considered easy to care for and donkeys were also said to be very docile. An advantage of using horses or donkeys was that they stayed nearer the villages than cattle so they were easily accessible for work. It was thought that one man could easily manage a pair of horses, while a team of oxen required more additional help (Table 1). This was seen as being particularly important if the younger men of the area were away working in the cities. It was also felt that donkeys and horses could be hired to others more easily than oxen and that equids were suitable for women to use, although only a very small minority of the people interviewed were female. Equids were also considered suitable for children to help with, but many people stressed that, especially in the case of donkeys, this should be strictly supervised as children had a tendency to be cruel and abusive (Table 1).

Many donkey owners cited poverty, lack of money, unemployment or physical handicap as their reason for starting to use donkeys to cart water and wood for other members of the community. Donkeys and horses were considered more suitable than oxen or tractors for ploughing small garden plots or hilly fields. Many donkey users ploughed gardens on a commercial basis for their neighbours.

Horses, and particularly donkeys, were regarded as being able to cope better with prolonged dry conditions. A point made by one group of farmers was that horses regained condition more quickly after the dry season than cattle and thus were able to start land preparation more promptly in September and October.

Table 1: Survey 1 - Reasons for choosing equine draught animals

Reasons	Number of times mentioned	
	Horses	Donkeys
Less labour required than cattle	7	4
Poverty, unemployment or disability	1	12
Economically viable or cheaper than cattle	4	3
Tradition or followed someone else’s example	2	3
Resistant to drought	3	1
Easy to look after	2	1
Docile or suitable for women and children to use	1	
Faster than cattle	1	
Easy to hire	1	
Suitable for small areas	1	

For some people the use of donkeys and horses was a tradition inherited from their fathers or a skill learned while working on a commercial farm during their youth.

Interest in mules and heavy horses Working with horses and mules was thought to be faster than with donkeys. Opinion was fairly equally divided as to whether or not mules would be an improvement on the donkeys and horses currently used. Only one farmer interviewed actually used mules. Several said that they would like mules but that they were hard to get. Those who wanted them had not considered breeding mules using local pony mares. Others did not want mules on the basis that they were ‘rough’, ‘cruel’, ‘moody’, ‘too strong’, ‘unreliable’, ‘time conscious’ or that they must be worked every day. One man said that he would like a mule but that his family would be frightened of it.

One or two farmers expressed an interest in getting heavy horses while others felt that their grazing would not support them. This feeling was supported by one man who bought two Percherons but found that they both died within a short time. Another suggestion was that a group of farmers could buy a heavy stallion to mate with their smaller mares thus increasing the size and potential for growth of the foals born. Some donkey owners would like horses but realised that they could not afford them, while several would prefer to increase the number of donkeys they already have.

Role of equids Agricultural roles included ploughing which involved spanning 4-6 donkeys or 2-3 horses. Planting, cultivating, harrowing and transport of harvest and manure were other farming tasks (Table 2). Horses had an additional role in that they could be used to herd cattle or check stock, which might be grazing at a considerable distance from the village.

Other roles included personal transport, either by donkey cart or on horseback, as well as transport of water, firewood, kraal bushes, sand and building materials (Table 2). However, because all the villages can be reached by road, the main means of transport over longer distances is the motorcar or taxi.

Table 2: Survey 1 - Roles performed by horses and donkeys

Roles performed	**Number of times mentioned**	
	Horses	**Donkeys**
Ploughing	10	21
Planting	8	3
Weeding	7	5
Harrowing	4	5
Personal transport	5	3
Transport of water	6	13
Transport of wood	5	24
Transport of harvest or vegetables	2	4
Transport of manure	1	2
Transport of building materials	2	6
Transport of sand	1	6
Herding cattle	8	
Payment of “Lobola’	3	
Racing	1	
Use at weddings or cultural events	2	

In some communities horses, fully equipped with saddles and bridles, could be used for ‘lobola’ (given by a man to his future wife’s family) while in others this was not the case. Donkeys were never used for lobola, presumably because of their low status. Other non-working activities included horseracing, which a small minority of owners took part in, and shows at weddings, a tradition which is maintained by a few people. No use was made of horse or donkey meat or hides. After death they were either eaten by dogs or buried.

Economic aspects The median number of donkeys owned by the 20 individual owners interviewed was six (range 2-12) while the median number of horses owned by 12 individuals was one (range 1-10). Prices quoted for horses were R500-R1050 while donkey prices were R50-R200. One or two farmers suggested that a horse could be swapped or bartered for an ox or a heifer although cattle were generally felt to be more valuable. One person said that he exchanged one goat for a donkey.

Some earnings were quoted for various tasks. To plough 0.5 hectares, which a team of donkeys could do in a day, would earn approximately R80. The current rate for tractor ploughing (1998) is R270 per hectare. The charge for delivering 200 litres of water varied from R8-R40. The estimated daily income from working donkeys varied from R20-R150. It is difficult to compare income generated on a daily basis with that from regular full-time employment but, to give some idea of other wages, a farm labourer earns approximately R1000 per month while a pension or welfare grant might amount to about R400 per month. The potential return from a modest investment in donkeys can be considerable by comparison with other enterprises. For example, an analysis of small-scale broiler production in Ciskei showed that an initial investment of about R800 in young birds, feed and medicines was required to make a profit of R250 when the broilers were finally sold and paid for three months later (ARDRI, 1997). A similar sum could buy a new plough and a team of four donkeys, which could generate income immediately and could continue to do so with a minimum of further investment.

Equipment

Tillage Most farmers had an adequate supply of implements such as mould-board ploughs (most commonly the "VS 8"), planters, harrows and cultivators. These tended to be old and to have been designed for oxen, not for small horses and donkeys. New implements can be purchased in larger urban centres such as Queenstown and East London.

Transport The most common means of transport was the two-wheeled cart with a single pole. Carts tended to be homemade and heavy, based on old car axles. Several larger four-wheeled wagons and sledges were also seen. An interesting innovation, seen on carts was the use of rubber 'brake-pads' made from old tyres. Only one person interviewed used her donkeys as pack animals for carrying water rather than carting. This was done using two 20-litre drums tied together and padded in a manner that protected the donkey's spine from any pressure.

Harnessing All the donkey harnesses and almost all the horse harnesses were homemade breast-band types. The quality varied from very good to very poor, but in general, an effort was made to ensure that the animal's skin was protected from sharp edges, metal staples and wire. Materials used included pulley belts, seat belts, rubber tubing and old tyres. Foam rubber and sheepskin padding was occasionally seen. Some cases of bad hitching practices were seen. For example, breeching straps were often absent. The weight of the cart was sometimes transferred to the animals by a thin rope in some cases and sometimes the animals were tied together in such a way that they could not work easily.

Training and working life expectancy Some interviewees stressed the importance of handling young animals gently from an early age. The ages at which horses and donkeys were broken-in or trained to work varied considerably from 1.5 years to five years of age. The most commonly reported age was three years. Some people went by the weight and appearance of the animals and whether or not they urgently needed to use them, rather than age. The length of time taken to train a young animal varied from 2-3 days to 1.5 weeks. Inexperienced animals were generally introduced to draught work by pulling light loads such as a tyre or branches along the ground or by spanning them with experienced animals. Most people expected a horse to work for 7-15 years and a donkey for 15-30 years. Apart from the very young animals, people tended to be vague about the ages of their horses and donkeys. In some cases, a quick examination of the animals' teeth suggested that that they were considerably older than their owners thought.

Feeding The main source of nutrition for horses and donkeys was communal grazing of the veld. This means that if the dry season (winter) is prolonged, food shortages can occur and horses tend to lose condition. Most farmers (11 out of 12 who discussed this topic) indicated that they supplemented their horses' diets before and during the ploughing season. Supplements mentioned included maize and lucerne and, less commonly, maize stover, vegetable leaves, oats, barley and sorghum malt. Feeding was also practised to ensure that horses remained tame and easy to catch and handle. The majority of donkey owners (12 of 17) did not give any supplementary feeding.

Security While theft was said to be rare in the Victoria East District, it was said to be common in Keiskammahoek, Peddie, Hewu, Seymour, Zwelitsha and Mdantsane. Police reaction was said to be inadequate. Where stock-theft was a problem animals tended to be kept in enclosures or kraals. Another reason for keeping donkeys in kraals was that there was a danger of them being teased by children or maliciously wounded if left out in communal areas. This problem was reported once in Keiskammahoek, while in Mdantsane, one man had lost two donkeys and in Zwelitsha, another had lost 10 as a result of ill treatment by other people.

Lameness and shoeing Lameness, reported by one horse owner and three donkey owners was seldom a significant problem. No donkeys and virtually no working horses were shod. The only animals actually seen wearing shoes were riding horses at Kamastone village in the Hewu district. Only one farmer reported a problem with his horse's hooves which he said were very flat so that the horse was walking on his heels. Lack of shoes and of local blacksmiths were not seen as important constraints to use of equids for work.

Breeding For the vast majority of donkeys and horses in the communal areas, breeding was unplanned. Nine out of 13 horse owners who discussed this topic and 19 out of 20 donkey owners did not control their animals' breeding in any way. Occasional owners selected stallions to mate with their mares. The expected lifetime production of foals for a mare would be from 6 to 12 foals. Donkey owners in particular reported foaling at regular yearly intervals with mating taking place soon after parturition. Most foaling occurred in spring and summer (September onwards) and were unobserved by owners. Only one man said that he knew how to assist if necessary. In-foal mares were generally worked, but care was taken in the later stages of pregnancy. Very occasionally abortions were reported. One owner felt that one of his donkey mares had aborted as a result of ill treatment by children. Another reported deaths in young foals due to snake bites. A commonly mentioned problem was that of donkey jacks attacking and even killing young foals at the time of post-parturient mating.

Castration Some donkey and horse owners expressed a preference for using entire stallions for work because they are considered to be stronger than mares or geldings. Castration is often not performed unless behavioural problems arise. The most common age for castration was 5-7 years. Reasons given were to facilitate handling male horses and to prevent donkeys from roaming and fighting. Veterinary assistance for castration was rare with most operations being carried out either by the owner or by another local person using a knife. One horse owner used a burdizzo while two or three donkey owners also favoured this method. One death following a donkey castration was reported. The lack of people who could castrate properly and the absence of training in this area were frequently mentioned as problems, particularly by donkey users.

Health Most owners reported that they experienced no sickness with donkeys although several carried out some form of tick control by direct application of used engine oil or by using 'Deadline' pour-on (Flumethrin) or cattle-dip. One owner reported mange, which she treated with cattle-dip while another treated warts with 'Kerol' (carbolic acid). No worm treatments were given. Bites as a result of males fighting were mentioned. Skin wounds, possibly resulting from ill-fitting harness, were observed.

Various problems were reported with horses including ticks and, much less frequently, warts and mange. These were treated in a similar fashion to the same conditions in donkeys. Babesiosis was frequently mentioned. Other conditions included mild coughing, worms, coughing associated with worms, 'papies' (bots), nodular skin eruptions (possibly epizootic lymphangitis), 'grundling' and coughing leading to sudden death (possibly African Horse Sickness).

Some owners obtained medicines from co-ops and agricultural officers for conditions such as Babesiosis. Several mentioned using herbs but rarely specified which ones. The only dewormer mentioned was 'Equiguard' but generally, no worm treatments were given. No vaccinations were carried out. A veterinary service was seldom available locally. Agricultural officers who had formerly given advice no longer did so.

SURVEY 2

Among the black and coloured communities 34 donkey owners were interviewed in Ndwayana, 24 in Ndlambe and 25 in Grahamstown, of these only three in Ndwayana, and two in Ndlambe were women. No women owners were interviewed in Grahamstown.

Table 3: Survey 2 - Reasons for choosing donkeys for work

Reasons for keeping donkeys
For work carrying water and wood
To generate income
Economically viable or cheaper than cattle
Better at surviving disease and drought than cattle
Easy to look after and train
Work well
Suitable for small areas

The women did however have as good a grasp of the issues as the male informants. Only one woman (a widow at Ndlambe) used her donkeys herself. Male interviewees at all three locations all said women do not usually use donkeys, as they are either afraid of them, do not, or are not able to use them. Women did own donkeys, but their male relatives used them. The women were not particular about using the donkeys, possibly because the donkeys are used mainly to transport wood and water (Table 3) and if they learnt to use them, they would then have to also do the fetching and carrying, instead of getting others to do it.

Donkey characteristics Data were collected in Ndwayana and Grahamstown from 34 and 25 people respectively, owning a total of 59 and 51 donkeys. In Ndwayana the median number of donkeys kept was four (range 1-11), the estimated adult donkey weight was 110-140 kg with a condition score range 3 of 6. In Grahamstown the most common number of donkeys kept was two (range 2-4), the estimated adult donkey live weight was 110-120 kg with a condition score range of 2-4.

Role of donkeys All interviewees used their donkeys for carting, but a few used them for other work in rural areas (Table 4). Six donkeys made up a ploughing team and 2-3 to ridge or cultivate. Donkeys were borrowed to make up teams from friends or relatives. On a cart, typical loads were firewood, water, building materials, crop residues for food for other livestock, harvested crops and people. Donkeys form the major type of local transport within communities although the main means of transport over longer distances is the motorcar or taxi.

Table 4: Survey 2 - Roles performed by donkeys

	Location		
Roles performed	**Ndwayana**	**Ndlambe**	**Grahamstown**
Carting - daily except Sunday	3	4	25
Carting - more than 2 weekly	28	18	
Carting - less than 2 weekly	3	2	
Carting usual journey distance	5-10 km	5-10 km	20
Ploughing	1	3	
Ridging		1	
Cultivating		3	
No of interviewees	34	24	25

Economic aspects The most significant input was the cost of the donkeys, which had risen in price as they had become more difficult to obtain. Several owners were prepared to travel over 50 km to get one, but the animals were not available. The value of the animals for a 2-donkey cart was approximately the same price (in 1996) as that of the equipment needed for a cart. A reasonable local wage at the time of the survey was R20. Donkey prices ranged from R30 for a foal to R200 for an adult, with small differences from area to area, whereas typical returns are shown in Table 5. One person said that he exchanged an adult pig or goat for an adult donkey. Others would consider exchanging a donkey for a cart. Carts cost R300 in Ndwayana and R100-200 in Ndlambe and Grahamstown. In 1996 harness cost R45 in Ndwayana and R60 in Grahamstown. Bales of lucerne would cost R20 in Ndwayana, R7-20 in Ndlambe and R30 in Grahamstown.

Table 5: Survey 2 - Rates of earning from carting using donkeys carts in 1996

Task	Cost in each location (R) Ndwayana	Ndlambe	Grahamstown
Firewood	R20	R10-15	R30
Maize to mill for grinding		R5	
Sand		R15	
Water	R15		
Building poles			R30
No of interviewees for whom donkeys are the only or main source of income	11	13	24
No of interviewees	34	24	25

Equipment
Tillage Farmers used ox-drawn ploughs and ridgers with their donkeys.

Transport All interviewees owned their carts. The carts were similar to those seen in the first survey - two-wheeled cart with a single shaft, home-made of wood or metal, based mainly on old car axles, with the differential and the springs. Several people harnessed three donkeys, with the third harnessed to the left and sharing an extended swingle tree. In Ndlambe sometimes four animals were harnessed to a rigid side extension on the sides of the front of the cart, with traces attached to fixed points on the bar.

Harnessing All the donkey harnesses were homemade breast-band types to a variety of standards from the very good to very poor. Nylon webbing and machine belts were the most common materials used. Breeching straps were often absent especially in Ndlambe. The weight of the dissel-boom was supported often on the donkeys' necks via a cross-tree and webbing straps.

Training and working life expectancy Training started when the animal 'was big enough'. One measure for this was when the mother had another foal. Donkeys were perceived as easy to train, usually by the owner or a relative skilled in training. Life expectancy was more than 20 years, in rural areas some would be retired to run wild. The main cause of death given was old age. No use was made of the carcass. It was left to scavengers.

Feeding The main source of nutrition for donkeys was communal grazing on the veld. Donkeys would travel long distances from their villages to get to good areas - as much as 10 km. Feed supplements were rarely given and then only in times of extreme drought or when the donkeys were too weak to work. In the rural areas, lucerne was brought from the commercial farmers on the far side of Fish River and use was made of crop residues and stubbles. The winter in rural areas was considered the best time for the donkey, due to the supply of harvest residues. In Grahamstown some concentrate feed was used, also discarded food from human shops, such as old vegetables, swill. Lucerne and silage were brought from commercial farmers occasionally. Management was kept to a minimum, donkeys were often kraaled in rural areas when needed for work and in urban areas at night for security.

Security For all interviewees security was the most important issue. Theft, unauthorised use of animals, and straying were the problems of the rural participants, while attacks on animals were added by the urban interviewees. In Grahamstown at the time of the survey attacks on donkeys had escalated in the equivalent of 'taxi wars', which seemed to be aimed at putting the carters out of business. Occasional attacks on donkeys were noted in rural areas.

Lameness and shoeing No donkeys were shod and, as in the first survey, lack of shoes and of local blacksmiths were not seen as important constraints to the use of donkeys. Lameness was not reported.

Breeding No records on breeding were kept. The expected lifetime production of foals for a donkey mare was up to 12 foals with the first foal being born when the donkey was three years old. Owners reported donkeys foaling at regular yearly intervals with mating taking place soon after parturition. Most foaling occurred in summer with the peak in December. Mating occurred in the veld and no planned weaning of young stock occurred.

Castration In Ndwayana castration is normally done early at less than one year old, but in Ndlambe it was only done if the animal strayed or was a problem temperamentally. One gelding was seen in the survey, which suggested castration of donkeys was not common.

Health The general opinion was that donkeys do not suffer from any disease and no prophylactic measures were reported. The main problems were with work related injuries (harness sores -100% of owners in Ndlambe had problems with this but only 20 % in Ndwayana - traffic accidents, bites from other donkeys). Other problems were ticks and a mange-like condition which occurred in the summer. Some use of herbal remedies was reported, but usually as a spin-off from the treatment of cattle.

All owners would like better access to veterinary services and more information on disease. In Ndlambe one shop owner wanted to stock veterinary medicines, but also wanted training in how to use them and give advice. A veterinary service was seldom available locally. The nearest veterinary surgeons to Fish River were in Grahamstown, adding transport costs to the costs of consultations and treatments. In Grahamstown donkey owners used the basic service provided by the SPCA three times a week in the town. Cost recovery of basic charges, which had been previously free, was a major deterrent to donkey owners making use of services when available.

Concern was expressed for the welfare of animals owned by younger people or used by children. Examples of malpractice cited were kraaling overnight before use, overloading carts, not using enough animals on steep hills, speeding and over-use of the whip. Many individuals suggested children should be trained in animal care at school.

DISCUSSION AND CONCLUSIONS

The use of draught animals cannot be promoted in isolation from other aspects of agriculture in Ciskei. Advice also needs to be given about tillage methods and the most appropriate crops to grow taking local soil types and rainfall into consideration. As the arable land available to most smallholders is only about two hectares, they do not need large numbers of draught animals unless they plan to work for other people. A pair of small horses is often quite adequate to meet their requirements.

DONKEYS

As is the case in many parts of the world, donkeys, costing as little as R50 each, are the first affordable option for the person with limited capital (Pearson and Smith, 1994). Donkeys can make an enormous contribution to the economic well-being of their owners. The status of the donkey is still very low and it can be ridiculed and subjected to senseless abuse to the extent that many people are forced to keep their animals in an enclosure or kraal at night for security reasons. The recent development of lightweight donkey implements means that fewer animals should be needed to perform agricultural tasks thereby reducing the pressure on limited communal grazing. In practice, it is more likely that the use of larger teams and older, heavier equipment will continue in the short term at least.

HORSES

The small horse is a considerable step up from the donkey and can be multipurpose, being a relatively fast means of transport as well as being used for work. Traditionally the horse enjoys comparatively high status although this may have declined due to the advent of the motorcar (Steyn, 1988). Most horse owners interviewed used their horses for work, but they could probably be used for a wider variety of tasks. For example, in Kamastone, there are an estimated 90-100 riding horses in the village but their contribution to agriculture is less than it might be due to a lack of harness. Similarly there is considerable interest in horse racing in the Ciskei area and there is no reason why horses kept primarily for racing should not also be used for draught work. Promoting this idea might be a way of getting young people, who already take pride in their horses, interested in animal traction because the riders at races and shows are usually young boys.

HEAVY HORSES

No farmers interviewed currently used heavy working horses. Commercial farmers who use them on their own farms have sold several heavy horses into the former Bantustans, but many of these ventures have reportedly not been successful. It is suggested that communal grazing is not adequate to support heavy horses and their use in Ciskei should not be encouraged at this stage. Further investigation of this problem might be helpful. Quite apart from the welfare aspect, the loss of a Percheron represents a financial loss of about R5000, which would be a major blow to a poor family.

MULES

Much has been said about the exceptional ability of the mule to work hard in an unfavourable environment (Fielding and Krause, 1998). However, this survey found only one farmer using a mule. As no one in the area is breeding mules they must be purchased elsewhere and are quite expensive. A weaned foal, which will not be ready to work for almost three years, costs from R1000 upwards, while a trained mule would cost around R2500. To justify buying a mule at these prices a farmer would need to be sure that his animal was worth three times as much as a local horse or 10-20 times as much as a donkey in terms of how much work he could expect from it. A further disadvantage of the mule is that it cannot reproduce. Also, it may be less risky to buy two or three cheaper animals than to invest a large sum in one animal, however good that individual may be. The other side of this argument is that it costs less to feed one good animal than several bad ones but, with communal grazing, farmers are less likely to consider this. However, anyone who made the effort to breed mules locally would be likely to have plenty of customers for his young stock.

OXEN

The big disadvantages of using horses and donkeys as opposed to oxen are that equine harnessing is more complicated and there is no meat or skin value if the animals can no longer work. If farmers in Ciskei are already using oxen, there is no reason why they should change to equids unless they require animals for transport. Oxen are generally regarded as being suitable for heavy work such as ploughing, but are slower than equids, which is a disadvantage, if they are needed for haulage. However in Ciskei most haulage over long distances is done by motor transport. Draught animals still have a role in carrying goods over shorter distances and to and from more inaccessible areas where speed is not so important and ox-carts might be quite adequate.

WORKING PRACTICES AND EQUIPMENT

Tillage The promotion of lightweight implements suitable for small horses and donkeys should be encouraged. Ploughs that can be pulled by a single donkey have been developed and evaluated in other countries (Inns, Shetto and Mkomwa, 1995). Single donkey ploughs are unlikely to be suitable for the heavier South African soils but small ploughs requiring about 700N draught force under South African type conditions have been developed (Starkey, 1998). A donkey can generate a draught force of around 240-280 N so two donkeys would be insufficient to pull this type of plough, but two ponies could easily manage it.

Harnesses Harnessing was seen to be a problem in both surveys. While some horses had professionally-made leather harnesses, these were in the minority. Leather is expensive and requires regular maintenance. Leather harnesses for a pair of donkeys would cost around R2000 or about ten times as much as the donkeys themselves. Consequently, cheaper materials such as old seat belts are commonly used to make perfectly adequate harnesses. Ideally a harness should be strong but light, because extra weight gives the animals extra work. The straps should be broad especially where maximum pressure is exerted and padding may also help to prevent skin injuries. Some people use machine belting, which may be too rigid and cause sores (Wells, Krecek and Kneale, 1997). The provision of breeching straps when carting is often neglected. Breeching is not necessary if tillage tasks like ploughing are being carried out. The breast-band harness is probably the best to promote. Professionally made collar harnesses need to be individually fitted and are generally not available in South Africa. A simplified three-pad collar has been designed (Dibbits, 1991) which would be worth further evaluation.

Some areas report greater problems with harness sores than others for example 24 out of 24 interviewees owning donkeys in Ndlambe, but only 5 out of 34 in Ndwayana said they had problems. It is now well recognised that body condition and therefore feed supply, and management, not just harness quality affect incidence of harness sores. In view of this, and the difference seen in incidence of harness sores within the different areas surveyed, a more detailed investigation of the problem of harness sores seems indicated.

The use of snaffle bits is to be recommended. Although it is suggested that homemade bits can be satisfactory (Jones, 1997), care must be taken to avoid using thin wire or metal with sharp edges. It is possible to train donkeys for work without using bits (Jones, 1997) and this would also have welfare benefits. Not using a bit would reduce the expense involved, as a new bit costs around R72. Observations made during the time spent on the surveys suggest that rough handling of donkeys' mouths by hauling on their bits is a common problem. Similarly, a further saving of material can be made by not using blinkers. Blinkers restrict the animal's vision to what is directly in front of it, the theory being that this stops it from being distracted or frightened by seeing the load it is pulling. It could be argued that a horse or donkey is more likely to be frightened by a rattling cart which it cannot see. Lop-sided or half-functional improvised blinkers can often be a hindrance (Rendle, 1997). Nosebands and throat-lashes can also be unnecessary.

Carts and wagons One frequently observed problem with the use of equids for haulage was the heavy weight of the carts or wagons used, which require considerable energy to pull even when empty. When building carts the importance of using strong but light materials should be stressed. Most of the carts currently in use are based on old car axles, which are heavy but will probably continue to be used for economic reasons. Lighter axles, which would be suitable for animal-drawn vehicles, are available but cost about R1200. The popularity of small motor-drawn luggage trailers on the roads would suggest that lighter, second-hand axles might become available in the future.

The hitching system, whereby the animal and its load are linked deserves attention especially when two-wheeled carts are used, as the animals have to support some of the vertical loading. All the carts seen had a single central shaft or dissel-boom. With this system the weight of the cart is transferred to the horses and donkeys by a breast-yoke (or klein dissel-boom) suspended from the animals' necks by straps. Ideally, the breast-yoke should be a light bar suspended by a wide strap but in practice, this is often not the case and thin rope is often used. If there is no braking system or breeching harness the neck also acts as a partial brake. Alternative systems such as dorsal back yokes and hitch carts could be investigated.

Several lightweight carts have been designed, some of which are suitable for single donkeys (Anderson and Dennis, 1994a), but none of these were seen in Eastern Cape. The locally built, 'V' shaped, Golovan cart is designed to ensure that the weight of the load is always directly above the axle. A similar vehicle suitable for pulling with two donkeys is available. It costs R2400 with pneumatic wheels or R1900 with steel wheels. This is unlikely to be attractive to a potential buyer from a communal farming area. Its manufacturer points out that the labour involved in making small carts and donkey harnesses is just as great as that required for making equipment for bigger animals.

Advice about payloads for carts should be included in extension exercises. The total weight of cart and load for two average donkeys should be about 700 kg (Anderson and Dennis, 1994b). As a rough guide the load on a cart should be equal to the weight of the animals pulling it. If the work involves going up and down hills the loads carried should be reduced.

Packing, although not popular in Eastern Cape, may be more efficient than carting with donkeys when the cost of harnesses and carts is taken into consideration (Jones, 1997). Care must always be taken to ensure that loads are balanced and that the spine is protected.

HUSBANDRY

Nutrition Communal grazing was the main source of nutrition for all working equids. The information obtained on feeding practices was vague in terms of exact quantities given, but there was a definite tendency for horses to receive supplementary feeding when working, while most donkeys are not given food supplements. This trend is similar to that in other countries (Pradhan, Mahato and Joshi, 1991).

The draught power output of any animal is largely a function of its live weight, provided it is in good health (Pearson and Smith, 1994), so it is in the owner’s interest to ensure that it does not get too thin during the dry season. Also, it is important to ensure that young animals are given ample feed and the opportunity to grow to their maximum possible size before starting to work. Good handling of young stock may be advisable, but working before the age of three is to be discouraged. The overall efficiency of a draught animal system is greater if a small number of heavy animals are used rather than a large number of light ones. Less harnessing is required and a small team is more easily managed (Pearson *et al.,* 1995).

Many people said that they would like more animals but bearing in mind that communal grazing is a limited resource, it might be better to concentrate on maximising the efficiency of the number of animals currently owned. Practical advice about supplementary feeding is required, particularly if the working day is long or the animals are kept in at night. Because many donkeys are kraaled at night, the time available for feeding is curtailed. Owners must be aware of the necessity to compensate for this. It is often said that poor farmers cannot afford to feed their animals well but it should be possible to reserve some crop for animals. Lucerne hay can be purchased for about R15 for a 25 kg bale, while maize meal costs around R77 for 50 kg, and oats R58 for 50 kg (in 1998). Using these figures as an approximate guide, it should not be too difficult for an owner who is earning even R20 per day to give each donkey 0.5 kg concentrates daily when other food is scarce.

Shoeing Shoeing and lameness do not appear to be serious constraints to the use of equids in the Eastern Cape, which is quite different to the situation in many other developing countries where equids are used for work (Lopez, Chavira and Granillo, 1994). This is probably because very little roadwork is done. Only in Grahamstown were problems of over-worn feet on donkeys reported. Horse shoes are available in larger towns but cost around R61 for a set (in 1998). Skilled blacksmiths are rare but at the present, there seems to be little need for such expertise. However, it is possible that an assessment carried out by a professional farrier might identify areas for improvement.

Breeding Breeding is largely at random and it can be argued that a natural selection process has been taking place for over 100 years, resulting in horses and donkeys which are well adapted to the local conditions. However most villages have relatively small equine populations and, because castration is not carried out until 5-7 years and many people prefer to use entire males for work, it would seem that a high degree of inbreeding is inevitable. The system of communal grazing makes it difficult to control breeding and the co-operation of all equine users would be required to decide which colts to castrate and which to keep as stallions. Even then, it cannot be guaranteed that a roaming male won't come from another district. The suggestion that local people might breed their own mules is an interesting one which is worth considering. However most commercial mule breeders use the larger Spanish donkey for this purpose and it is said that jacks kept for breeding with horse mares need to be 'brought up' with horses from an early age. Selected local donkey jacks could be used but again the practical problems associated with the communal system where there are no fenced-off areas arise. However controlled breeding of mules, donkeys and horses is possible if people are willing to put some effort into making it work. It may not however be the number one priority at this stage.

Purchasing a Spanish donkey jack to mate with local jennies or a strong stallion to cross with pony mares are other ways to introduce new genetic material to the communal areas, but before buying in new stock, the disease hazards should be considered carefully.

VETERINARY PROBLEMS

Castration As mentioned above some stallions were deliberately not castrated but for many people this was not a matter of choice. There was no one in the area that could provide this service. There is no regular veterinary service in the rural study areas at the present so it may be necessary to train local people to castrate. Veterinary experts generally frown upon the use of the burdizzo with equids and surgical removal of the testicles is preferred. The burdizzo does have the advantages of not causing any bleeding and not leaving an open wound that could get infected. However if the testicle itself, rather than the cord, is caught in the implement, severe pain and inflammation of the scrotal region can be expected. If the burdizzo must be used, castration should be carried out at an early age when the testicles are small.

Other health problems 'Coughing and sudden death' may be due to the pulmonary or 'dunkop' form of African Horse Sickness. African Horse Sickness is a major constraint to keeping horses in other parts of Africa and it does occur in Eastern Cape Province. A vaccine is available and, although it is not 100% effective its use should be promoted with horses. The cost is reasonable (R15-20). Mules are less susceptible than horses and donkeys are thought to be relatively resistant to the virus (Coetzer and Erasmus, 1994). Babesia was also mentioned as a cause of illness and death. Animals born in endemic areas will often develop immunity without showing clinical signs if exposed to the disease at an early age (de Waal and van Heerden, 1994). ‘Grundling’, in which the animal wastes away and dies, possibly refers to a chronic form of Babesiosis but this is by no means certain. One case was described which sounded like epizootic lymphangitis (Scott, 1994). No cases of tetanus were mentioned but it would appear sensible to advise tetanus vaccination particularly at castration, a recommendation also made by Canacoo (1991).

Donkeys on both surveys were perceived to have very few health problems and to live for a long time. This finding was similar to the observations of Wells *et al*. (1997). Most owners attached some importance to tick control, often using cattle dipping time as an opportunity to dip their equids. Care should be taken that equids are not treated with amitraz which is toxic to them (Smith, 1994) although this acaricide is not currently used in the study areas. Another potential problem to be aware of is that used engine oil, which is commonly applied topically, and may be effective against certain ectoparasites due to its sulphur content (Fielding, 1994), also contains high quantities of lead which is potentially toxic.

Worm treatment was rare and some of the worm egg counts obtained in the study were relatively high suggesting heavy worm burdens. The question which arises is whether the worms are actually having a serious pathological effect. No animals seen were clinically ill or in particularly poor body condition but it would probably be advisable to promote anthelmintic treatment once or twice a year. Dosing was found to improve the body condition score of donkeys in Morocco (Khallaayoune, 1991) and strategic dosing late in the rainy season and again at the end of the dry season was recommended in Zimbabwe (Pandey and Eysker, 1991). The keeping of donkeys or horses in kraals causes a build-up of worm eggs so owners need to be aware of this and adopt a control policy such as regular removal of faeces (Matthee and Krecek, 1998 and in these Proceedings – Matthee *et al*.). Another problem to be avoided is that of indiscriminate use of anthelmintics, which can result in the emergence of resistant parasite strains.

It is often suggested that anthelmintics are prohibitively expensive in developing countries including South Africa (Starkey, 1998) but this is not invariably so. The price for ‘Panacur’ (fenbendazole) is around R91 for a litre which would be sufficient for 10 horses or 20 donkeys. Similarly acaricide treatment is affordable when judged against the earnings generated by draught animals. ‘Deadline’ (flumethrin 1%) pour-on costs R63 for 200 ml. This would treat 10 donkeys weighing 200 kg each.

CONCLUSIONS

- Although they are not indigenous to South Africa, horses, donkeys and mules have made a major contribution to agriculture, transport and cultural events in the past. This tradition provides a good foundation on which to develop their present day use among poorer communities.
- Donkeys and horses were seen to play important roles in communal farming areas. They were involved in land preparation, weeding, planting, carting manure and transport of harvest from the fields. They also have a role in personal transport at a local level and commercial transport of water, firewood and building materials.
- The constraints which equine users face include bad harnesses, heavy equipment, lack of advice on feeding and lack of veterinary services.

- Key issues, although common to most equine owners, can have different priorities in the different areas. For example in the rural communities access to veterinary services is a key issue whereas, in the urban areas, security against theft and abuse, and availability of grazing areas are seen as more major problems.
- To some extent equids are under-utilised and could be employed for other tasks but, perhaps more significantly, they are often used inefficiently. Examples of this include being harnessed together carelessly and wasting energy pulling carts which are very heavy even when empty.
- At present, emphasis should be placed on maximising the efficiency of the horses and donkeys currently available. Heavy horses do not appear to be suitable for small-scale farmers, but mule breeding at a local level may be worth considering.

Effective animal traction extension requires close co-operation with the farmers and carters themselves and regular monitoring of progress made. At the moment extension needs appear to include the following:

- Improved training of young people and children in draught animal management and care.
- Local training of individuals in the communities in veterinary matters to improve local access to animal health care.
- Practical demonstrations on making simple, effective harnesses and carts.
- Practical demonstrations to show appropriate tillage systems.
- Simple advice on feeding.
- Practical information on basic health care, castration and parasite control.
- Basic information about selecting an animal for work and how to estimate age by looking at the teeth.

REFERENCES

Anderson, M. and Dennis, R. 1994a. Improving animal-based transport: options, approaches, issues and impact. In: *Improving Animal Traction Technology.* Proceedings of the First Workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia (eds. P. Starkey, E. Mwenya and J. Stares). pp 278-395. CTA, Wageningen, The Netherlands.

Anderson, M. and Dennis, R. 1994b. Improving animal-based transport: technical aspects of cart design. In: *Improving Animal Traction Technology.* Proceedings of the First Workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia (eds. P. Starkey, E. Mwenya and J. Stares). pp 396-404. CTA, Wageningen, The Netherlands.

ARDRI, 1997. *ARDRI FSR-E Unit 1996/97 Annual Report*. Agricultural and Rural Development Research Institute, University of Fort Hare, Alice, South Africa.

Canacoo, E.A. 1991. Management of the donkey: a Southern Ghana experience. In: *Donkeys, Mules and Horses in Tropical Agricultural Development.* Proceedings of a colloquium held in Edinburgh, 3-6 September 1990 (eds. D. Fielding and R.A. Pearson). pp 189-193. CTVM, University of Edinburgh.

Coetzer, J.A.W. and Erasmus, B.J. 1994. African Horse Sickness. In: *Infectious Diseases of Livestock with Special Reference to Southern Africa* (eds. J.A.W. Coetzer, G.R. Thomson and R.C. Tustin). pp 460-475. Oxford University Press Southern Africa, Capetown, South Africa.

De Waal, D.T. and Van Heerden, J. 1994. Equine Babesiosis. In: *Infectious Diseases of Livestock with Special Reference to Southern Africa* (eds. J.A.W. Coetzer, G.R. Thomson and R.C. Tustin) pp 295-304. Oxford University Press Southern Africa, Capetown, South Africa.

Dibbits, H. J. 1991. Harnessing systems for donkeys - experiences from Kenya. In: *Donkeys, Mules and Horses in Tropical Agricultural Development.* Proceedings of a colloquium held in Edinburgh, 3-6 September 1990 (eds. D. Fielding and R.A. Pearson). pp 174-180. CTVM, University of Edinburgh.

Fielding, D. 1994. Indigenous knowledge of working equids: the key to their improved welfare and use. In: *Working Equines*. Proceedings of the Second International Colloquium, Rabat, Morocco, 20-22 April 1994 (eds. M. Bakkoury and R.A. Prentis). pp 331-340. Actes Editions, Rabat, Morocco.

Fielding D. and Krause, P. 1998. *Donkeys.* MacMillan Education Ltd., London and Basingstoke.

Inns, F.M., Shetto, R.M. and Mkomwa, S. 1995. Single donkey ploughing - design basics and operation of a modern light-weight swingplough and associated harness. Paper given at the ATNESA workshop *Meeting the Challenges of Animal Traction*, 4-8 December 1995, Ngong Hills, Kenya.

Jones, P.A. 1997. *Donkeys for Development*. Animal Traction Network of Eastern and Southern Africa (ATNESA) and Agricultural Research Council of South Africa (ARC/IAE), Pretoria.

Khallaayoune, K. 1991. Benefit of a strategic deworming programme in working donkeys in Morocco. In: *Donkeys, Mules and Horses in Tropical Agricultural Development*. Proceedings of a colloquium held in Edinburgh, 3-6 September 1990 (eds. D. Fielding and R.A. Pearson). pp 174-180. CTVM, University of Edinburgh.

Kneale, J.A. 1996. An investigation of the key issues for donkey users in a rural and urban area of the Eastern Cape Province of South Africa using Participatory Appraisal. MSc thesis, CTVM, University of Edinburgh, Scotland.

Krecek, R.C., Starkey, P.H. and Joubert, A.B.D. 1994. Animal traction in South Africa: research priorities in veterinary science. *Journal of the South African Veterinary Association* 65, 150-153.

Lopez, A., Chavira, H. and Granillo, A. 1994. Foot and hoof disorders in the underpriviliged equids of Mexico. In: *Working Equines*. Proceedings of the Second International Colloquium, Rabat, Morocco, 20-22 April 1994 (eds. M. Bakkoury and R.A. Prentis). pp 57-64. Actes Editions, Rabat, Morocco.

Matthee, S. and Krecek, R.C. 1998. Donkey research at the University of Pretoria in South Africa. *Draught Animal News* 28, 9-11.

O'Neill, D.H., Sneyd, J., Mzileni, N.T., Mapeyi, L., Njekwa, M. and Israel, S. 1999. The use and management of draught animals by smallholder farmers in the former Ciskei and Transkei, Eastern Cape Province, South Africa. *Development South Africa* 16, 319-333.

Pandey, V.S. and Eysker, M. 1991. Internal parasites of equines in Zimbabwe. In: *Donkeys, Mules and Horses in Tropical Agricultural Development.* Proceedings of a colloquium held in Edinburgh, 3-6 September 1990 (eds. D. Fielding and R.A. Pearson). pp 167-173. CTVM, University of Edinburgh.

Pearson, R.A. and Ouassat, M. 1996. Estimation of the live weight and body condition of working donkeys in Morocco. *The Veterinary Record* 138, 229-233.

Pearson, R.A. and Smith, A.J. 1994. Improving draught animal management. In: *Improving Animal Traction Technology*. Proceedings of the First Workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia (eds. P.Starkey, E. Mwenya and J. Stares). pp 122-129. CTA, Wageningen, The Netherlands.

Pearson, R.A., Nengomasha, E.M. and Krecek, R.C. 1995. The challenges in using donkeys for work in South Africa. Paper given at the ATNESA workshop *Meeting the Challenges of Animal Traction*, 4-8 December 1995, Ngong Hills, Kenya.

Pradhan, S.M.S., Mahato, S.N. and Joshi, B.R. 1991. Equines in Nepal. In: *Donkeys, Mules and Horses in Tropical Agricultural Development*. Proceedings of a colloquium held in Edinburgh, 3-6 September 1990 (eds. D. Fielding and R.A. Pearson). pp 22-25. CTVM, University of Edinburgh.

Rendle, C.C. 1994. Appropriate work, harness and implements for equids - some ideas and practical experience. In: *Working Equines*. Proceedings of the Second International Colloquium, Rabat, Morocco, 20 –22 April 1994 (eds. M. Bakkoury and R.A. Prentis). pp 243-248. Actes Editions, Rabat, Morocco.

Scott, D.B. 1994. Mycoses. In: *Infectious Diseases of Livestock with Special Reference to Southern Africa* (eds. J.A.W. Coetzer, G.R. Thomson and R.C. Tustin). pp 1521-1533. Oxford University Press Southern Africa, Capetown, South Africa.

Simalenga, T.E., and Joubert, A.B.D. (eds.) 1997. *Animal Traction in South Africa: Today and Tomorrow*. Proceedings of the SANAT Workshop held 26-28 March, 1996. University of Fort Hare, South Africa.

Smith, S.E.G. 1994. Treatment of mange in horses. *Veterinary Record* 134, 508.

Starkey, P.H. (ed) 1998. *Improving donkey utilisation and management*. Report of the International ATNESA workshop held 5-9 May 1997, Debre Zeit, Ethiopia. ATNESA, Harare, Zimbabwe.

Starkey, P., Jaiyesimi-Njobe, F. and Hanekom, D. 1995. Animal traction in South Africa: overview of the key issues. In: *Animal Traction in South Africa: empowering rural communities* (ed. P. Starkey). pp 17-30. Development Bank of South Africa, Halfway House, South Africa.

Steyn, G.J. 1988. A Farming Systems Study of Two Rural Areas in the Peddie District of Ciskei. Doctor of Science Dissertation, University of Fort Hare, South Africa.

Taylor, D. 1999. The use of donkeys, horses and mules in the former Ciskei region of the Eastern Cape South Africa. *Centre for Tropical Veterinary Medicine, Draught*

Animal Power Technical Report 3, Centre for Tropical Veterinary Medicine, University of Edinburgh, Easter Bush, Roslin, Midlothian, EH25 9RG, UK.44p.

Trawford, A.F. and Crane, M.A. 1995. Nursing care of the donkey. *Equine Veterinary Education* 7 (1), 36-38.

Wells, D., Krecek, R.C. and Kneale, J.A. 1997. Socio-economic and health aspects of working donkeys in the North-West and Eastern Cape Provinces, South Africa. Paper given at the ATNESA workshop *Improving Donkey Utilisation and Management*, 5-9 May 1997, Debre Zeit, Ethiopia.

Feeding oxen to meet energy needs for work I. Matching feed energy resources to animal power requirements

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ABSTRACT

Two studies were conducted to test feeding standards for cattle used for work in the Eastern Cape Province, Republic of South Africa. In the first study, the energy balances of three teams each of four oxen fed at the same level with poor quality lucerne and working at different levels of energy expenditure were studied. Estimates of live weight changes from energy balances calculated from the feeding standards did not always agree with actual changes, but they represented reasonable estimates. Possible reasons for the discrepancies are discussed.

In the second experiment the effect of quality of feeding during work on performance of oxen was investigated. Twelve oxen were allocated to two treatments according to live weight. In treatment 1, oxen were fed a high energy intake (1.8 x maintenance ME requirement) while in treatment 2, oxen were fed on a low energy intake (0.8 x maintenance ME requirement). Oxen in all treatments performed the same type of work. Oxen on the low energy ration lost weight and body condition continuously whilst those on the higher energy intake maintained their live weights and body condition. Animals on the high energy ration walked faster during work but the difference was not significant. There were no statistically significant differences in work performance of animals in the two treatments. In the second part of experiment 2, all oxen were fed the high energy ration and work output was measured. There was no statistically significant difference between the two groups in work performance. The animals with low body condition score (from treatment 2) gained weight while working. Results indicate that at a body condition score of 3 and above, poor body condition does not influence work capacity as long as animals are well fed during work.

INTRODUCTION

Draught animals play a major role in smallholder semi-arid crop/livestock farming systems. Agriculture under the system increasingly relies on draught animal power for most farm activities. However, in many areas animal feed resources are decreasing and farmers find it difficult to maintain their animals especially during the long dry season. The end of the dry season is the time when draught animals are required to plough, ready for the cropping season. Work performance of draught animals tends to be reduced at this time. Ideally, a plentiful supply of food is needed to provide the extra energy for working. It is necessary to develop strategies that will improve efficiency and sustainability of use of available feed resources for draught animals. This can only be achieved through investigations into food energy resources available and how to match them to animal energy requirements.

Feeding standards for draught cattle have been published (Lawrence and Pearson, 1999) and it is now possible to predict energy requirements for working. However Pearson *et al*. (1999) cautioned that some information was still needed to validate these feeding standards. They need to be verified on a wide selection of animals and under different working periods. The aim of the present studies was to test the feeding standards under semi-arid conditions typified by of the Eastern Cape Province in the Republic of South Africa. Two experiments were conducted,(i) to study energy balances of oxen fed on a restricted forage diet and undertaking three different amounts of work and, (ii) to study effects of quality of feeding of oxen during work on their work performance. Preliminary results are reported here.

EXPERIMENT I

ENERGY BALANCES OF OXEN FED ON A RESTRICTED FORAGE DIET, UNDERTAKING THREE TYPES OF WORK

In order to determine energy requirements for working ruminants, Lawrence (1985) used the British metabolisable energy system for predicting maintenance energy requirements and then developed the factorial method for estimating extra energy required for work. This led to the publication of feeding standards for working ruminants (Lawrence and Pearson, 1999). Two weaknesses have been pointed out in connection with use of the factorial method to estimate extra energy for work (Lawrence and Stibbards, 1990). First the factors used might have been determined under conditions that are different from those under which the animals are working. Secondly the nature of the ground surface and slope on which animals are working will change the energy cost of walking and hence the total energy expended on walking. This can account for more than 50% of the total energy used in work. In addition to the two weaknesses, Teleni and Hogan (1989) reported that the level of training of animals did influence their utilisation of energy. They observed that trained buffaloes were more efficient in using metabolisable energy than untrained ones.

MATERIALS AND METHODS

This experiment was conducted for seven weeks from March to May 1997 at the Animal Traction Centre in the livestock section of the research farm of University of Fort Hare.

Animals and feeding Twelve trained draught oxen of mixed breeds grouped into three teams of four, according to their live weights were used in this study. The average live weight of the oxen at the beginning of the study was 456 kg (ranging from 360 to 596 kg). The oxen were housed in individual concrete floored pens which had separate concrete feed and water troughs. All experimental animals were fed on the same diet consisting of a restricted amount of low grade lucerne hay (79-82 g/kg $M^{0.75}$) supplemented with a commercial concentrate mixture (14-15 g/kg $M^{0.75}$) so as to provide the animals with an estimated 1.3 x maintenance metabolisable energy. The daily hay ration was divided into two portions, one of which was fed after the morning work session and the other one after the afternoon work session, or at 0900h and 1600h on non-working days. Concentrate was given in the afternoon before the lucerne hay. The animals had free access to drinking water when they were not working.

Experimental methods

The experiment consisted of three work treatments (1) heavy workload with high daily estimated energy expenditure of 0.9 x maintenance (team 1), (2) medium workload with daily estimated energy expenditure of 0.6 x maintenance (team 2), and (3) low workload with daily estimated energy expenditure of 0.3 x maintenance (team 3). Work consisted of pulling metal sledges loaded with different weights over different distances on farm routes for each working team to give the desired energy expenditure. An ergometer (Lawrence and Pearson, 1985) was used during the preparation phase of the experiment to measure draught forces for known workloads. From these measurements a regression of force on workload was derived and used to determine the load required for each team so that that the average draught force exerted on the level was equivalent to 8 kgf/kg $M^{0.75}$ (team 1) or 5 kgf/kg $M^{0.75}$ (for both team 2 and team 3). Each team of four oxen worked twice a day for four days per week, starting at 0800h in the morning session and at 1400h in the afternoon work session. Team 1 was expected to cover about 12 km, team 2 about 10 km and team 3 about six km per day.

MEASUREMENTS

Feed intake Each day a sample of each feed type was taken while weighing feed. The daily lucerne samples were pooled to get weekly feed samples whose dry matter content was determined. Refusals were collected and weighed every day before feeding. The dry matter content of refusal samples of each feed type, collected daily, were determined for each animal in order to calculate the daily dry matter intake of each animal. The dried refusal samples from each animal were sub-sampled and pooled over each week. Dry matter content of lucerne, concentrate and refusals from each animal were determined by drying the samples to constant weight in a forced air oven at 60°C. The samples were then ground through a 1 mm screen and stored ready for laboratory analysis.

Live weight The live weight of each animal was measured three times every week on Mondays, Wednesdays and Fridays. All the live weight measurements were taken in the morning before working or feeding the animals.

Work output The total time taken by each team of oxen to travel around their route was recorded daily as well as the times at which each team passed points marked at intervals of one km along all the routes. The times recorded for each interval were used to calculate the walking speed of each team of oxen. On each working day the ergometer was used to record work done, distance travelled and elapsed working time of one of the teams of oxen. Recording of work was done on a rotational basis among the three teams.

Digestibility of diets The digestibility of lucerne hay used in this experiment was determined at the end of the trial. Three oxen were used for this study. The oxen were totally confined to their individual pens during the whole period. Feed intake measurements and total faecal collection were done for 7 days after a preliminary period of 10 days. Faeces were collected regularly, off the floor from each animal separately. The faeces were weighed and placed into buckets then stored in a cold room. At the end of each day, faeces were mixed and a sample (proportionally 0.05) was taken and frozen. After the 7-day collection period, the daily samples were thawed, mixed and a sub-sample(1 kg) was taken. This sample was oven dried to constant weight at 60°C to determine dry matter. A sub-sample was then taken, ground to pass through 1 mm screen and stored ready for analysis.

Laboratory analysis All the pooled weekly food samples and the weekly individual refusal samples collected were analysed to determine acid detergent fibre (ADF), neutral detergent fibre (NDF), hemicellulose, protein, ash and acid insoluble ash.

Energy balances The energy balance of each individual animal and the average balance for each team were estimated using information obtained from feeding standards for working cattle (Lawrence and Pearson, 1999). It was assumed that the ME content of lucerne and concentrate used was 7 and 11 MJ/kg DM, respectively. Heat increment associated with energy transactions was assumed to be 32%. In calculating energy balances, the value of 1.5 J/m/kg M was assumed to be the energy cost of walking over the rough track. Two further assumptions were tested, (i) all animals in any given team of four worked equally or, (ii) that only half of the animals in a team worked while the other half just walked without exerting any effort to pull the load. Estimates of live weight change made from the standards making these assumptions were compared with observed live weight changes of each animal.

RESULTS

The average daily dry matter intake (± standard deviation) of the oxen on treatment 1 (the heavy workload) was 16.6±0.6 g/kg $M^{0.75}$, on treatment 2 (medium workload) was 15.1±0.7 g/kg $M^{0.75}$ and on treatment 3 (light workload) was 16.5±0.3 g/kg $M^{0.75}$. Table 1 shows the nutrient composition of the lucerne hay used in this study and average composition of its refusals from each treatment. The apparent digestibility coefficients for the different food components are also given in the table. Food refusals from the heavy workload treatment had lower average NDF, ADF and hemicellulose compared to the other treatments. Crude protein content was highest in refusals from treatment 1- the heavy workload.

Table 1: Nutrient content of food offered and refused (g/kg DM), digestibility coefficients (%) of different food components and mean (± standard deviation) dry matter intake (DMI) of cattle on each treatment.

	DM g/kg	**NDF**	**ADF**	**Hemi-cellulose**	**Protein**	**Ash**	**Acid insoluble ash**
Lucerne	945.4	626.4	469.8	156.9	148.1	67.3	23.0
Refusals							
Heavy Workload	960.0	535.7	396.1	139.6	169.2	88.2	193.8
Medium Workload	956.4	567.5	422.4	145.1	161.7	84.3	159.5
Light Workload	957.9	564.0	418.6	145.4	155.2	85.2	194.7
Digestibilty Coefficients	45.7	41.6	42.6	40.7	59.0		

The work performance characteristics of oxen in the three treatments were as shown in Table 2. There was no difference in the percentage of time spent working by each team of oxen despite the differences in workloads. The speed of walking of animals in the different treatments followed a trend similar to the workload pattern with the team having the lightest workload walking faster than all the others. The differences in walking speed between the three teams were not statistically significant ($p>0.05$).

Table 2: Average daily work performance parameters for oxen on the three treatments

Treatments	Daily work (MJ)	Distance (km)	EWT (min)	Time worked %	Draft force (kN)	Power (kW)	Speed (m/s)
Heavy Workload	14.8	12.2	166	94.6	1.21	1.47	1.2±0.01
Medium Workload	9.5	9.7	128	95.1	0.98	1.23	1.3±0.01
Light Workload	5.6	6.9	87	94.5	0.80	1.07	1.3±0.01

means with different superscripts are significantly different ($p<0.05$)

The average energy balances of all oxen under the three treatments, their positions in their respective teams and corresponding live weight changes as estimated from the feeding standards for working cattle (Lawrence and Pearson, 1999) under different assumptions were as shown in Table 3. Observed live weight changes are also shown in the table.

Estimates of weight changes from average energy balances for oxen in any particular team showed different trends. The two rear oxen in the heavy workload treatment lost weight while their two front counterparts gained weight. This seemed to agree closely with the estimates made under the assumption that only the two rear animals were pulling the load (assumption 3, Table 3) while estimates made under the assumption that all the animals were working equally (assumption 1) tended to hold for the animals positioned in the front. All animals under the medium and light workload treatments gained weights (Table 3). Estimates of average live mass changes from the feeding standards tended to vary from one animal to another. Two oxen under the medium workload treatment (one front and one rear) showed good estimates under the assumption that they were just walking without applying any effort to pull the load while the remaining two under the same treatment showed reasonable estimates under the assumption that work was equally distributed among all animals. For animals under the light workload treatment the best estimate for the whole team was observed under the assumption that only two animals were pulling the load.

DISCUSSION

Changes in live weights of animals under the three treatments were different from what would have been anticipated. Given that all animals were fed at the same level (1.3 x maintenance ME requirement) but assigned work demanding different energy expenditures, one would have expected more pronounced differences between treatments in live weight changes. The animals in treatment 3 (light workload) were expected to register the highest proportionate gain but this was not the case.

Table 3: Live mass at start, position in a team during work, observed daily average change in live mass and estimates of daily average live mass change from energy balance using feeding standards for each individual animal under three different assumptions.-

Ox No.	Work-load	Position	Live mass (Start) kg	Observed average mass change (g/d)	Live mass change estimate		
					1	2	3
1	Heavy	Rear	508	-286	216	548	-209
2	Heavy	Rear	498	-82	199	540	-240
3	Heavy	Front	360	122	60	490	-530
4	Heavy	Front	382	82	58	476	-510
5	Medium	Rear	520	204	328	535	88
6	Medium	Rear	586	408	-16	220	-292
7	Medium	Front	524	571	382	580	153
8	Medium	Front	494	204	331	544	82
9	Light	Front	402	245	343	486	183
11	Light	Front	384	82	349	494	187
10	Light	Rear	360	41	416	561	256
12	Light	Rear	456	245	417	545	276

1= all animals in team working equally - animal pulling 25% of load
2= animal just walking without pulling load - animal pulling no load
3= only 50% of animals in team pulling load - animal pulling 50% of load

Although all animals were given the same feed allowance the amount consumed by each individual was different and this might have accounted for some of the observed differences in live mass changes between individual animals and between different treatments. It is also probable that the initial live weight and body condition of the animals played a part in bringing about the observed changes. The animals that were subject to a medium workload had the highest average initial body mass and they registered the highest average daily gain. Probably these animals were depositing fat compared to the animals that were subject to the light workload, which had lower average initial body mass and registered lower gain despite the fact that they expended less energy for work.

The determination of energy balances and estimation of live weight changes from the feeding standards showed differences between treatments and between individual animals under same treatments. Estimates of live mass changes for animals under similar treatments tend to indicate that most probably animals in the same treatment were working differently. It is likely that animals which lost weight or registered lower gains compared to their team mates were doing most of the work pulling the load while the others were simply walking or applying very little effort to pull the load. Pearson and Lawrence (1990) pointed out many factors that could influence the work of individual animals, or teams of animals. Estimates made under the assumption that animals worked differently tended to be more accurate compared to the actual changes. It is also possible that some of the assumptions made in making estimates of energy balances were not correct. The average energy cost of walking (1.5 J/m/kg M) used for all the estimates might have been either too high or too low for the different parts of the surfaces over which the animals walked. As pointed out by Lawrence and Stibbards (1990) the accuracy of the factorial method which was used in developing the feeding standards depends very much on similarity of conditions under which cattle are working and those under which the factors used were determined. Feeding standards for cattle used for work (Lawrence and Pearson, 1999) recommend the energy cost of 1.5 J/m/kg M for smooth flat land. Animals in this study walked on a track with a constantly varying surface and slope therefore it is possible that different energy costs for walking on different parts of the routes might have been more appropriate. Rometsh *et al.* (1994) reported values of 0.8 and 0.6 J/m/kg M for oxen walking downhill for slopes of 6 % and 3 %, respectively. In the estimates made under this experiment, the same figure was applied for walking over the whole route irrespective of slope. It is also possible that the assumption of a 7 MJ/kg DM ME content of lucerne and 11 MJ/kg DM ME content for concentrate might have been incorrect contributing to the discrepancies.

The nutrient composition of refusals from the lucerne fed to the animals tend to point out some differences in selection of food between animals in the three treatments. Animals subject to heavy workload tended to consume more dietary fibre than those in the other two treatments. Probably their higher demand for nutrients as a result of the extra workload might have been resulted in them being less selective in the diet they were consuming.

Despite some discrepancies between observed live weight changes and those estimated from the feeding standards, the estimates observed in this study are reasonable and could be applied. In order to improve the accuracy of the estimates, it could be appropriate to make more determinations of factors that could be applied under more specific conditions rather than generalised situations.

EXPERIMENT II

EFFECT OF THE QUALITY OF FEEDING DURING WORK ON THE PERFORMANCE OF DRAUGHT OXEN

Although every farmer would like to have his animals in good condition in order to perform work well, in practice it is not always possible under conditions of smallholder farming systems in semi-arid areas to attain the level of feeding that is necessary to maintain the desired condition. Animals therefore tend to lose weight both before and during working. Goe (1983) affirmed that animals in good condition can withstand weight loss during working better than those in poor condition. The only way weight losses could be avoided under these conditions is through provision of supplements. However several authors have questioned the value of dry season supplementary feeding of draught animals. Teleni (1993) argued that since the major factor influencing work capacity is body weight rather than body condition, losing body condition during the working season is not a problem provided the critical body weight for a certain draught load is not compromised. In Mali oxen lost up to 50 kg live weight during the dry season without showing any adverse effect on work performance. This led Bartholomew, Khibe and Lye (1995) to conclude that maintenance of good body condition and hence high energy reserves for use during work was unnecessary since additional energy for work could more efficiently be supplied through supplementary feeding during work.

Results (Bartholomew, Khibe and Little, 1994; Francis and Ndlovu, 1995; Fall *et al.,* 1997) on the relative importance of body weight and body condition in relation to working capacity are inconclusive. This study investigated the effects of the quality of the diet before and during work on performance of draught oxen and testing the hypothesis that work performance and live weight change during work are dependent on live weight but not necessarily on body condition.

MATERIALS AND METHODS

This study was conducted at the Animal Traction Centre in the livestock section of the research farm of the University of Fort Hare from August to November (1997).

Animals and feeding Twelve oxen of mixed breeds weighing on average 442 kg (range 372-532 kg) were used in this study. The animals were matched according to their live weights and trained to work in pairs. Each animal was individually housed and fed. Food for all animals consisted of maize stover, lucerne and a commercial concentrate for beef cattle. Water was available to the animals all the time when they were in their pens.

Experimental plan The experiment consisted of two parts. In the first part there were two dietary treatments (i) low energy (0.8 x maintenance ME requirement) treatment and (ii) a high energy (1.8 x maintenance ME requirement). The six pairs of oxen were assigned to the two treatments so that live weight and animal body sizes were balanced between the treatments as far as pairing for work could allow. This part of the study lasted for seven weeks.

In the second part of the experiment all animals were fed the diet at the higher level (1.8 x maintenance ME requirement), the animals from the low energy treatment in the first part were in poor body condition (body condition score 3.5) and those from the high energy treatment were in good body condition (body condition score 6.5). The second part of the study lasted six weeks.

Working All oxen performed the same work in pairs pulling sledges loaded at 10 kgf/100 kg M over the same route and distance throughout the experiment. Working stopped when animals either completed the set distance or were too tired and reluctant to continue. The oxen worked four days per week starting at 0800 hrs daily.

Data collection Body weights were measured on Monday, Wednesday and Friday of every week. Body condition scoring was done once per week. Using an ergometer (Lawrence and Pearson, 1985) work data was recorded from one team on each working day, while the speed for each team was recorded continuously over every working day as in experiment 1.

Food intake Daily rations of maize stover and lucerne for each animal were weighed on a weekly basis. During weighing weekly samples of stover and lucerne were collected and their dry matter content determined. Refusals were collected, weighed and sampled every day before feeding. The dry matter content of both maize stover, lucerne and refusals from each animal were determined by drying the samples to a constant weight in a forced air oven at 60°C and used to calculate voluntary dry matter intake. Dried refusal samples from each animal were sub-sampled and pooled over each week. The weekly food and refusal samples were then ground through a 1 mm screen and stored for analysis.

Laboratory analysis All stover, lucerne and concentrate samples as well as all refusal samples were analysed for NDF, ADF, protein, hemicellulose, ash and acid insoluble ash.

Data analysis Data obtained from this study was subject to analysis of variance using the following model:

$Y_{ijk} = \mu + \alpha_j + \beta_k + \alpha\beta_{jk} + \varepsilon_{ijk}$

where Y_{ijk} was the dependent variable (live weight change, body condition score, work output, speed, power or draught force)

μ was the overall mean

α_j was the effect of the j^{th} treatment (j = 1, 2)

β_k was the effect of the k^{th} working week (k= 1, …6)

$\alpha\beta_{jk}$ was the interaction between the j^{th} treatment and the k^{th} working week

ε_{ijk} was the error term for the i^{th} team of oxen on the j^{th} treatment in the k^{th} working week

RESULTS

Weight changes of animals and their average weekly body condition scores during the whole period of study are shown in Figures 1 and 2. During the first part (week 1-7) of the study, animals on the low energy diet lost weight continuously while those receiving a high energy diet maintained their body weights.

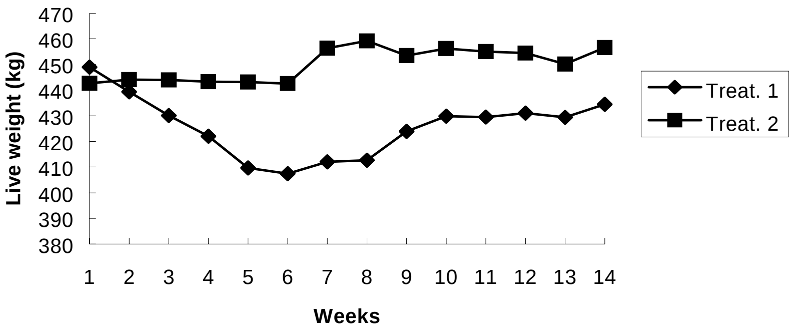

Figure 1: Average weekly live weights of oxen on treatment 1 (low energy for seven weeks then high energy for six weeks) and treatment 2 (high energy diet throughout)

The loss in body weight (Figure 1) was accompanied by progressive decline in body condition (Figure 2). In the second part (week 8-13) animals with a low body condition score gained weight continuously. Table 4 summarises average weekly body weight gains, body condition scores, average daily speed, work, draught force and power. Differences in live weight changes between the two treatments in both the first and second part of study were statistically significant ($p<0.05$). Oxen on the high energy diet

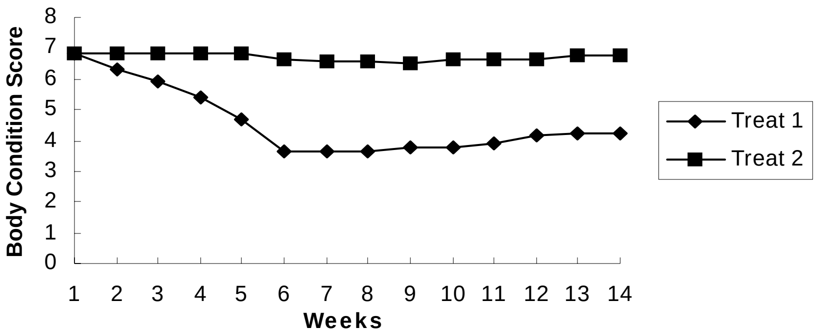

Figure 2: Average weekly body condition scores of oxen on treatment 1 (low energy for seven weeks then high energy for 6 weeks) and treatment 2 (high energy diet throughout)

had slightly higher average speed but the difference in speed of working between the two treatments during the first part of the experiment was not statistically significant ($p>0.05$). In the second part oxen in good body condition had a higher speed of working than those with low body condition score and the difference between treatments was statistically significant ($p<0.05$). There was highly significant interaction between treatments and weeks of working.

Table 4: Average weekly live weight gains, average body condition scores (BCS) of the individual oxen and average daily working speed and work output, draught force (DF), and power of the ox teams (pairs) in the two treatment groups (±sd)

	Week 1-7		Week 8-13	
	High Energy	**Low Energy**	**High BCS**	**Low BCS**
Average weekly gain (kg)	2.4±0.7[a]	-5.2±0.8[b]	-0.4±1.5[a]	3.7±0.9[b]
Average BC Score	7.0±0.1	5.0±1.3	7.0±0.1	4.0±0.3
Average daily speed (m/s)	1.28±0.04[a]	1.25±0.08[a]	1.31±0.07[b]	1.27±0.04[a]
Average daily work (MJ)	10.0±0.3	9.8±0.5	8.9±0.3	9.8±0.7
Average DF (kN)	0.83±0.04	0.85±0.04	0.79±0.06	0.82±0.03
Average power (kW)	1.05±0.08	1.08±0.10	1.05±0.03	1.10±0.07
Live weight change (kg/animal)	16.5±5.2	-36±5.6	-2.6±9.2	21.9±5.6

Means with different superscripts along the same row in weeks 1-7 or weeks 8-13 are significantly different ($P<0.05$)

One team of oxen in the low energy treatment had to be stopped from working during week seven of the experiment due to the weakness of one animal in the team. The team had lost 98 kg and average body condition score had gone down to 2.5. Table 5 shows the nutrient composition of lucerne, stover and their refusals from animals on the different treatments. Animals under the low energy diet consumed more fibre than those on the high energy regime during the first part of study as seen from the lower content of NDF, ADF and hemicellulose in their refusals.

Table 5: Nutrient composition (g/kg DM) of lucerne, stover and their refusals from oxen on treatment 1 (low energy diet for seven weeks, part 1, then high energy for 6 weeks, part 2 ,HE, Low BCS) and treatment 2 (high energy diet for seven weeks, part 1, then high energy diet for 6 weeks, part 2, HE, high BCS)

	DM (g/kg)	NDF	ADF	Hemi	Protein	Ash	AI ash
PART 1							
Lucerne	946	633	483	150	139	69	8
Refusals:							
Low Energy	950	462	358	103	207	71	211
High Energy	945	591	449	142	164	72	66
Stover	954	771	517	254	55	23	48
Refusals:							
Low Energy	960	590	411	179	100	46	268
High Energy	957	692	478	215	71	39	138
PART 2							
Lucerne	934	621	461	160	138	68	7
Refusals:							
HE Low BCS	938	603	455	148	150	70	73
HE High BCS	937	579	430	149	167	71	97
Stover	939	771	502	269	52	26	22
Refusals:							
HE Low BCS	946	732	487	245	57	32	75
HE High BCS	944	732	483	249	64	31	71
Digestibility:							
Lucerne	53	50	49	53	57		
Stover	54	57	56	63	39		

HE, high energy ratio; BSC, body condition score

DISCUSSION

All teams of oxen in this experiment were subject to the same work loading (10 kgf/100 kg M) fixed at the start of the experiment. There was no significant difference (p>0.05) in work performance of animals on the two treatments despite the fact that animals on the low energy regime were losing weight (therefore their workload was actually increasing the more weight they lost). One team of oxen had to be rested during week seven due to weight loss (58 kg) and the average body condition score of the team went down to 3.3. Fall *et al.* (1997) suggested that the lowest body condition score that could be attained without the risk of causing permanent damage to the working animals was 3. One animal in the team that had to be stopped had reached a body condition score of 2.5.

With a weight loss of 58 kg probably the team had approached their critical minimum weight for the given workload. The team was stopped not because they could not work but because of the difficulty with which the animals worked and their physical appearance compared to their counterparts. The observations made here on the work performance of the animals on the low energy diet (week 1-7) and the low body condition score (weeks 8-14) show the importance of body weight on working capacity. Although the body condition scores of the animals were decreasing during weeks 1-7, this did not affect their working which remained almost uniform throughout the whole experimental period.

The results of this experiment seem to agree with the conclusion drawn by Bartholomew *et al.* (1994) that body weight is a more useful indicator of capacity for work than body condition. Fall *et al.* (1997) made similar observations whereby live weight but not body condition affected work performance and live weight losses did not have detrimental effect on work performance. Although animals could still work with a body condition score as low as 2.5, it would seem appropriate to consider a body condition score of 3 as the minimum for working animals. Since there was no difference in the work performance of animals fed on low or high energy diet, it means that where conditions are marginal animals could be worked over short periods without providing them with any supplement and losses in body weight resulting from working could be regained when conditions improve.

REFERENCES

Bartholomew, P.W., Khibe , T. and Little , D.A. 1994. Effect of live weight and body condition on work output from draught oxen. *Tropical Animal Health and Production* 26, 58-64.

Bartholomew, P.W., Khibe, T. and Ly, R. 1995. In village studies of the use of work oxen in Central Mali. *Tropical Animal Health and Production* 27, 241-248.

Fall, A., Pearson, R.A., Lawrence, P.R. and Fernández-Rivera, S. 1997. *Feeding Strategies for Oxen used for Draft Purposes in Semi-arid West Africa*. ILRI, Nairobi, Kenya. 76 pp. ISBN 92-9146-029-X.

Francis, J. and Ndlovu, L.R. 1995. Improving feeding management of Mashona oxen through strategic supplementation with cob sheath-groundnut stover. *Tropical Animal Health and Production* 27, 249-257.

Goe, M.R. 1983. Current status of research on animal traction. *World Animal Review* 45, 2-17.

Lawrence, P.R. 1985. A review of the nutrient requirement of draught oxen. In: *Draught Animal Power for Production.* (ed. J.W. Copland) pp 59-63. Proceedings of an International Workshop held at James Cook University, Townsville, Qld, Australia, 10-16 July 1985. ACIAR Proceedings Series No. 10, Canberra.

Lawrence, P.R. and Pearson, R.A. 1985. Factors affecting the measurements of draught force, work output and power of oxen. *Journal of Agricultural Science (Cambridge)* 105, 703-714.

Lawrence, P.R. and Pearson, R.A. 1999. Feeding standards for cattle used for work. Centre for Tropical Veterinary Medicine, University of Edinburgh. 69p. ISBN 0-907146-082.

Lawrence, P. R. and Stibbards, R.J. 1990. The energy cost of walking, carrying and pulling loads on flat surfaces by Brahman cattle and Swamp Buffalo. *Animal Production* 50, 20-29.

Pearson, R.A. and Lawrence, P.R. 1990. Some observations on work output and feeding of draught animals in the Koshi hills of Nepal. In: Livestock in the Hills of Nepal – 2 (eds R.M. Gatenby, B Thapa and N.P. Shrestha), pp 32-44. Pakhribas Agricultural Centre, P.O. Box 106, Kathmandu, Nepal.

Pearson, R.A. , Zerbini, E. and Lawrence, P.R. 1999. Recent advances in research on draught ruminants. *Animal Science* 68, 1-17.

Rometsh, M., Newman, O., Buchenan, M., Susenbeth, A., and Becker, K. 1994. Energy expenditure of Hinterwalder oxen walking downhill. In: Sustainable Small-Scale Ruminant Production in Semi-Arid and sub-Humid Tropical Areas, (eds K. Becker, P.R. Lawrence and R.E. Orskov), pp 131-135. Institute for Animal Production in the Tropics and Sub-tropics, University of Hohenheim, Stuttgart, Germany.

Teleni, E. 1993. Energy expenditure and nutrient requirements of working animals. In *Draught Animal Power in Asia-Australia Region.* (ed W.J. Pryor) pp 93-99. ACIAR Proceedings Series No. 46, ACIAR, Canberra.

Teleni, E. and Hogan, J.P. 1989. Nutrition of draught animals. In: *Draught Animals in Rural Development* (eds. D. Hoffman, J. Nari and R.J. Petheram). pp 118-133. Proceedings of an International Research Symposium, Cinapas, Indonesia ACIAR Proceedings Series No. 27, ACIAR, Canberra.

Feeding oxen to meet energy needs for work: II. Strategies to improve the effectiveness of supplementary feeding for working cattle in semi-arid crop/livestock systems

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ABSTRACT

In experiment 1 six pairs of working oxen on a restricted diet of Chloris guyana hay were alloted to one of two supplementary diet treatments: (i) lucerne (0.5kg/100kg liveweight, M) and cob meal (1.5kg/day) for 7 weeks before and 7 weeks during working, (ii) lucerne (1.0 kg/100 kgM) and cob meal (3 kg/day) for 7 weeks, only during work, in order to assess the effects of each strategy on work performance. In experiment 2 the same oxen were fed on maize stover and assigned to three treatments in a 3x3 Latin square arrangement intended to assess the effects of three supplements on improving the feeding value of maize stover for working oxen. The supplements were lucerne, sunflower cake and cob meal. In both experiments oxen performed the same work of pulling sledges loaded at 10 kgf/100kgM for 15 km or 4 hrs daily for 4 days per week.

Oxen not supplemented before work in experiment 1 lost weight (up to 9 %) and although weak at work initially, they regained the lost weight within 2 weeks. The overall differences in work performance between the two groups were not significant (p>0.05). The results suggest that both strategies were acceptable.

All three supplements in experiment 2 seemed to improve the feeding value of maize stover by preventing weight loss during work (oxen gained on average 0.54 and 0.33 kg per week on sunflower cake and cob meal, respectively) or by minimising loss of body weight (oxen on lucerne lost only 0.46 kg per week). Sunflower cake gave best results followed by cob meal with lucerne showing least effects in terms of weight gain, consumption of stover and work performance. Working tended to reduce daily voluntary dry matter intake, but had no influence on dietary treatment effects.

INTRODUCTION

One of the major problems that farmers in the smallholder crop-livestock systems in many tropical countries face is that of feeding their animals. The animals rely mostly on grazing of natural pastures that are communally owned. These pastures are generally poor in quality and due to lack of control they are overgrazed. During the dry season the pastures do not produce enough fodder to maintain the animals. They have to mobilise their body reserves for maintenance and other activities and end up losing body weight. The main source of power in these small farming enterprises comes from human beings and animals (usually cattle). On these farms the hardest task of ploughing takes place at the end of the dry season when feed supplies are low and work animals are in poor condition. The work performance of these animals is likely to be impaired unless some measures are taken to lessen the shortage of food. One method that farmers could adopt is to conserve some food and use it as a supplement. Cereal crop residues are one source of food that could be set aside for feeding working cattle during the ploughing season. However feeding quality of most crop residues is so poor that animals cannot consume and digest enough to derive adequate amounts of nutrients for maintenance let alone for work. In addition, once the residues are stored, it is likely that their quality will deteriorate even further. An aspect, which needs to be explored, is the appropriate time for supplementing working cattle in relation to work. We also need to consider practical ways of improving consumption and digestibility of the crop residues by working cattle so that energy requirements for work can be met with minimal weight loss. Two experiments were conducted (1) to investigate the appropriate time for supplementation relative to the working period when cattle are fed on poor quality fodder, and (2) to assess the effects of three supplements on intake and digestibility of maize stover a poor quality fodder and their influence on work performance of oxen. Preliminary results and findings are reported here.

EXPERIMENT I

ASSESSMENT OF THE EFFECTS OF DIFFERENT STRATEGIES OF SUPPLEMENTING DRAUGHT CATTLE ON THEIR WORK PERFORMANCE

Provision of supplementary feeding to oxen during the dry season has often been recommended to ensure optimum work performance during the ploughing season. However some studies (Bartholomew, Khibe, and Little, 1994; Fall, Pearson and Fernández-Rivera, 1997a) emphasised a lack of necessity for dry season supplementary feeding when oxen were to be used for a short period each year and suggested that supplementation should only be considered when the working period exceeds 6 weeks. Bartholomew, Khibe and Ly, (1995) concluded that feeding supplements in order to maintain or increase live weight was of little value in increasing the potential capacity for work and that the additional energy requirement for work could be obtained through supplementation during work. Francis and Ndlovu (1995) supplemented working oxen at high level for a short period (five weeks) or at low level for a long period (10 weeks) before beginning to work. In both cases they reported beneficial results in terms of live weight changes, work and power output, and area ploughed. However, their results did not show any significant differences between a long period at a low level or a short period at a high level of supplementation before work. They concluded that whatever the supplementing strategy, farmers should aim to at least maintain a reasonable live weight of their animals before they start working. The objective of the present experiment was to assess the effects of supplementing working oxen on their work performance and body weight changes when supplements were fed for a period before beginning to work as well as during work, compared to feeding them the same supplements only during the working period at twice the previous rate.

MATERIALS AND METHODS

The experiment was conducted at the livestock section of the research farm of the University of Fort Hare, Alice between May and August 1998.

Experimental plan The experiment consisted of two treatments. In the first treatment oxen were given supplements for seven weeks before beginning to work and for seven weeks while working. Oxen in the second treatment received the same supplements for the seven working weeks at twice the amount given in the first treatment. Animals in both treatments were fed on restricted amounts (equivalent to 0.8 x their maintenance energy requirements) of the same basal diet of *Chloris guyana* hay.

Animals and management Twelve oxen weighing on average 456 kg (380 to 550 kg) and 4-6 years old were used in this study. The oxen were individually housed on concrete floored pens with separate water and food troughs. Feeding was done in the morning after cleaning or on working days after all the animals had completed work. Drinking water was available to the animals all the time while penned. The animals were assigned to treatments according to their body weights so that heavy and light animals were balanced in each treatment. Cleaning of the pens was done daily.

Diets The basal diet which was fed to all oxen consisted of a restricted amount of *Chloris guyana* hay (calculated for each animal to supply 0.8 x maintenance energy requirements). Supplements used in this experiment were lucerne and cob meal, the latter was prepared by hammer milling maize cobs together with their grain. The daily rations for animals on each treatment were as shown in Table 1.

Table 1: Composition of the rations used

	Treatment 1 (weeks 1-14)	**Treatment 2 (weeks 1-7)**	**Treatment 2 (weeks 8-14)**
Chloris guyana hay	0.8 x maintenance energy	0.8 x maintenance energy	0.8 x maintenance energy
Lucerne	0.5 kg / 100 kg M	0	1 kg/100 kg M
Cob meal[1]	1.5 kg	0	3.0 kg

[1] For each animal mixed with 7 g salt and 100 g monocalcium phosphate per day

Working Animals worked in pairs. Working consisted of each pair pulling a loaded metal sledge along the same farm route with all pairs working at the same time 4 days per week. The load for each team of oxen was calculated so that they all exerted the same draught effort per unit of initial live weight - equivalent to 10% of their weight. Work began at 0800 h daily and continued until a distance of 15 km had been covered or when 4 h of working were completed. A working session for a team was terminated when one or both of the animals began showing signs of distress or refused to continue working.

MEASUREMENTS

Live weight Live weights were recorded three times per week before working or feeding the animals.

Food intake Weighing and sampling of food was done on a weekly basis. Every morning before cleaning any food remaining from the previous day ration was collected for each animal separately, weighed and sampled. All feed and refusal samples were dried to a constant weight in a forced air oven at 60 C to determine dry matter content from which daily voluntary dry matter intake was calculated. Sub-samples were taken from the dried daily refusal samples and these were pooled every week. Weekly food and refusal samples were ground through a 1 mm screen and stored for laboratory analysis.

Work Every working day an ergometer (Lawrence and Pearson, 1985) was used to record work output of one of the teams. This was done on a rotational basis. The distance travelled and speed of each team was calculated daily during work from times which were recorded when each team of working oxen passed set points marked along the route at 1 km intervals.

Data analysis Data collected from this experiment was subject to analysis of variance for a randomised block experiment with weight as the blocking factor. The following statistical model was applied:

$$Y_{ijk} = \mu + \alpha_j + \beta_k + \alpha\beta_{jk} + \varepsilon_{ijk}$$

where Y_{ijk} was the dependent variable (live weight change, work output, speed, power or draught force)

μ was the overall mean

α_j was the effect of the j^{th} treatment (j = 1, 2)

β_k was the effect associated with the k^{th} block (k= 1, 2; 1= light; 2= heavy)

$\alpha\beta_{jk}$ was the interaction between the j^{th} treatment and the k^{th} block, and

ε_{ijk} was the error term for the i^{th} team of oxen in the j^{th} treatment and the k^{th} block

RESULTS

Figure 1 shows average weekly live weights of oxen in the two treatments over the whole experimental period. Animals that received no supplements for the first 7 weeks (treatment 2) lost weight (up to 34 kg or 9 %) during this time but they regained it during the working period when they were supplemented. The average weight loss was steady in the first 5 weeks and in the 7^{th} week (370 g/d). Between the 5^{th} and 6^{th} week there was a sharp increase in the rate of weight loss (1493g/d). During the working period when the animals in the first treatment received supplements the pattern of weight gain for the animals followed a similar pattern whereby initially there was a high average rate of gain (1881 g /d) followed by a steady average rate of gain (437 g/d) up to the end of the experiment. Oxen that received the supplements throughout (treatment 1) gained weight during the first 7 weeks when there was no working. The rate of weight gain during the first week was on average 413g/d. Between the second and the third week of the experiment there was a sharp increase in the rate of average weight gain (1754 g/d) after which the oxen maintained a steady average rate of gain (413 g/d) up to the 7^{th} week.

During work (weeks 8-14) oxen in the first treatment at first lost weight (weeks 8-10) and then their average body weight remained stable up to the end of the working period.

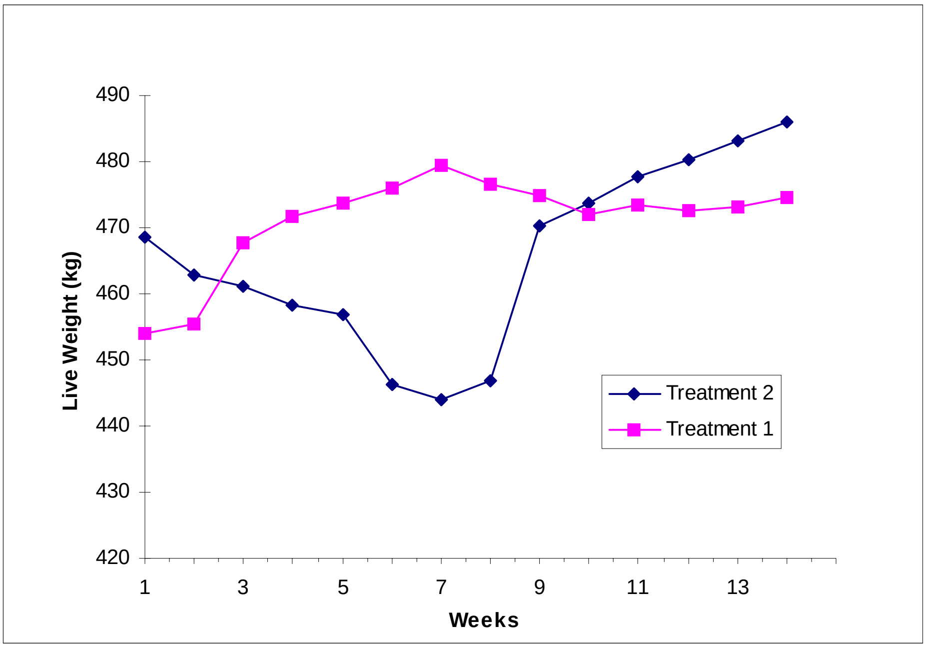

Figure 1: Weekly average live weights of oxen on treatment 1 (supplemented before and during work) and treatment 2 (supplemented during working i.e last 7 weeks)

Table 2 shows the average work output from oxen in the two treatments. There was no significant difference in the average working performance of animals between the two treatments. Except for one team of animals in treatment 1, all oxen managed to complete the set distance all the time during the experiment. All oxen in the first treatment

Table 2: Average live weight at start and average work performance parameters for oxen on the two treatments - treatment 1 – supplemented before and during work and treatment 2 only supplemented during work. See text for details of dietary treatments

Parameters	Treatment 1	Treatment 2
Average live weight (start)	468±58.9	446±57.8
Average daily work (MJ)	11.7±1.2	11.2±1.2
Distance covered (km)	14.2±0.9	14.6±0.2
Draught force (N)	832±47.9	776±72.2
Power (W)	1078±76.5	1042±71.0
Speed (m/s)	1.3±0.02	1.4±0.04

completed the working day with some difficulty during the first two weeks of working. There was a tendency for these oxen to become tired compared to their counterparts and they needed more pushing from their drovers. Animals in team 3 of treatment 1 could not complete the set distance and moved slowly compared to the other teams of oxen during four out of the first six days of working. The animals in teams 2 and 3 of treatment 1 appeared weak with visibly poor body condition compared to their counterpart in team 1 of the same treatment. While oxen in team 2 improved in their physical appearance, animals in team 3 remained weak throughout the working period although this was not reflected in the body weights that were increasing.

Differences in the overall average daily work output power developed and average daily speed of oxen teams in the two treatments were not statistically significant($p>0.05$).

DISCUSSION

Bartholomew *et al*. (1994) concluded that body weight as indicated by body size was the main indicator of power output. Since all animals in this experiment were subject to the same stress of work by making each team pull a load that was proportional to their combined weight it would seem that oxen that worked erratically during the first week had a lower capacity for the given work until after the first week when they gained weight and restored their capacity for working. The one team of oxen that was more affected had low initial body weights (small bodysize). Francis and Ndlovu (1993, 1995) made similar observations, whereby heavy oxen out-performed light ones.

In this experiment oxen that were not given any supplement before the beginning of the working period lost up to 34 kg (or 9 %) of their initial weight within the first seven weeks. The same group of animals regained their initial body weights within two weeks of supplementation and continued to gain while they were working. Fall *et al*.(1997) and Bartholomew *et al*. (1994) recommended that oxen should be supplemented when the working period exceeds six weeks to avoid impairment of work capacity. In this study it would have been very unlikely for some of the oxen that were not supplemented before working to withstand the given workload if they were not fed supplements during working, even if the working period was short. This could be deduced from the work performance of these oxen which was erratic during the first week of working. The overall differences in work performance between them and the group that received supplements for seven weeks before and during working were not statistically significant ($p>0.05$) and this could be attributed to the rapid rate at which the oxen regained lost weight and restored their capacity for working.

Results of this experiment show that both strategies of supplementation had some effects on weight changes that could be beneficial depending on the conditions under consideration. If the aim of supplementing is to ensure that body weight is maintained in order to preserve working capacity, as will probably be the case when dealing with small-sized oxen, it is appropriate to provide supplements for a period before working begins. If on the other hand, there is no risk of lowering capacity for work or dry season feed is difficult to obtain then it could prove more beneficial to use feed resources to supplement only during work, so as to supply only the extra energy needed for work. In the latter situation, it might be a good idea to supplement them for a short period (at least 1 week) before actual working begins. This would allow them to boost their energy reserves and avoid the slow-down that could occur at the beginning of working as was observed in this experiment. This would be important in areas with very severe shortage of feed at the end of dry season and where the planting period is short and the oxen are required to work long hours of over a short cultivation season.

EXPERIMENT II

IMPROVEMENT OF THE EFFECTIVENESS OF MAIZE STOVER AS FEED FOR WORKING CATTLE THROUGH SUPPLEMENTATION

Farmers in the semi-arid tropical areas have often been urged to make use of cereal crop residues to alleviate the shortage of food for feeding their working cattle during the peak ploughing time at the end of the dry season. However, Fall *et al*, (1997b) and Soller, Reed and Butterworth (1991) noted that working oxen fed on cereal crop residues alone are unlikely to consume quantities that will be sufficient to provide the extra energy required for working. This is due to the fact that crop residues are low in nitrogen content and they have low levels of rumen degradable nitrogen, thereby limiting microbial synthesis in the rumen, the capacity for fibre digestion and hence dry matter intake. Intake and utilisation of cereal crop residues could be improved by supplementation with nitrogen sources (Ffoulkes and Bamualim, 1989) or by increasing amounts offered to the animals so that they can select more of the digestible parts (Fall *et al.,* 1997b). Where animals will be subjected to long periods of hard work or are in poor condition and cannot maintain body weight, Ffoulkes and Bamualim (1989) suggested supplementation with rumen-undegradable concentrates.

Previous studies (Prasad, Khombe and Nyathi, 1994 and Ndlovu, Francis and Hove, 1996) where working oxen were fed on fodder residues from maize combined with a source of nitrogen have shown reduced weight loss and improved work performance. The aim of this study was to assess the effects of including sunflower cake, cobmeal or lucerne, all locally available supplements, on the intake and digestion of maize stover by working oxen. At the same time any effects of the supplements on work performance were assesed.

MATERIALS AND METHODS

This experiment was conducted between August and November 1998 at the livestock section of the research farm of University of Fort Hare.

Animals and their management The same twelve working oxen used in experiment 1 were used in this study. The oxen weighed on average 505 kg (ranging between 412 kg and 600 kg). Management of the animals was similar to that in experiment 1. During summer, dipping of all animals was done fortnightly.

Experimental design The experiment was arranged in a 3x3 replicated Latin square design with the rows of each square formed by oxen teams (pairs) and the time periods forming the columns. The treatments consisted of three dietary supplements: A) lucerne B) Sunflower cake C) Cob meal. All oxen were fed on a basal diet of maize stover. The ox teams were allocated in such a way that during each period there was an equal distribution of heavy and light animals in each treatment. Each period lasted four weeks.

Working Except for the time of starting work, all arrangements for working were the same as those in experiment 1. In this experiment work began after 0830h every working day.

MEASUREMENTS

Live weight Weighing of animals was done on Mondays, Wednesdays and Fridays. This was done in the morning before working or feeding.

Food intake The amount of stover offered to each animal was estimated to be 30% above the amount consumed on the previous day. Supplements were offered before the basal ration. The amounts of supplements offered per animal were 2.5 kg (approximately 0.25 bale) of lucerne or 3.6 kg of either cob meal or sunflower cake. A sample of stover offered was collected daily and pooled for each week. Every morning the refusals from the previous day's feeding were collected from each animal and weighed. Refusal samples were taken daily. All feed and refusal samples were dried to a constant weight in a forced air oven at 60^oC to determine dry matter content. The voluntary dry matter intake of each animal was then recorded as the difference between the dry matter of food offered and the refusal dry matter. The dried daily refusal samples were sub-sampled and pooled for each week. Weekly samples of each supplement were collected in a similar manner. All weekly stover, supplements and refusal samples were ground through a 1 mm screen and stored for laboratory analysis.

Work During each working day the work output of one team of animals was recorded using the ergometer (Lawrence and Pearson, 1985). This was done on a rotational basis and all work and speed measurements were done as in experiment 1.

Statistical analysis Live weight changes, daily food intake, distance travelled, speed and work output data were analysed subject to analysis of variance for a latin square design using the following model:

$$Y_{ijk} = \mu + \alpha_j + \beta_k + \gamma_i + \varepsilon_{ijk}$$

where Y_{ijk} was the dependent variable (team live weight change, feed intake, work output, speed, power or draught forces) for the ith team on the jth supplement in the kth period

μ was the overall mean

α_j was the effect of the jth supplement (j = 1,2,3)

β_k was the effect of the kth time period (k = 1,2,3)

γ_i was the effect associated with the ith team (i = 1,….,6)

ε_{ijk} was the error term for the ith team on the jth supplement and in the kth period

RESULTS

Intake of maize stover by oxen on the three treatments was as shown in Table 4. The mean daily voluntary dry matter intake of stover was significantly different ($p < 0.05$) between treatments. Work had no influence on the treatment effects on intake of stover. For all treatments average daily intake of stover was higher on non-working compared to working days.

The average working speed of oxen in treatment B was higher than that of oxen in the other treatments, however the differences in average daily speed were not statistically significant ($p > 0.05$). Similarly animals in treatment B tended to have higher draught forces and developed more power compared to those in the other treatments but the differences between treatments were not statistically significant (p>0.05).

Table 4: Average live weight at the start, voluntary dry matter intake (DMI) of stover and work parameters for oxen receiving the different supplements, see text for details of amounts given

Parameter	Treatment A (Lucerne)	Treatment B (Sunflower)	Treatment C (Cob meal)
Intake of stover (kg DM)	12.5± 2.3[a]	14.9± 3.3[b]	13.6± 2.3[c]
DMI stover (g/kg $M^{0.75}$)	57.8±5.1[a]	69.2±5.9[b]	64.56±2.2[c]
DMI stover work days (kg DM)	10.9±1.4[a]	13.3±1.5[b]	12.9±0.8[c]
DMI stover non-work days (kg DM)	13.2±1.2[a]	15.7±2.2[b]	14.1±0.6[c]
Average weekly gain (kg)	-0.46	0.54	0.33
Average daily work (MJ)	11.5±1.9	13.4±2.1	12.6±2.1
Speed of working (m/s)	1.3±0.02	1.3±0.03	1.3±0.1
Average draught force (N)	835±44	862±55	831±34
Average power (W)	1060±68	1127±105	1056±5

means with different superscripts along a row are significantly different (p<0.05)

The differences in average live weight changes of oxen in the three treatments were not statistically significant (P>0.05). Oxen in treatment A lost some weight while oxen in the other two treatments gained some weight.

DISCUSSION

It has been established that maize stover alone cannot provide enough nutrients for working oxen to cater for their maintenance and work energy requirements and that nitrogen-rich supplements are needed when stover is the main diet (Ffoulkes and Bamualim, 1989). The weight changes observed under the three treatments suggest that all three supplements helped to improve utilisation of maize stover as evidenced by the trend of live weight changes over the whole experimental period. The average weekly live weight changes showed that animals supplemented with lucerne lost a little weight while those supplemented with either sunflower cake or cob meal gained a little weight. The superior performance of animals supplemented with sunflower cake could be attributed to its higher crude protein and energy content compared to cob meal and lucerne. Normally lucerne hay has a higher crude protein content than cob meal, but its energy content was lower in this experiment than the cob meal. This might have been the reason for loss of weight when stover was fed with lucerne. Among the three supplements, lucerne showed the lowest intake of maize stover. This could be attributed to the bulky nature of lucerne.

Voluntary dry matter intake of stover by animals in all treatments tended to be higher on non-working days. Pearson and Smith (1994) observed that daily dry matter intake of animals prevented from feeding for four hours everyday was not affected. The number of hours worked per day in this experiment was at most four hours, but there was a tendency for the animals to rest for some time after finishing work before they began to eat, therefore the actual time spent eating on working days was far less than on non-working days. This might have been the main contributing factor to the lower voluntary dry matter intake. At a daily food allowance adjusted to 30 % higher than the amount consumed the previous day, intake was 57.8-69.2 g/kg $M^{0.75}$. Fall *et al*. (1997b) obtained very similar intakes (65.5 g/kg $M^{0.75}$) when feeding millet stover to oxen working for 5 hr/day at a daily allowance adjusted for refusals to amount to 50 % of food offered. In order to allow working oxen enough time to feed, it could be good practice to ensure that work begins early so that it also ends early enough to give the oxen enough time for feeding. This is especially relevant where the animals are able to graze only during day time, and are kraaled at night.

If several supplements are available for use it would be a sound idea to combine them so as to take advantages of each and possibly reduce the overall cost. Where a supplement is to be offered it should be given before the main diet to ensure that it is all consumed. There is a need to carry out more experiments making use of graded levels of supplements and try different combinations of supplements so as to identify most suitable mixtures and recommend optimum levels of inclusion in rations for draught oxen working in the Eastern Cape.

REFERENCES

Bartholomew, P.W., Khibe, T. and Little, D.A. (1994). Effect of live weight and body condition on work output from draught oxen. *Tropical Animal Health and Production* 26, 58-64.

Bartholomew, P.W., Khibe, T. and Ly, R. (1995). In village studies of the use of work oxen in Central Mali. *Tropical Animal Health and Production*, 27, 241-248.

Fall, A., Pearson, R.A., and Fernández-Rivera, S. (1997a). Nutrition of draught oxen in semi-arid West Africa 3. Effect of body condition prior to work and weight losses during work on food intake and work output. *Animal Science* 6, 227-232.

Fall, A., Pearson, R.A., Lawrence, P.R. and Fernández-Rivera, S. (1997b). Nutrition of draught oxen in semi-arid West Africa. 2. Effect of work on intake, apparent digestibility, and rate of passage of food through the gastro-intestinal tract in draught oxen given crop residues. *Animal Science* 64, 217-225.

Ffoulkes, D. and Bamualim, A. (1989). Improving the nutritional level of draught animals using available feeds. In*: Draught Animals in Rural Development..* (eds. D. Hoffman, J. Nari and R.J. Petheram). Proceedings of an International Research Symposium, Cinapas, Indonesia). 134-145 ACIAR Proceedings No. 27, ACIAR Canberra

Francis, J. and Ndlovu, L.R. (1993). Work capacity of Mashona oxen. *Zimbabwe Journal of Agricultural Research* 31, 93-98.

Francis, J. and Ndlovu, L.R. (1995). Improving feeding management of Mashona oxen through strategic supplementation with cob sheath-groundnut stover. *Tropical Animal Health and Production* 27, 249-257.

Lawrence, P.R. and Pearson, R.A. (1985). Factors affecting the measurement of draught force, work output and power of oxen. *Journal of Agricultural Science (Cambridg*e), 105, 703-714.

Ndlovu, L.R., Francis, J. and Hove, E. (1996). Performance of draught cattle in communal farming areas in Zimbabwe after dry season supplementation. *Tropical Animal Health and Production* 28, 298-306

Pearson, R.A. and Smith, D.G. (1994). The effects of work on food intake and ingestive behaviour of draught cattle given barley straw. *Animal Production* 58, 339-346.

Prasad, V.L., Khombe, C.T. and Nyathi, P. (1994). Feeding crop residues for improved draft power. In: *Improving Animal Traction Technology*. (Starkey, P., Mwenya, E. and Stares, J.) pp 164-166. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 18-23 January 1992, Lusaka, Zambia. Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. 490pp.

Soller, H., Reed, J.D. and Butterworth, M.H. (1991). Effect of work on utilisation of cereal crop residues by oxen. *Animal Feed Science and Technology* 33, 297-311.

Veld conditions in communal grazing systems keeping draught animals at Esixekweni in the Eastern Cape Province of South Africa

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ABSTRACT

An intensive veld condition assessment was conducted at Esixekweni (Farm B), a communal village in the Eastern Cape Province. The main aim was to investigate the condition of the vegetation in veld under a communal grazing system, where draught animals are extensively used. Twenty two sites in four camps were surveyed to assess veld condition. The average veld condition score (VCS) was 78%. In addition to botanical composition, basal cover and standing herbaceous biomass were estimated in the 22 sites. Eighteen of the sites had woody plants and browsing capacity was estimated at these sites. The stem:leaf ratio indicated that leaves were more than stems, due to the fact that continuous grazing tends to keep grass short and leafy. The basal cover of the veld was good with an average of 0.7 cm point to tuft distance. The estimated standing herbaceous biomass per hectare was 1.4 tons/ha. The veld condition was good because the veld was dominated by the decreaser species.

INTRODUCTION

A major challenge associated with the use of draught animals, is that of feeding the animals to ensure adequate supply of nutrients for working in addition to other essential activities like milk production and beef production. In the Eastern Cape Province natural veld is the main feed resource available for most livestock production systems. In order to ensure good work output by draught animals and a sustainable, high level of livestock production, it is necessary to ensure a good veld condition. The latter can only be achieved through proper veld management practices. Good management will involve assessment of veld condition and determination of optimum carrying capacity that will ensure availability of enough feed for all classes of livestock throughout the year. The aims of this research were:

- To investigate the veld condition of the area.
- To determine the nutritional value and leaf:stem ratio of the study area.
- To investigate the quantity of herbaceous biomass of the study area.
- To assess relationships between veld condition, nutritional value, and standing herbaceous biomass.

MATERIALS AND METHODS

The study area at Esixekweni is situated in the Middledrift district of the Eastern Cape at Debe Nek. The area of the farm is between the latitudes 32°53’ S and 32° 56’ S and longitudes 27°4’ E and 27° 5’ E. The altitude is between 450 m and 550 m above mean sea level. The orthophoto map: Ciskei 41/43-X/AA at a scale of 1:10 000 and the topocadastral map: 3227CC DEBE at a scale 1:50 000 were used. One hand drawn map is provided for the study area, to show the locality, and the land use sections (Figure 1).

VELD CONDITION SURVEY METHODS

Data were collected using methods to assess veld condition as explained by Trollope (1986) for both grass and bush, and the information was analysed with the simplified techniques of Beckerling *et al.,* (1995).

Assessing veld condition The homogeneous vegetation units (HVU's) were identified from aerial photographs at a scale of 1:10 000.

Figure 1: Map of Esixekweni (Latitude 32^{0}53'S to 32^{0}55'S and longitude 27^{0}4'E to 27^{0}.5' E) in the Middledrift district of the Eastern Cape Province.

Grass sward The assessment of the condition of the herbaceous layer is based on the botanical composition and the basal cover of the grass sward. Sample sites of 50 m x 100 m were assessed through a step-point method. The technique used for analysing the condition of the grass sward involved comparing the presence or absence of the key grass species in a sample site with those in a benchmark site which was representative of that type of veld in optimum condition for livestock production (Danckwerts, 1989).

The woody component and data analysis The technique used was that developed by Teague, Trollope and Aucamp, (1981) which was aimed primarily at estimating the browsing capacity of bush for utilisation by goats.

Leaf to stem ratio and chemical analysis Samples of four dominant grass species were harvested, weighed and dried at 100°C to a constant weight for the determination of dry matter. Each sample was split into two parts. One part was analysed for crude protein (CP), neutral-detergent fibre (NDF) and acid-detergent fibre (ADF) according to the Association of Official Analytical Chemists (1990). The second part was weighed separately, and the leaf to stem ratio was estimated.

Measurements of standing herbaceous crop Standing herbaceous crop was estimated with a disc pasture meter as explained by Trollope, Clarke and Trollope (1981). The main purpose for estimating the standing herbaceous crop was to estimate the amount of available forage in the veld. With the chemical analysis, these measurements can index the quality and the quantity of the veld.

LIVESTOCK WEIGHTS AND NUMBERS

The 1994 and 1997 livestock numbers were used as the most significant numbers that had led to the prevailing veld condition at the study area. These numbers were taken from the dipping foreman at Middledrift Department of Agriculture. Random weighing of cattle (bulls, oxen, cows and heifers) was done at the study area. Only 23 animals were weighed due to the difficulty of handling the animals without cattle-crush facilities.

RESULTS

GENERAL OBSERVATIONS

The total study area was 636 ha of which 159 ha was arable land, with 70 ha of this land under cultivation. The rest of the area consisted of grazing land (442 ha) and residential areas (35 ha). All boundaries and different land use sections were fenced. The grazing camps were not properly fenced and the cropping area had a perimeter fence only. There were four camps (two camps were 110 ha and the other two camps were 111 ha) with only two common drinking points that were always dry during dry seasons. The animals used one entrance point to the four camps. The poor infrastructure has meant that continuous grazing is the veld management practised at Esixekweni. The grazing area was communally used by the villagers. Cropping areas and residential areas were privately owned. Grazing occurred freely around the residences and on cropped areas after harvesting.

VELD CONDITION

Average veld condition score (VCS) was 78 % (Table 1). The average grazing capacity was 3.5 ha/AU. Total animal units (AU) were 128. *Acacia karroo* percentage, when it

Table 1: Veld condition assessment at Esixekweni.

	Area (ha)	VCS (%)	Grazing capacity (ha/AU)	Animal unit (AU)	*Acacia karroo* (%)	Bush phyto-mass (TE/ha)	Bush density (plants/ ha)	Browsing capacity (ha/SSU)	Small stock unit (SSU)	Potential browsing capacity (ha/SSU)
Camp 1										
1		73.6	2.7		55.2	1075	1450	2.6		2.6
2		60.5	3.1		100	975	1550	2.6		2.4
3		64.4	3.1		100	750	1100	3.4		3.4
18		70.2	2.9		55.3	2208	4250	1.2		1.2
19		39.9	7.5		65.3	1625	2450	1.6		1.6
20		48.1	4.2		0	0	0	0		0
21		49.4	6.1		0	0	0	0		0
22		90.2	2.2		0	0	0	0		0
Tot/avg	110	62.0	4.0	28	47.0	829.1	1350	1.4	79	1.4
Camp 2										
4		105	1.9		90	233	500	8.6		8.6
5		91.5	2.2		80.0	392	750	6.3		6.3
6		81.6	2.4		100	375	1350	5.3		5.3
7		85.5	2.3		31.6	242	950	10.0		10.0
8		93.2	2.2		22.2	217	900	9.2		9.2
15		58.9	5.1		7.1	117	700	18.5		18.5
16		93.0	2.2		100	1525	3350	1.6		1.6
17		39.9	7.5		90.2	825	2050	2.7		2.7
Tot/avg	110	81.1	3.2	34	73.1	490.8	1319	7.8	25	7.8
Camp 3										
9		64.5	3.1		64.3	200	700	10.0		10.0
10		79.4	2.5		26.3	275	950	7.7		7.7
14		92.4	6.5		0	0	0	0		0
Tot/avg	111	78.8	4.0	28	30.2	158.3	550	5.9	18.8	5.9
Camp 4										
11		101	2.0		10	117	500	17.1		17.1
12		106	1.9		0	0	0	0		0
13		61.6	4.9		0	0	0	0		0
Tot/avg	111	89.5	2.9	38	3.3	39.0	166.7	5.7	19.5	5.7
Total/ avg	442*	78	3.5	128*	38.3	379.3	846.2	5.20	142*	5.2

*The area (ha), animal unit (AU) and the small stock unit (SSU) are given in totals not averages, TE: tree equivalents, VCS: Veld condition score.

was compared to other bushes was more than 50 % per hectare in camp 1, but the average for the whole area was 38.3 %. Bush phytomass was on average 379 tree equivalents per hactare (TE/ha) and average bush density was 846 plants/ha. The average browsing capacity was 5.0 ha per small-stock unit (ha/SSU) which was similar to the potential browsing capacity, that was 5.2 ha/AU. The total small-stock units (SSU) were 142 (Table 1).

Table 2: Botanical composition of veld at Esixekweni

Camps & Sites	VCS (%)	Decreaser species (%)	Increaser 1 species (%)	Increaser II species (%)	Invaders (%)	Others (%)	Basal cover (cm)	Bush phyto-mass (TE/ha)	Bush density (plants/ha)
Camp 1									
site 1	73.6	32.2	5.6	0.9	0	61.4	0.8	783	1450
site 2	60.5	33.0	9.7	11.7	0	45.6	0.8	975	1550
site 3	64.4	29.1	4.8	7.8	0	58.3	1.9	750	1100
site 18	70.2	33.0	1.0	10.6	0	55.4	0.7	2208	4250
site 19	39.9	18.1	0	11.5	0	70.4	0.9	1625	2450
site 20	48.1	21.4	0	45.7	0	32.9	0.6	0	0
site 21	49.4	25.2	1	25.2	0	48.6	0.5	0	0
site 22	90.2	36.9	0	24.3	0	38.8	0.5	0	0
Avg	62.0	28.6	2.8	17.2	0	51.4	0.8	829.1	1350
Camp 2									
site 4	105	50.5	2.90	2.0	0	44.6	0.6	233	500
site 5	91.5	41.2	0	2.8	0	56.0	0.6	0	0
site 6	81.6	33.4	0	8.6	0	48.6	0.9	375	1350
site 7	85.5	34.3	5.80	4.8	0	55.1	0.8	242	950
site 8	93.2	40.8	0	9.7	0	49.5	0.6	217	900
site 15	58.9	23.0	8.5	49.6	0	49.6	0.4	117	700
site 16	93.0	38.8	1.0	11.6	0	58.0	0.5	1525	3350
site 17	39.9	5.9	0	37.3	0	56.8	0.7	825	2050
Avg	81.1	33.5	2.3	15.8	0	52.3	0.6	490.8	1319
Camp 3									
site 9	64.5	48.5	11.7	8.7	0	31.1	0.7	200	700
site 10	79.3	29.5	2.0	14.3	0	54.2	0.5	258	950
site 14	80.3	27.2	0	14.5	0	58.3	0.5	0	0
Avg	78.8	35.1	4.6	12.5	0	47.9	0.7	158.3	550
Camp 4									
site 11	101	48.5	3.9	14.6	0	33	0.7	0	0
Site 12	48.1	21.4	0	45.7	0	32.9	0.6	0	0
site 13	61.6	25.2	1.0	25.2	0	48.6	0.5	0	0
Avg.	70	31.7	2.6	17.6	0	48.9	0.7	506	1068
Avg-tot	77.9	32.2	2.8	18.5	0	47.5	0.7	379.3	846.2

TE: tree equivalents, VCS: Veld condition score

Botanical composition of the study area is displayed in Table 2. The dominating key species were the decreaser species which formed an average 32.2 %, followed by increaser II species forming an average 18.5 % and increaser I species contributing an average of 2.8 %. The other species, which are not referred to as key species and are not found in the standardised score sheet, were 47.5 % (Table 2). The decreaser species were dominating in most sites, except four sites in Camp 1 (plot 20), Camp 2 (plots 15 and 17) and Camp 4 (plot 12) (Table 2). These were the sites at the camp entrances and for up to 2 km away from the entrances. Animals used only one entrance to all camps. These sites were in the middle of the slope to the west.

The compositions of the main species observed at the sample sites are given in Table 3. The species tended to be low in protein content and high in fibre content.

Table 3: The composition of dominating grass species at Esixekweni

Species	Dry matter (g/kg)	NDF (g/kg D.M)	ADF (g/kg D.M.)	Crude protein (g/kg)
Hyperrhenia hirta	957.4	761.1	534.2	30.9
Digitaria stolon	952.0	726.0	461.3	57.6
Themeda triandra	948.3	758.7	523.8	39.8
Eragrostis capensis	944.3	751.1	394.0	62.4

NDF, neutral detergent fibre; ADF, acid detergent fibre

The stem to leaf ratio was less than 1:1 because most of the grass was short and leafy due to continuous grazing (see table 4).

Table 4: The stem:leaf ratio of the main grass species at Esixekweni.

Species	Wet mass (g)	Dry mass (g)	Dry mass of leaves (g)	Dry mass of stems (g)	Stem : leaf ratio
Hyparrherria hirta	35.1	33.6	20.1	13.5	1:1
Digiteria stolon	25.9	24.7	18.9	5.8	1:3
Themeda trianda	32.5	30.8	21.7	9.1	1:2
Eragrostis capensis	11.8	11.2	9.4	1.8	1:5

The mean disc height was 2.7 cm, which is equivalent to 1.4 tons/ha as standing herbaceous crop. The mass of the standing herbaceous crop was estimated to be 613.5 tons over the whole grazing land in the study area.

LIVESTOCK NUMBERS, RATIOS AND LIVEWEIGHTS

Ownership of cattle at Esixekweni is summarised in Table 5. The total number of cattle in 1997 was 228 and in 1994 was 84. The average ownership was three cattle in 1994 and eight cattle in 1997. The number of cattle owners has increased from 27 to 30 between the years 1994 and 1997. In 1994 numbers of oxen were higher than any other livestock. In 1997 there were 73 cows and the oxen were the second highest in number, which was 55.

Table 5: Number of cattle owners and herd composition for Esixekweni.

Year	No of owners	Cows	Heifers	Calves	Oxen	Total	Average ownership
1994	27	21	26	1	35	84	3
1997	30	73	42	47	55	228	8

In 1994 there were 1200 sheep at Esixekweni and typical ownership was 30 to 35 sheep. The total number of sheep in 1997 was 889 and farmers owned 20 to 30 sheep. The goat population in 1994 was 125 with a typical ownership of five to seven goats, while in 1997 the number of goats was 168 and farmers owned from five to 15. The livestock ratio (AU:SSU) in 1997 was 1AU:4SSU and in 1994 it was 1AU:12SSU. Cattle weights of the sample weighed within the area, ranged from 115 to 580 kg, bulls weighed from 535 kg to 580 kg. The average live weight of the cattle was 390 kg.

DISCUSSIONS AND CONCLUSIONS

The veld condition is the botanical composition and resistance to soil erosion of the veld. If the veld is dominated by decreaser species, that veld is taken as in good condition. The condition of the vegetation is signified by the veld condition score (%) at the sample site as compared to the benchmark site, the grazing capacity in ha/AU, the total number of animal units, the browsing capacity in ha/SSU, and the total of SSU, the potential browsing capacity in ha/AU, percentage of *Acacia karroo* and the density of bush in TE/ha and BU/ha. All these factors are added from different sample sites and divided by the number of sample sites to get the average.

The majority of sample site scores were higher than those of the benchmark site using the method of Trollope (1986). This gave problems in analysing the data, because the formulation of a new benchmark site was needed based on a sample site that gave the highest score. The simplified techniques of Beckerking *et al.*, (1995), were therefore used to analyse the data. In Esixekweni there were many species that were specified as ‘others’ as compared to the key species for the veld, which was probably due to the fact that the simplified techniques have not been researched a great deal for this type of veld.

The high scores at Esixekweni could have been caused by understocking in the veld currently, combined with the fact that when the standardised score sheets were developed, in the past, the stocking rate was high. They could also be due to the biodiversity which is defined by Soil and Water Conservation Science (SWCS, 1996) as the indicator of the relative stability of any particular community or ecosystem when viewed in the context of relative species richness, amount of water available, amount of physical space or volume, other habitat and ecological niche constraints.

The ecological stability based on the basal cover of the study area was very good with an average point to tuft distance of 0.7 cm. The veld condition was generally the same except in the camps and areas within the study areas where the basal cover was poor around the entrances and pathways from them.

Botanical composition of the study area seemed to be good because it was dominated by decreaser species. There was no clear trend in stages of grassland succession because certain parts or camps were understocked or overstocked relative to others.

The veld may reach the increaser I stage, especially in Camp 1, which did not have drinking points and is therefore less likely to have the same grazing pressure as the camps with water. The sites that are 3 to 4 km away from the entrances of the camps again may not have the same grazing pressure as those near the entrances and have less trampling. The over-grazing and trampling near the entrances as the animals are driven daily to and from the camps causes these sites to be dominated by increaser II species. A poor balance of livestock, reflected in a far-from ideal livestock ratio would cause the development of increaser I species. The recommended livestock ratio for mixed veld is 1AU:6SSU but sheep are in far less than the recommended ratio to cattle generally in Esixekweni. Camps that had more than 50 % *Acacia karroo* at Esixekweni were the camps or sites that were undergrazed or selectively grazed. This might be the reason that *Acacia karroo* invaded these camps. To avoid this problem, continuous browsing is needed to control both the height and the invasion of bushes, especially during the growing season in spring.

The study area had a good potential for producing forage for livestock. This was signified mostly by the trend of the veld condition score. As the veld was more than 45 % *Accacia karroo*, in certain camps, it would be necessary to chop the *Acacia karroo* to allow veld adjustment to maintain the potential of the veld. The area was capable of carrying higher numbers of livestock, because the mean grazing capacity was 3.5 ha/AU. The botanical composition and the basal cover play an important role in indicating the state of health of the veld.

The veld condition is not affected by the presence specifically of draught animals. As long as the veld is well managed, as in any livestock production system, it will continue to sustain livestock. Draught animals need well managed veld, with a well planned veld management programme that will provide good quality and quantity of forage for them, especially at the time of the year when animal power is in greatest demand. This time of greatest demand occurs during crop planting in spring when the veld is often poor in terms of quality and quantity.

Provision of optimal grazing from the veld cannot be done without a good layout or well planned and implemented infrastructure of drinking points and well fenced camps in rural areas. Consideration must also be taken of the importance of the ecosystem to maintain good biodiversity. The empowerment of the community in order to manage to sustain their environment is required.

The livestock production in communal grazing systems cannot always be sustained due to variation from one year to another year. These variations in veld condition are caused by both socio-economic and natural factors, such as the land tenure systems, overpopulation of people and animals, lack of community leadership, failure of transfer of technology through an appropriate research and development programme and droughts. There are some factors that need to be revisited in order for good veld conditions to be sustainable in communal grazing systems.

The land tenure system needs to be considered a great deal. This is because in most communal grazing areas farmers or the community do not want to take any responsibility to maintain or repair any resources. Many see it as a resource that does not belong to them.

The communal grazing systems, whereby all members of the community graze their animals together and there is little or no control of numbers, is quite controversial. Many experts feel that this system of land tenure is one of the main obstacles to agricultural development in rural areas (Steyn 1988). The high population of people in communal grazing areas will always compete for land. Ciskei is a heavily populated rural area with approximately 130 people per sq km as opposed to the 21 people per sq km in the non homeland regions of South Africa (ARDRI, 1990a). The residents will compete for residential areas in cropping and grazing areas. The hunters will always burn the veld to drive the wild life when hunting. The present communal grazing areas need an administrative personnel that can take into consideration all the activities that might take place for development in rural areas.

The grazing system that currently exists in communal grazing areas cannot be changed because of the socio-economic factors, particularly the political factors that exist in these areas. What is needed is that individual farmers who have the largest numbers of livestock, and people with agricultural qualifications, who see farming as a career, should be given responsibility for land. This could be achieved by perhaps selling land into private ownership or by encouraging leasing as private farms. So much money has been spent in communal grazing systems, without any changes in terms of development, largely because no one feels ownership of the land and therefore has little incentive to improve it.

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REFERENCES

ARDRI, 1990. Portrait of a rural population. *Ardrinews, (September),* pp 5-7. Agriculture and Rural Development Research Institute, University of Fort Hare Alice , South Africa.

Association of Official Analytical Chemists. 1990. *Official methods of Analysis of the Association of Analytical Chemists.* 15th edition. Association of Official Analytical Chemists, Virginia, USA.

Beckerling, A. C., Trollope, W. S. W., Mbetu, M. M. and Scogings, P. F. 1995. *Simplified Techniques for assessing veld condition for livestock production in the Ciskei region*. Agriculture and Rural Development Research Institute and

Department of Livestock and Pasture Science, University of Fort Hare, Alice, South Africa.

Danckwerts, J. E. 1989. Grazing management principles and practices. In: *Veld Management in the Eastern Cape* (eds J.E. Danckwerts and W.R. Teague) pp 61-73. Pasture Research Section, Eastern Cape Region, Department of Agriculture and Water Supply.

Soil, Water Conservation Science (SWCS) 1996. Biodiversity. *Journal Of Soil and Water Conservation* 51, 265-267.

Steyn, G.J. 1988. A farming systems study of two rural areas in the Peddie District of Ciskei. D. Sc Dissertation, University of Fort Hare, South Africa.

Teague, W. R., Trollope, W. S. W. and Aucamp, A. J. 1981**.** Veld management in the semi-arid bush-grass communities of the Eastern Cape. *Proeedings of the Grassland Society, South Africa* 16, 27-33.

Trollope, W. S. W. 1986. Land use surveys: Assessment of veld condition in Ciskei. In: *Republic of Ciskei National Soil Conservation Strategy*, Vol. 1, Public Department of Agriculture and Forestry, Ciskei.

Trollope, W. S. W., Clarke, B. K. and Trollope, L. A. 1981. *The Disc Pasture Meter*. University of Fort Hare, Private Bag X 1314, Alice, Eastern Cape, South Africa.