



DRAUGHT ANIMAL NEWS

No. 37

November 2002



Produced by:

Centre for Tropical Veterinary Medicine, University of Edinburgh

Funded by:

British Department for International Development

DRAUGHT ANIMAL NEWS

No. 37

November 2002

**Centre for Tropical Veterinary Medicine
University of Edinburgh, Scotland**

ISSN 1354-6953

- ☆ In this issue of Draught Animal News we have information on a wide range of topics reflecting the many uses working animals are put to in a variety of different places. Articles have been sent in from Kenya and Ethiopia, reflecting the economic and social as well as the practical value draught animals have. We have report from meetings as far apart as Syria and El Salvador.
- ☆ Draught Animal News accepts articles in Spanish and French, as well as in English. If you submit an article in Spanish or French we would also like a short summary in English to accompany it. For those sending in articles, notes and news we prefer you to send us your input (especially if it is a longer article), on a 3" disk (using Microsoft Word, Word Perfect or Rich Text Format) or via email. If you wish to include photographs, please ensure these are original and of good quality because of losses in the reproduction process. High-resolution photographs saved in .tif format are preferable (using Winzip to compress the file if necessary). We always acknowledge the person taking the photograph so please give us the name. For those without access to a computer, contributions are especially welcome, hand-written or typed.
- ☆ We are always pleased to hear of any meetings, forthcoming events, new books and useful websites that can be advertised in the newsletter. Letters from draught animal owners, users or those people wanting information on a particular topic or problem are always welcome. Please send in articles and news to the editor, Dr R.A Pearson, Editor, *Draught Animal News*, Centre for Tropical Veterinary Medicine, Easter Bush Veterinary Centre, Roslin Midlothian, EH25 9RG, Scotland, UK (fax +44 (0)131 445 5099; email: anne.pearson@ed.ac.uk).
- ☆ The drawing on the front cover by Archie Hunter is drawn from a photograph of an ox in Colombia taken by Walter Galindo.
- ☆ This publication is currently funded by the UK Department for International Development (DFID) for the benefit of developing countries. The views expressed in it are not necessarily those of DFID.

CONTENTS

Research & Development Projects	Meeting Reports 44
Africa 2	Forthcoming Events 52
Asia 21	New Books 53
Short Notes and News 42	Recent Publications 55
Letters to the Editor 43	Contributors to <i>Draught</i>
	<i>Animal News 37</i> – back cover

RESEARCH AND DEVELOPMENT PROJECTS

1. AFRICA

(a) Ethiopia

Draught animals in the livelihoods of mixed smallholder farmers in North Wollo, Ethiopia

R Trevor Wilson¹, NJ Bech² and E van Waveren²

¹Bartridge House, Umberleigh, North Devon EX37 9AS, UK; ²DHV Agriculture and Natural Resources, Amersfoort, The Netherlands

Geographical and biophysical environment of North Wollo

North Wollo Zone is located in the north-eastern part of Amhara National Regional State in the central highlands of Ethiopia and covers an area of 12 706 km². The rural population density of just over 100 persons/km² is very high for Africa. The landscape is characterised by dissected high plateaux, steep hills and mountains and broad valleys. Elevation varies from 1,100 m above sea level to over 4,200 m. Some 90% of North Wollo is classified as highland with altitudes exceeding 1,500 m and more than half of this is higher than 2,400 m. The steepness of the terrain severely limits the potential for agriculture and causes problems for infrastructure development. Subsistence rainfed crop production and extensive grazing are the dominant land use types. Land degradation has resulted from the high population density in large parts of the Zone.

The Zone is generally seen as a relatively cool and dry area but due to the pronounced differences in altitude and aspect this applies to part of the area only. A wide range of agroclimatic conditions is related mainly to rainfall and temperature. Mean annual rainfall is generally in the range 600–1,300 mm with two main rainfall patterns. East of the principal watershed rainfall distribution is predominantly bimodal with short rains or ‘belg’ in the period February–May and main rains or ‘kiremt’ falling in June to October. The short rainy season is less pronounced to the west of the main watershed and it is virtually absent in the extreme west. Temporal variability in rainfall is considerable and the dependable annual rainfall (the minimum amount that can be expected in most years) is considerably less than the annual mean in the range 450–750 mm. Mean annual temperature is largely a function of altitude on the basis of which five temperature zones can be distinguished. These are: Warm (altitude <1600 m, mean annual temperature >21°C; Moderately warm (1,600–2,400 m, 16–21°C); Cool (2,400–

3.

3100 m, 11–16°C); Cold (3,100–3,800 m, 7.5–11°C); and, Very cold (>3800 m, <7.5°C). The length of growing period (LGP) provides a measure of the duration of the period with sufficient moisture for crop production. The LGP is calculated on the basis of a simple water balance using rainfall, potential evapotranspiration (as a proxy for the water requirement of the crop) and soil moisture storage capacity. Because of the high interannual variability of the rainfall the LGP also varies between years. The dependable LGP is. The three moisture zones delineated on the basis of the dependable LGP (that is, the minimum length of growing period expected in four out of five years) are: a submoist zone with a dependable LGP of 2–4 months; a moist zone with 4–6 months dependable LGP; and, a transitional zone with a dependable LGP of 3–5 months. Adverse thermal conditions may further limit the growing season and indeed part of the area with a relatively favourable LGP is too cold for crop production. This is particularly the case in the cold and very cold zones where low temperatures inhibit the cultivation of nearly all crops with barley as a notable exception.

Land use is predominantly small scale and largely subsistence oriented rainfed crop production with about 30% of the area under cultivation. The remainder is under various types of vegetation and mainly used for extensive grazing and the collection of fuel wood and other materials. The total area of cultivated and non-cultivated land available per household in 2000 was 3.7 ha. Most holdings comprise two or three spatially separate parcels and although fragmentation is inimical to modern crop husbandry it is distinctly advantageous to subsistence farmers in terms of reduced risk because parcels are often of different soil types and may be situated in different physiographic and agroclimatic locations.

Numbers of livestock

The 33 sub-districts ('kebele') of the district ('woreda') of Bugna are the focus of this analysis. Official statistics indicate a total of 187,381 cattle, 95,529 sheep, 104,228 goats, 24,819 equines and 131,722 poultry in the area (although unofficially the indications are of many more animals and particularly goats and sheep). At conventional conversion ratios when one head of cattle represents 0.7 of a Tropical Livestock Unit (TLU), a sheep or goat 0.1 TLU and one equine 0.8 TLU the district has a standing stock of 167,351 TLUs. It is likely that the TLU calculation is an underestimate on the actual number because of the large proportion (25.3% of the total number) of mature work oxen in the cattle herd. If, however, conventional TLU ratios and official number data are accepted livestock densities vary among sub-districts from those with comparatively lower density with more than 3.5 ha of total land available per TLU to those that are under very heavy feeding pressure with less than 0.5 ha/TLU.

Functions in the household economy

Whereas livestock density is high at an average of 1.6 ha/TLU the average holdings of 4.3 head of cattle (including 1.1 oxen), 4.6 small ruminants and 0.25 equines per household is rather low. Livestock sales are infrequent and hard money from this source is considerably less than from crops and does not contribute more than 30% to the annual cash income. Livestock sales are highest in the richer households and virtually non-existent in the poorer ones (SC-UK, 2001).

Indeed for all the larger species that includes cattle and equines cash income is not the main objective of keeping livestock. The real functions of livestock are underlined

by farmers perceptions of their reasons for maintaining livestock and indicated the order of importance in which they perceived their roles (Table 1). Whereas many roles are important to farmers the functions vary among species. Cattle are thus generally most important in the provision of draught power and equines in the provision of transport. Draught power is truly a critical precondition of crop production in Ethiopia (Bech and van Waveren, 2002) because of the emphasis on small grains cereal production and the mostly heavy soils. Sheep and goats and poultry are kept mainly for raising smaller cash needs.

Table 1: Reasons for keeping and utility of various species of livestock as perceived by farmers.

Rank of function	Livestock species and perceived utility/function			
	Cattle	Equines	Sheep and goats	Poultry
1	Draught power	Transport	Cash	Cash
2	Milk	Cash	Meat	Meat
3	Cash	Draught power	Skin	Eggs
4	Meat	Manure	Manure	
5	Manure and fuel	Prestige	Prestige	
6	Threshing			

The primary and indeed overwhelmingly important role and function of the guild of domestic livestock in most of North Wollo is thus the use of cattle for the provision of draught power which can be translated as ploughing. Other cultural uses such as harrowing and weeding with oxen are not or extremely rarely practised. All other roles are perceived to be and actually are subordinate to ploughing although it is probable that the real importance of cattle for threshing (and of equines to a lesser extent) is higher than the perceptions indicated in Table 1. In the higher parts of the area at probably above 2,800 metres altitude but certainly above 3,000 metres the role of power is taken over to some extent by equines although cattle still retain a considerable measure of importance. A probable exception to the primordial role of cattle for power is in the lower altitudes in the extreme west of the area and again in the lowlands of the east where milk production for home consumption and the rearing of male cattle for eventual sale (to other areas of the area?) as work oxen may be important. Home consumption of milk and meat contributes to food security and to a higher quality human diet and poultry are important for raising small amounts of cash, for barter and as an important food item as both meat and eggs in the local diet.

Ratios of oxen to other cattle and to equines

In the lowland 'kebele' in the west of Bugna district less than 14 per cent of the cattle herd are oxen indicating that cropping is less important here than in most other parts of the 'wereda'. Other 'kebele' with low percentages of oxen are possibly extremely poor as they have limited areas of cropping due to thin and infertile soils. Most of the central 'kebele' where cropping is important have more than 30% of oxen in the cattle herd with one having more than 40%. These data provide strong support for the hypothesis that herd structure reflects herd function. Large numbers of oxen exert, however, a negative effect on the possibility of maintaining herd numbers without recourse to external

sources of supply. Sub-districts with 35% or more of oxen, for example, are unlikely to be self sufficient in reproductive performance. Overall the percentage of cows in the 'wereda' herd is 25%. This is considerably below the norm for African traditional herds which usually have a percentage of this class of stock of 31–32 (de Leeuw and Wilson, 1986). The lowland 'kebele' already referred to and with 30% of cows in the herd is the only one in the 'wereda' to approach this norm. Others with less than 25% of cows in the cattle herd are certain to be dependent on imported work oxen to maintain their production system. In extreme cases, as in the severe drought in Tigrai in the 1970s, work oxen can make up as much as 70% of the total herd as farmers struggle to keep them alive or on the farm at the expense of other classes of stock (Wilson, 1975).

The relationship of the number of equines in the district to the total number of cattle is 13:100 and of equines to draught oxen is 52:100. There is considerably less variation among subdistricts in the former ratio than in the latter. Notable again is the western lowland 'kebele' where there are under 2 equines to every 100 cattle and only 13 equines to 100 draught oxen. Two 'kebele' — the one with 8 and the other with 7 — are the only other of these units with less than 10 equines to 100 total cattle. Also notable is the ratio of equines to oxen in one sub-district where there are 89 equines to every 100 oxen and where there are only 17% of oxen in the cattle herd. A similar situation prevails in another unit where oxen in the cattle herd are 18% and where there are 102 equines for every 100 oxen. There are many equines to oxen (97:100) in another 'kebele' for no very apparent reason (although for development planning purposes it is classed as 'very remote') but where 25.5% of livestock biomass is horses, mules and donkeys compared to 14.8% for the district as a whole. There is also a high ratio of equines of 94:100 in another sub-district where overall oxen numbers are low. Elsewhere the ratio equines:oxen seems to vary rather randomly with the detailed analysis providing little evidence to support earlier suggestions that there are relatively more equines in the mountainous sub-districts than there are elsewhere.

Use and management of oxen

The sample district is typical of much of highland Ethiopia in that draught cattle are crucial to agricultural production. The composition of the cattle herd (which as already indicated is closely related to its function) is such that for much of the year it is non productive not only in the abstract but also in the literal sense. This is because the oxen which comprise the bulk of the herd in both numbers and live weight biomass are used for a limited number of hours on only a few days in the year and are idle the remainder of the time (Figure 1). Compounding this short term efficiency is the long term effect of starting work at relatively advanced ages: oxen training for ploughing starts at an average age of 4.3 years in the range 2–8 years (NEDECO/DHV, 1998) from which it is clear that certainly the oldest group do not have a long productive life. Most feed is thus used for maintenance and perhaps only as much as 15% of the total is used for "production" whether this be generation of draught power, reproduction or growth.

Increases in human population pressure resulting in greater areas under cultivation and thus a need for yet more draught power mean that animals are no longer fed adequately from the available resources. Oxen do receive priority in supplementary feeding of hay and crop residues. The amounts available and their quality are, however, inadequate to mitigate completely the stressed condition of the oxen that is primarily due

6.

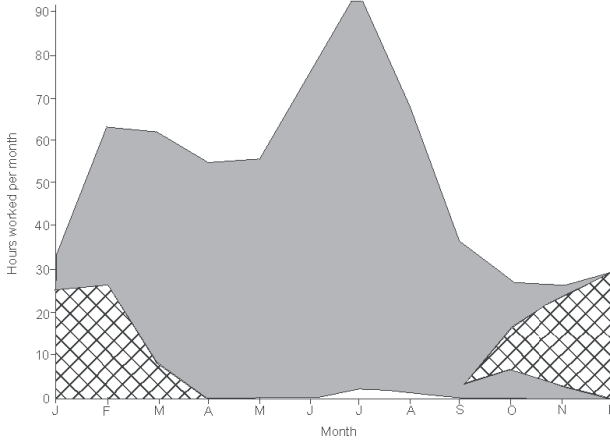


Figure 1: Schematic representation of timing and type of work performed by oxen (Source: GRM, 1994).

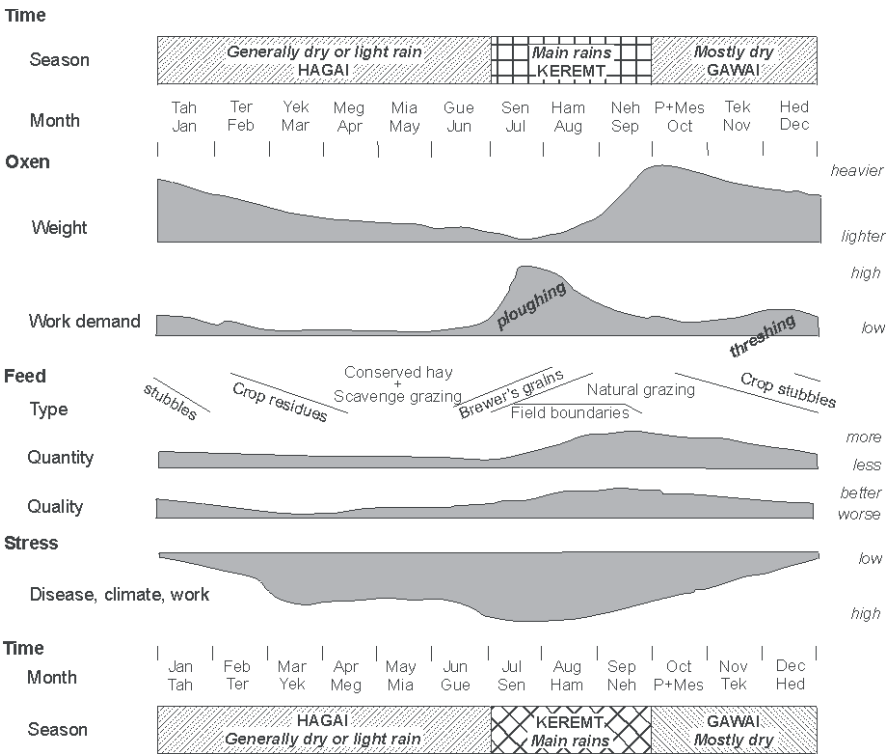


Figure 2: Ecological profile of work oxen in Bugna wereda (Source: compiled by author).

to under and malnutrition that is probably compounded by subclinical disease and the presence of internal and external parasites. Draught animals are thus usually most debilitated at the time of year they are called upon for work (Figure 2). This reduces further their already limited power output due to low body weights (draught power output is directly proportional to body weight). Inefficiency in conversion of feed resources is further compounded by the fact that the average working day for an ox is little over five hours but effective time is reduced by frequent stoppages. In a study in Tigray some 6 hr 46 min of resting time was interspersed in 45 hr 07 min of working time over 11 days so animals were in the field only 4.7 hours/day (Wilson, 1975). An area of 19,990 m² was ploughed in that study at a rate of 26.4 hours or 5.62 working days per hectare per animal pair or 11.24 animal days/ha. That is for a single pass but it is usual to plough three or four times in Ethiopia before sowing thus making the number of oxen day per hectare in the range 35–45.

In addition to the biological constraints to efficient use there are social ones associated in particular with the culture and tradition of the region. Under this scenario even during peak periods no productive work is performed on up to several days of holiday per week enforced for religious reasons. If farmers could be persuaded to use their oxen more effectively the probably 25–30% of total time they work at present could be considerably improved and would reduce the need forever more. Improvements in oxen condition and heavier body weights might allow the use of a single animal for ploughing in some areas on some types of soil. Greater use of cows for work would also increase the efficiency of the whole herd.

Animal numbers may possibly be increasing as a result of the need for power by an increasing human population but any rise in numbers will contribute to a further deterioration in the feed equation. More and more farmers have insufficient draught power (note from earlier that the average ox holding per household is 1.09 whereas at least a pair is needed for ploughing) and food security is thereby diminished.

Share cropping

Several hiring or sharing arrangements prevail in the area which allow some families with no or insufficient draught power to make use of it for ploughing and planting. Share cropping agreements vary widely depending on the need for draught animals and the availability of feed and labour. Common arrangements include: provision of all inputs by the owner of the animals in exchange for a proportion of the yield after threshing; payment by the land owner of a proportion of the grain harvest in return for the use of draught animals; and, provision by the land owner of two days of labour in exchange for one day's draught use. Under the first arrangement the owner of the animals pays an initial fee to the land owner and then provides labour, seed and draught power in exchange for a part of the yield — often as much as half the crop — after threshing. It is usual under this first arrangement for the animal owner to take all of the straw as it is this person who has the animals to feed: it may even be that this type of arrangement is primarily made to ensure the availability of animal feed rather than of human food. Under the second arrangement one quarter to one half of the grain production is paid as the fee. Under the third or labour exchange arrangement the owner of the animals also receives part of the grain harvest plus all of the straw. A possible advantage of the third arrangement is that it allows women to gain access to draught power which might under other circumstances be extremely difficult. In all of these arrangements there are

clear net disadvantages to the landowner which in real terms represent income foregone and reduced household food security for those without draught power. The 'rich' (owning oxen) get richer and the 'poor' (not owning oxen) get poorer.

Discussion and conclusions

Draught oxen contribute to food security and improved livelihoods in the smallholder mixed farming systems of highland Ethiopia. This is an indisputable truth but it is unfortunately not the whole truth.

They certainly contribute to human welfare for those families fortunate enough or rich enough to own them. For other families without or with insufficient draught power the scenario is not so heartening. This second class of family is often poor and the head of the household may be a woman. Their food insecurity can be further compromised by the need to hire draught power or enter into some other share arrangement in order to get their land ploughed. The cost is usually the loss of some and a usually not inconsiderable part of their yield.

Oxen may also affect livelihoods on a broader basis. They are the most numerous class of cattle and the heaviest. Their feed requirements — and for which they often receive priority — deprive other classes of stock of adequate nutrition. Their sheer numbers reduce the overall reproductive performance of the herd because of low numbers of females. They limit herd off-take because they themselves cannot be sold until their working career is finished and there is no room for other classes of stock. They contribute considerably to environmental degradation because of their feed massive requirements and directly through their trampling of the soil on what are very often steep and highly erodible hillsides.

In the context of highland Ethiopia with high human population densities exerting more and more pressure on the fragile natural environments best use must be made of all resources. Oxen are probably not being used in the most effective manner. Improvement pathways lie through better early nutrition to improve growth rates and so shorten the period between birth and effective work, making better use of oxen during working periods by supplementary feeding, improvements in implement design and in harnessing and in the use of a single ox and of cows for ploughing.

References

- Bech, N. and van Waveren, E. (2002). Environmental profile of North Wollo. Working paper of the Ethiopian Environmental Support Project Component 2. Bureau of Agriculture, Amhara National Regional State: Bahir Dar, Ethiopia.
- De Leeuw, P.N. and Wilson, R.T. (1986). Comparative productivity of indigenous cattle under traditional management in subsaharan Africa. *Quarterly Journal of International Agriculture* 26: 377–390.
- GRM (1994). Herd health and productivity monitoring study: final report of findings of three years of observations. GRM International Pty Ltd: Brisbane, Australia.
- NEDECO/DHV (1998). Tekeze River Basin Integrated Development Master Plan Project: Sectoral Reports Volume XV. Natural Resources (Land cover and land use, agriculture, livestock, fishery). Netherlands Engineering Consultants/DHV Consultants: Amersfoort, The Netherlands.
- SC-UK (2001). Wag Lasta Woina Dega Food Economy Zone Baseline Report. Save the Children Fund-United Kingdom: Addis Ababa, Ethiopia.
- Wilson, R.T. (1975). Tigray Rural Development Study; Annex 5, Livestock and Range Ecology. Hunting Technical Services, Borehamwood, UK.

(b) Ethiopia**Assessing the impact of a donkey project on poor women in Addis Ababa****Marina Martin Curran¹***Centre for Tropical Veterinary Medicine, University of Edinburgh, EH25 9RG, UK***Introduction**

Ethiopia has the largest population of donkeys per capita in Africa. In Addis Ababa they can be seen everywhere and at any time of day, carrying sacks of grain and food, hay and straw, or cement and stones. They come into the city in pairs or a dozen at a time. They are found at the market and are hired out to people wishing to have their purchases carried home. Among all this women and donkeys can be seen carrying large bundles of firewood: logs, branches, leaves and twigs (Plates 1 and 2). The women have come as far or further than the donkeys and sell their load for less than £1.

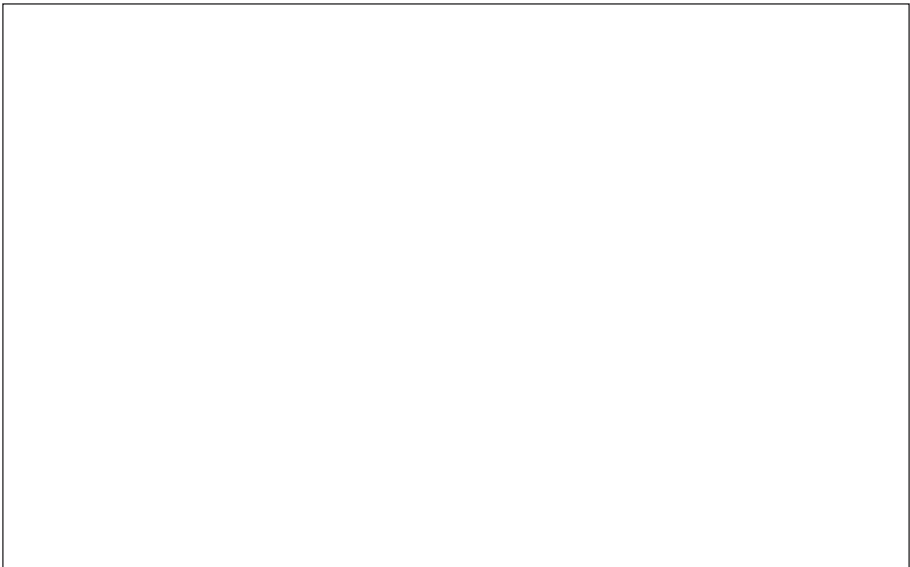


Plate 1: Carrying firewood to market with a donkey in Ethiopia (M.Curran).

In light of this, an Ethiopian NGO, Donkeys for Development Organisation (DDO), purchased and distributed over 350 donkeys to female-headed households in Addis Ababa. Their aim was to relieve the women from carrying the firewood themselves and instead load the donkey. In return, the women pledged to keep the donkey for two years. They received some basic training in donkey health and husbandry. The households selected to receive a donkey were mostly female-headed (no male income present) and had space for a donkey shelter.

Objectives

As part of a DFID Livestock Production Programme project, DDO's project was selected as a case study to investigate how access to donkeys affected people's livelihoods. The

investigation aimed to assess both the impact of DDO's project and to identify livelihood indicators.

Methods

DDO had distributed donkeys over the last 3 years to 388 households in 15 Kebeles (approximately a parish). Sixty-five households were randomly selected from 11 Kebeles. Four Kebeles were excluded because they had only received their donkeys in the last 6 months. A group of 18 households who had not received a donkey were selected randomly from the 11 Kebeles. The Kebeles were situated in the outskirts of the city and on all sides of the city.

The first section of the questionnaire focused on indicators and was open ended. The second section focussed on impact.

Questionnaire to identify livelihood indicators

- 1 Kebele number:
- 2 Household number
- 3 How many people are in your household?
- 3a Household size: 1-3, 4-6, 7+
- 4 Female head
- 5 Husband
- 5a Other adult
- 6 Children
- 7 Ages of children (1-3), (4-8), (9-19), (20+)
- 8 How many go to school?
- 9 How many people in the household are earning money?
- 10 What is your (head of household) main income?
- 11 Do you have any other source of income?
- 12 What other incomes from rest of family contribute to household?
- 13 Which is the most important income?
- 14 What do you spend most of your money on each week?
- 24 Are you able to save? (icoop)
- 24a Are you able to contribute to funeral scheme (idir)?
- 15 What type of food do you buy?
- 16 How many kg of tef do you buy at once?

Plate 2: Ethiopian lady carrying goods to market (M.Curran).

- | | | | |
|----|---|----|--|
| 17 | Are you a DDO beneficiary? | 25 | Do you grow any vegetables? |
| 18 | Do you have any other livestock? (including poultry) | 26 | Do you have any DDO trees? |
| 19 | How do you know how well your neighbours are doing? Cite indicators | 27 | Do you have access to healthcare? |
| 20 | They live like me | 28 | Do you use traditional medicine? |
| 21 | They do better than me | 29 | Do you have access to animal healthcare? |
| 22 | I do better than them | 30 | Do you use any traditional medicine? |

Questionnaire to identify impact of donkeys on livelihoods

- | | | | |
|-----|--|-----|--|
| 31 | Does informant have donkey? | 52 | How do you charge? (a) distance, (b) weight/vol, (c) time, (d) percentage it makes? |
| 32 | When did you receive the donkey? (months) | 54 | Is the contractor responsible for feeding the donkey? Yes/no
Has your life changed since you've had the donkey? |
| 38 | Do you use your donkey? | 55 | What is the main change? |
| 39 | Does someone else use the donkey? | 58 | Is there a constraint to owning a donkey? |
| 40 | When you use the donkey, what do you use it for? | 58a | What is the constraint? |
| 41 | Do you use it to carry firewood? | 59 | Would you recommend other people like you to own one? Why?
If informant has no donkey... |
| 42 | Do you use it to carry pots? | 60 | Has your life changed in the last 1–2 years? |
| 43 | Do you use it to carry water? | 64 | For both beneficiary and non-beneficiary: How do you rate your life now compared to 1–2 years ago? |
| 44 | Other | | |
| 45 | How often do you use donkey? 5–7 days a week (5), 3–5 days (3), 1–3 days (1)
If someone else uses the donkey: | | |
| 51 | Do you hire out your donkey? | | |
| 51a | Do you hire to (a) contractor, (b) load for others? | | |

Indicators

In order to assess the impact that the donkeys had on the households, it was first necessary to identify livelihood indicators that were appropriate and relevant to the people being interviewed. The informants were asked about the kinds of food they ate and purchased regularly. All ate tef, wheat and maize, tef was the most favoured staple, and then wheat and least favourite was maize. Maize was considered to be a very lowly foodstuff. Very few people ate meat, as it was expensive. Informants who bought tef were asked how many kg there were able to buy in a single purchase. The amounts varied from 2kg to 70kg. People preferred to buy larger quantities when possible.

In Addis Ababa, government schools are free. Most households sent their children to school except for a few who needed their children's labour to assist them in their daily chores and in making a living. Therefore the number of children at school was a useful indicator. Other useful indicators were the ability to save. Two schemes were available; one was a conventional saving scheme for saving money for goods. The other was more of an insurance scheme, people paid money into a scheme that would cover their funeral costs.

Some of the Kebeles visited were up to 15km from the city centre and were quite rural, indicators such as ownership of livestock and land were found here, whereas in the more urban Kebeles predominant indicators were permanent jobs and salaries.

The investigating team noted the aspect of the homes that were visited with a view to developing indicators based on the materials that the houses were made from (Plate 3). In rural areas, better off households were built from stone rather than from mud. In urban areas, better off households had tin roofs rather than thatch.

Impact of donkeys

The beneficiaries used the donkeys in different ways, some used them in the way that DDO had intended: the donkeys carried the firewood and other loads instead of the women. Some women hired out their donkey to a contractor. This provided the women with a regular monthly income, others went to the city and carried loads for other people and charged based on the weight of the load and the distance carried. In some places the donkeys accompanied the women to the woods and were loaded up in the woods. In other cases, the women and children loaded themselves with firewood and only burdened the donkey on market day. Some people did this because they didn't want to wear out their donkey; others said it wasn't safe to take the donkey to the woods as it was at risk of being stolen.

The beneficiaries unanimously thanked DDO for having provided them with a donkey. The majority felt that their lives had improved since owning a donkey; they felt more secure and were better off. They measured this in several ways: they were able to save, they always had food in the house, they were able to buy larger quantities of tef, and some were able to release their children from household chores and send them to school. Some said that they were saving to buy a second donkey, others were saving to buy other livestock, sheep and cattle mostly.

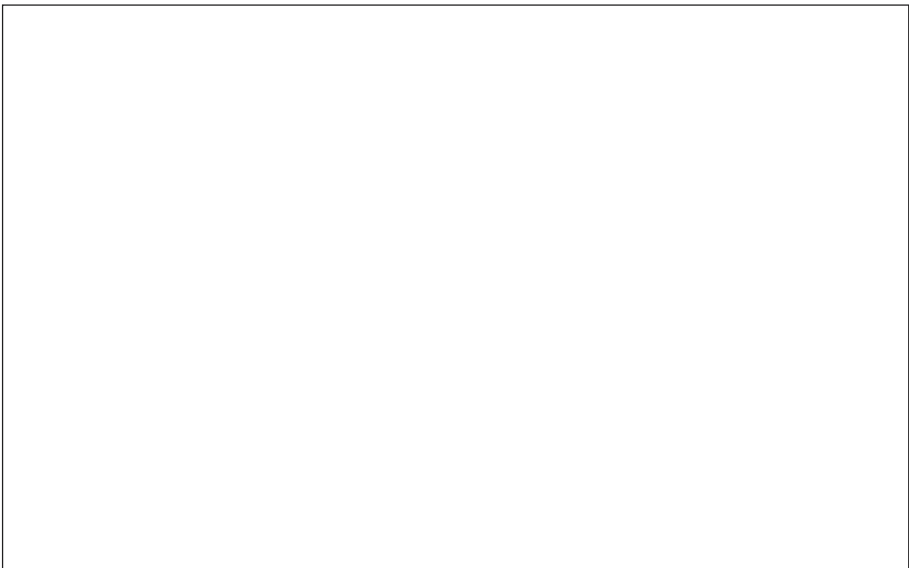


Plate 3: Stone house, thatch roof in Ethiopia (M. Curran).

Table 2: Summary results of the impact of donkeys on respondents.

Indicator	Beneficiary	Non-beneficiary
Type of food eaten	Trend to eat more tef	Trend to eat more wheat and maize
Weight of tef bought	Trend to buy more tef	Trend to buy smaller quantities of tef
Ability to save	No significant difference	No significant difference
Ownership of livestock	No difference	No difference
Rate life	Better off	Not better off
Number of children at school	More children at school	Less children at school

Some beneficiaries felt little benefit from their donkey; they said that there wasn't enough work for the donkey in their neighbourhood. This was because there wasn't enough wood available to gather (chopping trees is not allowed) or because the rainy season (interviews were held at the end of the rains) made paths impassable.

Conclusion

The locally identified indicators such as the type of food eaten, the weight of tef bought and the ability to save helped the investigating team to assess the impact of the DDO donkey project. The project had a positive impact on the lives of the households: they were able to eat more tef and buy larger quantities, they were able to send more children to school and generally rated their lives as better than before the project.

(c) Kenya

Sustained utilisation and welfare of work donkeys for Kenya

Fred Ochieng Oluoch

Kenya Network for Draught Animal Technology (KENDAT)

1. Introduction

'Sustained Efficiency of Utilisation and Welfare of Work Donkeys in Kenya' is a 3-year Brooke Hospital for Animals (BHA) funded project that is addressing animal misuse (painful use) and low work efficiency of donkeys due to poor harnessing, overloading and heavy and poorly designed carts. The project is being implemented in two regions: Kirinyaga/Mbeere (Mwea) and Lari/Limuru areas.

The KENDAT/BHA project aims to:

- improve the image of the donkey in the project areas and Kenya as a whole
- train users to love and care for their donkeys
- provide for comfortable use of donkeys through improved equipment, accessories health and nutrition
- enhance the use of donkeys in transport operations currently borne by women and children

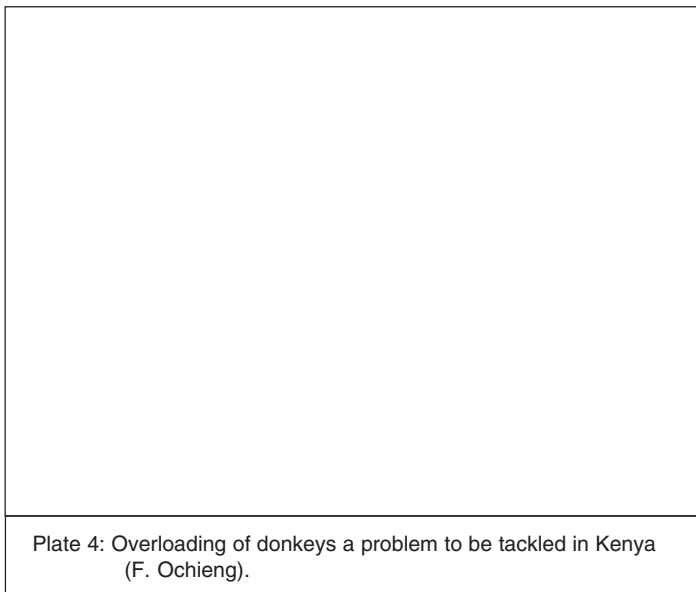
2. Situational assessment

2.1 Donkey welfare and utilisation

In both Mwea and Lari/Limuru areas of Kenya donkey welfare is solely in the hands of users. Many donkey owners more often hire their donkeys out to others to use. In such cases, they are strictly used to generate money, working for up to 12 hours a day and

only freed in the evening to browse and find their own resting-place. Common sights are donkeys feeding on garbage while others stay next to main roads. It is not surprising therefore that as useful as they are, donkeys do not get the love, respect or welfare that is cognisance with their work contribution.

In market centres such as Wang'uru in Mwea and Nyambare in Limuru, many donkeys are hired by young men who operate them for days or weeks, without the owners caring how their animals are being treated. These donkeys are worked for long hours without food or water, often overloaded (Plate 4), worked too young (Plate 5) caned profusely and even slashed by ignorant or insensitive users.

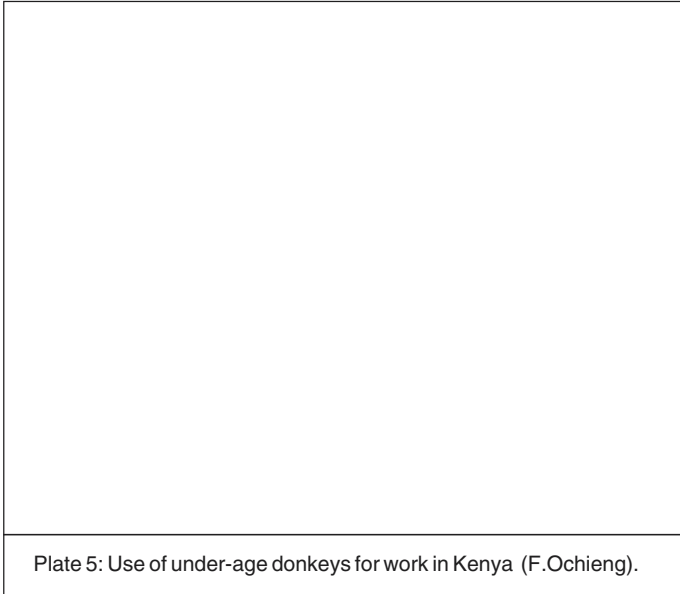


2.1.1 Peoples attitudes towards donkeys in the project areas

In one of the field days in Soko, Lari area, a villager (a Mr. Njoroge) remarked to a KENDAT staff member: *“instead of you struggling to better the lives of donkeys, why don't you help me take care of my two sheep which are sick. At least those (sheep) are food; these (donkeys) are work animals and nobody cares much if they die. In fact a donkey is only yours as long as you get work, - a lot of work from it.”*

The above statement edifies the common attitude of people towards donkeys. The animals, which are overworked yet underfed or starved, are more prone to tropical infections and diseases than health well managed animals. Once donkeys are unable to haul carts, owners abandon them to die. The situation is worse among urban than the rural users. The aggressive young donkey operators are unfriendly and cruel, and in turn their donkeys are vicious, kicking and biting to ward off misuse.

This problem reflects much not on the donkey but the owner/user. Nonetheless, in both project areas, owners and/or users concurred that there is a need to change the



attitudes and ways in which donkeys are handled. This, to KENDAT, is a good beginning.

2.1.2 Existing equipment and harnessing systems

Most donkey-drawn carts are unbalanced, crude and too heavy. These carts are mainly manufactured by artisans who have not undergone any training on good cart design and manufacture. Where skilled artisans are involved, they have compromised on quality to attract more customers who are always seeking low prices. Even load distribution is an issue often ignored by transporters, particularly those using more than one donkey. Most local carts therefore need extra shafts and extra harnesses.

Most common harnesses in Lari/Limuru areas are neck straps without any saddle or breeching straps (Plate 6). Neck straps overload the donkeys' necks and more so on hilly areas. In Mwea, most transporters use chain on wood saddles with little padding (Plate 7). Most transporters sit the saddles above the front legs so that it can do both the jobs of pulling and carrying the vertical load. In many cases, rubber tubes are used as padding placed directly on the donkey's skin. All these harnesses are permanently attached to the carts and are never washed to remove mud or sweat.

2.1.3 Present donkey management and health issues

Donkey users in Mwea use whips. They believe that a donkey has to be caned to work. No donkeys have ever undergone any training to obey commands. They are whipped during training and after. Users believe that when overloaded and unable to haul the load, whipping will make them move. Users seem to need to be reminded that a donkey has a limited capacity of load. And they do not understand that their ill-fitting harnesses cannot adequately tap the power of these hard working animals. Most donkeys have

16.



Plate 6: Neck straps used for harnessing carts to donkeys in Lari/
Limuru, Kenya (F.Ochieng).

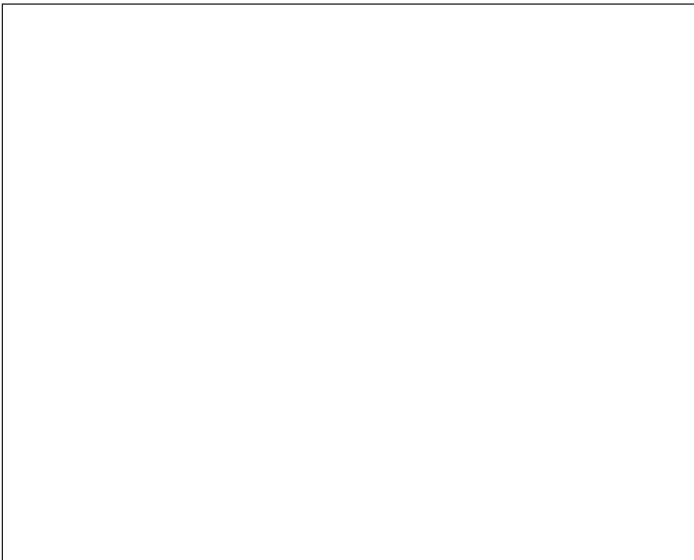


Plate 7: Wooden saddles used on donkeys in Mwea, Kenya
(F.Ochieng).

sores and wounds from whips, and lesions wherever collars put pressure on their necks and backs. The situation is worse in Lari/Limuru areas where the harnessing is worse.

The management and health issues, thus, to be addressed were agreed with beneficiaries as:

- donkey training for work
- feeding and watering of donkeys
- comfortable and affordable harnessing systems, light carts and other equipment
- power output of a comfortable animal
- disease control and prevention
- deworming, hoof trimming, etc.

2.2 Existing support groups and their interventions

2.2.1 Community groups and associations

The main community association in Mwea area is the Water Transporters Association. The association so far has had very little to offer on the side of improving the image of work donkeys. Other transporters (rice and village) have no associations or groups and everything revolves around individuals.

There are enthusiastic farmers and women groups in Lari/Limuru areas, though without much focus on donkeys. Four individuals have been trained in the Limuru by KSPCA on donkey management practices such as deworming and hoof trimming.

2.2.2 Charitable groups

The Kenya Society for Protection and Care of Animals (KSPCA) has worked in both regions for a long time, caring for sick and injured donkeys, however the impact is difficult to see as the society has not had constant presence in these regions, which is important for any change to be effected.

Christian Community Service (CCS) of the Anglican Church in Kenya has worked in Mwea for years but with little focus on donkey welfare and health. However, their continuous presence in the area together with a contact-farmers network is quite a boost to our collaborative efforts.

3. Project promotion and activities

3.1 The 'Heshimu Punda' project

During training, the trainees suggested that the project be called: **Heshimu Punda**, meaning 'Respect Donkeys' in Kiswahili.

3.2 Community mobilisation and sensitisation

KENDAT staff went round the project areas introducing and sensitising the communities and other stakeholders about the project. Several informal visits were made to market centres during market days in order to meet people and introduce the KENDAT/BHA project. Meetings were organised with charity organisations such as KSPCA and CCS (Mwea) and the Ministry of Agriculture and Livestock Development (MoALD), which are already in the project areas, for collaboration and partnership. Three schools were visited in Lari/Limuru seeking their involvement in the project. There are plans for more meetings and visits towards involving a larger cross section of stakeholders in the project. Further community mobilisation and sensitisation was conducted during field days.

A total of five KENDAT approved collar harnesses were placed with selected transporters (two in Mwea and three in Lari/Limuru areas). The selection of transporters in Lari/Limuru areas was done with the help of the MoALD staff, while in Mwea, Water Transporters Association assisted in the process.

3.3 Veterinarian support and stockist

Two pharmacies/chemists in Mwea and Soko were approached to be KENDAT's local outlets and stockists of drugs/medicine that may be required by donkey owners/users. Dr. Jane Mutungi, a Veterinary Officer of the MoALD, who runs Highrise Agroveter in Mwea agreed to be the local stockist. In Soko, KENDAT has an agreement with Kijabe Agroveter, run by Drs Samuel Gathuka and Peter Waithaka, as the local stockist. These pharmacies will also stock a range of equipment and harnesses for demonstrations and sale.

There will be two animal health assistants (AHAs), each based and resident in Kirinyaga/Mbeere and Lari/Limuru areas. They will be the project voice, back all activities and provide veterinary support. KENDAT's veterinary doctor will respond practically to donkey health issues, training of users and animal health providers for humane use, health management and husbandry. The vet will also effect a donkey health programme and manage AHAs in the project areas.

3.4 Training programme

All training sessions started with the trainees introducing themselves and giving a brief history of their association with work donkeys. They explained how they engaged themselves working with and their future projection with donkey.

The training was opened by mind-boggling questions on the use of donkeys, leading to expectations of the course. The responses for the two areas, which were discussed in plenary, are summarised as follows.

(a) What are the good things that the donkey is associated with?

- brings in money
- easy to keep
- few health problems
- does heavy work – carrying and ploughing
- does household work
- is calm
- grows/matures quickly
- very intelligent
- produces manure

(b) What good things does the owner of the donkey reciprocate with?

- feeding foliage
- watering
- giving special food, eg bran, maize
- deworming (every three months)
- protection from harm, tsetse flies
- providing sheds (some people in Lari)
- allowing to rest (after good work)
- trimming hooves

NB: It was observed that very few owners give their donkeys the above reciprocate treatment – good points for discussion were therefore raised.

(c) What are the bad things or omissions on the part of the owner?

- caning
- setting loose (donkeys wander in people's farms and are slashed, bitten by dogs and even poisoned!)
- not feeding well
- not watering well
- not deworming regularly
- abandoning when not productive at work due to disease, age or injury
- overloading
- no sufficient rest (some eat grass when still loaded)

(d) *Are there bad things from the donkey's side?*

- stubborn donkeys (some kick and bite)
- lazy donkeys
- danger of tetanus from their dung

(e) *What are your expectations from this course?*

- learn better ways of donkey care
- be able to sustain good health of the donkeys
- protection from infection with tetanus
- causes of blindness will be learned
- gain experience and expand scope of work with donkeys
- learn better ways of using the harness and neck yoke
- solve donkey problems easily
- learn about donkey parasites and diseases.

(f) *What are your expectations from the project?*

- free or subsidised medicine
- road signs/billboards be installed to warn motorist and hence reduce the many accidents.
- advancing beyond transport to tillage
- assistance to buy carts
- awareness sustained
- sensitisation of government transport departments to respect donkeys rights
- of way on the roads (anytime there is an accident involving a donkey the owner of the donkey is always assumed to be on the wrong)
- acquire better built carts
- training in making of puncture proof tyres
- provision of medical services
- training in making of harnesses

The contributions from the trainees were very useful in giving the background knowledge so that the training was from known to unknown – this being the basic principal of learning/teaching.

The expectations were compared with the aims of the project and this served the crucial purpose of giving the people what they desire most. It made them feel that the project was designed to meet their needs and therefore felt attached to it.

The training methodology was that of lectures based on handouts and demonstrations. Lecturers were orally translated to Kiswahili for ease of understanding and consumption. The trainees were later asked to evaluate all the training sessions (see later). This is also important in planning for similar sessions in future. Any visiting consultants were also asked to give an assessment on what they thought of the training (scheduling, trainees, gaps, strengths) and the field days and any other general observations.

3.5 Schools' component for the project

A number of schools have already been approached to seek their views on how best to involve students in the project. The month of August coincided with school-holidays. This would have been a useful time to bring school pupils to field day. The team for this aspect spent time planning for the new school term. It is a well-known fact that children have open minds and learn quickly when new ideas are presented in the right manner. When practical methods are properly applied using concrete objects, the ideas can be engraved in their minds for a lifetime.

To sustain efficient use and welfare of work donkeys; KENDAT will start with primary school pupils and spread the knowledge and skills to the wider society. This programme has two key aims:

1. Create sustained awareness among primary school pupils. In Kenya 53% of primary school pupils do not proceed with their education to secondary schools. They drop out and join the other members of the community. It is established that primary class pupils have been involved in handling and working with donkeys; hence they seriously and essentially need the awareness.
2. Transfer knowledge and skills acquired, by collaboration, from the pupils to their parents, guardians, neighbours and other children. Young people are usually enthusiastic when involved in interesting activities. They will participate in field days through presentations of poems, talks and exhibitions. An art competition titled “what good my donkey does for me” will be conducted between selected schools.

NB. The school system in Kenya is one of intense competitions in all aspects of life; including academic performance, games, music, drama and science congress.

The programme is therefore designed to exploit this well-established behavioural aspect of Kenyans. When the programme is carried to its end, many people will have been influenced positively and this will assure better care of work donkeys in future.

Donkey clubs will be formed in each school and through their activities sustained awareness will be perpetuated in the community.

Sensitisation will involve:

- | | |
|----------------------------------|-------------------|
| (a) Division education officials | (d) Pupils and |
| (b) School head-teachers | (e) Collaborators |
| (c) Contact teachers | |

4 Lessons learnt

The owners and/or users as well as artisans are willing to work together and co-operate in order to better the donkey working and living environment. Some of the roles they identified as their own include:

- Ensure proper/recommended harness is in place while working with the donkey
- Ensure donkey’s comfort at work
- Stop whipping donkeys
- Ensure donkey feeds well in clean troughs
- Stop overloading
- Ensure the cart is in good condition and light for the donkey
- Ensure proper medical attention is called for whenever the donkey is unwell
- Ensure the donkey receives correct training and not whips.

These commitments from owners/users may be ‘easier said than done’ but it is no doubt a step in the right direction. It may take a bit of time but is worth the wait.

Through discussions and deliberations with the trainees, the following were identified as suitable project roles and interventions:

- Training donkey users/handlers to be better users
- Improving harnesses focusing on donkeys comfort at work
- Improving carts to increase efficiency in workload
- Training of the youth who are regular and future donkey owners and users
- Training women who benefit much from the donkey’s assistance in domestic chores/duties (transport and tillage)
- Exposure to available options
- Creating publicity regarding the donkey as an important tool in our day to day living
- Creating good image of the donkey within the community

- Providing all the comfort needed for the donkey during work
- Information liaison between trained and untrained users and experts
- Disseminate and practice what is good in this field.

There are other issues that KENDAT was requested to facilitate for better impact of outputs. These include:

- Improvement of donkeys through cross-breeding for stronger and bigger donkeys
- Formation of clubs 'Donkey care clubs'
- Public awareness
- Home visits to all donkey owners
- Rules and regulations on the treatment of donkeys
- Involve local chiefs and other leaders and the police on crusades for proper donkey care
- Organising seminars and workshops in schools
- Put more emphasis on women and children's use of the animal because they are the ones who use it most
- A few users to be trained on hoof training and issued with trimming kits to assist the farmers/users at a nominal fee
- Training in harness making.

ASIA

(a) India

Camel versus bullock carting and it's economics in the hot arid region of the Thar Desert.

C. Bhakat, D. Chaturvedi and M. S. Sahani

National Research Centre on Camel, Bikaner – 334001, India

Abstract

A survey was conducted on various aspects of camel and bullock carting systems which involved four different Zones (north, south, east, west) of the Thar Desert. An economic study of both types of carting systems was undertaken making use of the linear programming method. The average working life of a camel was higher compared to bullocks used for carting. The average life of an animal-drawn cart was almost the same for bullock and camel carts. The average daily income from camel carting was higher (about 22%) than that for bullock carting. The total distance covered per day by a camel cart (21.4 ± 6.55 km) was greater than that of a bullock cart (14.9 ± 5.50 km). The camel carting required a higher investment in terms of interest rate, depreciation rate and expenses towards insurance. The overall total fixed cost was higher in camel carting than in bullock carting. In the case of bullocks the total annual expenditure for shoeing came to Rs. 800 / - where as it is not required for camels. The total variable cost was higher in bullock carting than in camel carting. The average yearly maintenance cost of an animal was around Rs15330/- and Rs14965/- for a camel and a bullock, respectively. The total expenditure for both type of carting was almost equal, but total earning and profit from camel carting was higher compared to that in bullock carting. It was evident that due to a shorter pay back period and a higher benefit : cost ratio camel carting was more profitable than bullock carting for small and marginal farmers in the hot arid Thar Desert.

Introduction

Animal carting provides a gainful source of employment and a regular flow of income to the farmers and other livestock owners in society. The complementary connection between the crop sector and draught animal power adds to the importance of maintaining draught animals. Agriculture and draught animal power go side by side in assisting farming business into a profitable enterprise. Heifer Project International (HPI), a private non-profit making NGO has been assisting tribal minorities who seek gainful employment using camels to transport agricultural and industrial products (Robert *et al.*, 1997). In Rajasthan the main population of draught animals are bullocks followed by camels. The camel, known in many places as the “Ship of the desert”, is better adapted than the bullock for survival in the desert. For instance cattle in the central desert of Australia with daily ambient temperatures of 40°C were reported to have died without water in four days while camels survived for more than 15 days in the same environment. Camels can tolerate high temperature, solar radiation and water deprivation and subsist on poor quality thorny vegetation. Since 85% of the gross cultivated area of the Bikaner district is rain-fed, camel carts have potential for making money (Amresh Kumar, 1999). Camel energy may not only be cost effective, but also be profitable and remunerable. The main characteristic features and economics of camel and bullock carting were studied to find out the economic viability of both types of carting systems.

Materials and Methods

Data collection: Using survey techniques, a comparative data were recorded on various aspects of camel and bullock carting systems. Systems using the single camel wooden carts with two wheeled pneumatic tyres (Plate 8) and single bullock wooden carts with two wheeled pneumatic tyres (Plate 9) were studied using a pre-tested questionnaire.

Sampling procedure: The study involved a total of four tehsils within Bikaner district. These comprised four different zones of the Thar desert, viz: Nokha tehsil (south zone) Lunkarensar tehsil (north zone), kolayat tehsil (west zone) and Bikaner tehsil (east zone). A total of 140 camel cart keepers and 119 single bullock cart keepers were randomly considered for data collection. The selection of respondent was carried out using the multistage stratified random sampling technique.

Economic analysis: The economics of both type of carting system were analysed by using linear programming (Loomba, 1992). To obtain the estimates of maintenance cost of animal (feeding and health cover) and carts, the opportunity cost of owned inputs and actual prices paid by the farmers for purchasing inputs were considered. To work out the total earning and expenditure from different sources of farmers, present day value and market prices were considered.

Results and discussion

The mean values (\pm standard error [s.e.]) of some characteristic features of camel and bullock carting are presented in Table 3. Animal-drawn carting system are common in the hot arid Thar region for all kinds of material transport to and from nearby villages to the cities and within the cities and towns. Both type of animal keepers transport different materials including crop harvest, crop residues, grain bags, fuel wood, fodder,

23.

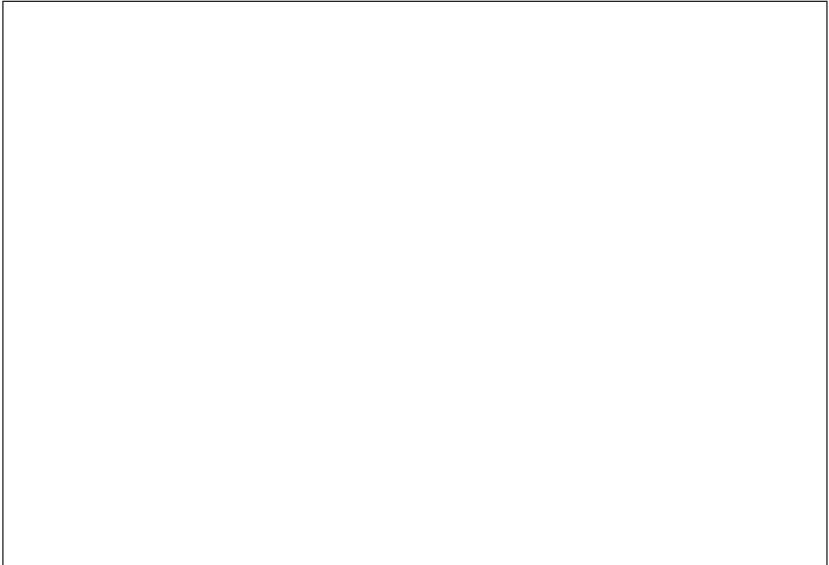


Plate 8: Single camel cart in Rajasthan, India (A. Pearson).

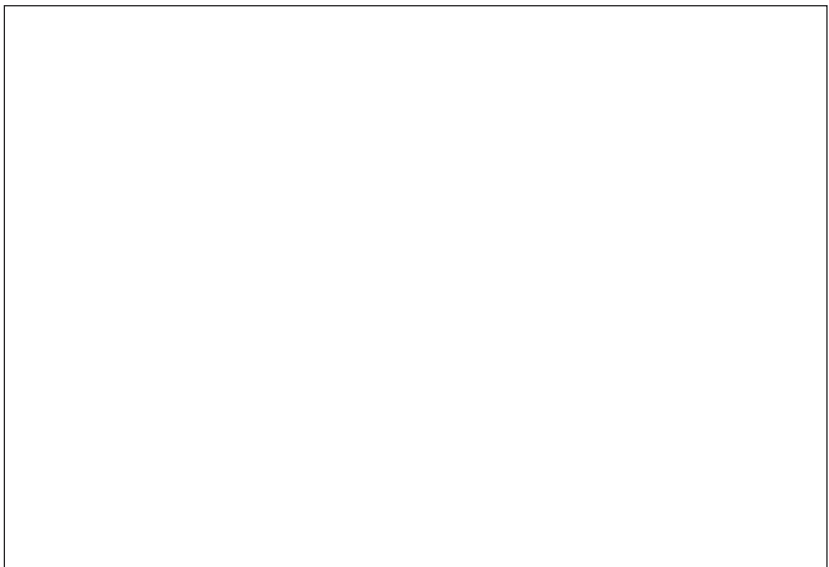


Plate 9: Single ox cart near Delhi, India (A.Pearson).

bhusa, water, gas cylinders, synthetic yarn and building materials. Saley (1993) reported that the main objective of camel rearing in Rajasthan was to meet the demand for animal power for pulling a cart. The two-wheeled pneumatic tyre wooden cart is made up of sheesham, babool, neem, desi sagwan. The average working life of a camel (14.5 ± 0.50 years) was higher than that of a bullock (10.0 ± 0.66 years) used for carting operations where as the average life-span of the animal-drawn carts were almost identical at about 11 yrs (Table 3). This supports the findings of Jain *et al.* (2000). Most farmers personally involved themselves in carting operations in both cases. But a few also kept some hired labourers to work in carting for them. The average cost of a camel cart was about 17% higher than that of a bullock cart. Most farmers preferred their male camel (96.4%) rather than female (3.6%) for carting operations. This agrees with previous observations (Bhakat and Sahani, 2000). The average working days in a year were very similar in both type of carting system (Table 3). The average working time for male camels was 9.3 ± 2.11 hr/day and for female camels was 8.0 ± 3.00 hr/day. For bullocks it was 8.7 ± 2.50 hr/day. The average weight / load carrying on a bullock cart (8.0 ± 4.11 quintals) was lower than that carried on a camel cart (14.5 ± 4.89 quintals), although a wide range of age of camel and bullock were used. The average ages of camels and bullocks used in carting were 7.5 ± 2.42 years and 5.9 ± 1.74 years,

Table 3: Mean \pm S.E of characteristic features of camel and bullock carting systems.

Parameter		Camel Carting (N=140)	Bullock Carting (N=119)
Working life of the animal (yr)		14.5 ± 0.50	10.0 ± 0.66
Life-span of the cart (yr)		10.7 ± 1.75 (9–12)	10.9 ± 1.16 (9–12)
Cost of animal (Rs)	Male	$9,500 \pm 279$	$5,672 \pm 488$
	Female	$8,860 \pm 365$	NA
Cost of cart (Rs)		$10,500 \pm 300$ (8,500–12,500)	$8,680 \pm 450$ (6,500–10,700)
Weight carrying by cart (per trip) (Quintal)		14.5 ± 4.89 (10–20)	8.00 ± 4.11 (4–12)
Age of cart animal (yr)		7.5 ± 2.42	5.9 ± 1.74
Working days in a year		240.6 ± 5.86 (235–246)	236.4 ± 8.78 (227–245)
Working time of cart animal (hrs/day)			
	Male	9.25 ± 2.11	8.65 ± 2.50
	Female	8.00 ± 3.00	NA
Total income per day (Rs)		255 ± 3.50	200 ± 3.00
Number of trip/day (km)		3.66 ± 1.25	4.25 ± 1.89
Distance covered/day (km)		21.45 ± 6.55 (15–28)	14.85 ± 5.50 (9–20)
Carrying cost of each grain bag (rs)		3.87 ± 0.50	5.22 ± 0.74
Number of bag carrying / round		18.00 ± 3.50 (15–21)	9.00 ± 2.58 (7–11)

Figures in parenthesis indicate the range value of parameters.

respectively (see Figure 3). The average daily total income from camel carting was estimated to be higher than that for bullock carting. Camel carts covered an greater average distance (21.5 ± 6.55 km) per day compared with bullock carts (14.9 ± 5.50 km). The average number of grain bags transporting per round were greater in camel carting (18.00 ± 3.50) than in bullock carting (9.00 ± 2.58) operations. Hence the average estimated carrying cost of each grain bag was less on a camel cart than on a bullock cart. Most of the farmers purchased their draught animals as well as their carts on cash payment followed by instalments and loan basis. The analysis of fixed, variable cost and economic estimate are given in Table 4.

The camel cart required higher interest on investment than the bullock cart. The depreciation on a camel cart was also high compared with that on a to bullock cart when the scrap value of a wooden cart was considered at 10% of average initial cost. The expenditures for insurance of camels was some what more than that of bullocks, when premium rate was considered at 5% of average initial cost, along with overall service tax at 5%. The insurance charges for carts were estimated to be higher in camel than in bullock carting operations. Here various subcomponents like basic value (Rs 30 /-), liabilities (Rs 5 /-), 1% of average actual value of cart along with 5% overall service tax were considered. The overall total fixed cost was high in camel carting than bullock carting due to a higher initial investment. The different components of variable cost were considered on a yearly basis. The repairing and maintenance cost of a camel cart was high compared to that of a bullock cart, when repairing of tyre puncture, replacement of tyre and repairing/replacement of different body parts etc. were considered. The expenses towards yearly maintenance (feeding and health cover) of camels and bullocks were almost the same. The bullocks which were used in the city needed to be reshod 1–2 times per month. The total variable cost was observed to be higher in bullock carting than in camel carting mainly because of this shoeing component.

Table 4: Analysis of fixed, variable cost and economic estimates.

Expenditure (Rs)	Camel Carting	Bullock Carting
<i>Fixed cost (F.C.)</i>		
Interest on investment (@ 9%)	1,800	1,292
Depreciation of cart	885	720
Insurance on animal (@ 5%)	499	298
Insurance on cart	147	128
<i>Total F.C.</i>	<i>3,331</i>	<i>2,438</i>
Variable Cost (V.C.)		
Repair and maintenance of cart	1,550	1,450
Wages of operator (@ RS. 80 per day)	19,245	19,714
Maintenance of animal	15,330	14,965
Shoeing (@ RS. 50 for 8 iron plates)	0	800
<i>Total V.C.</i>	<i>36,125</i>	<i>36,929</i>
Economic estimate		
Total expenditure (Rs)	39,456	39,367
Total earning (Rs)	61,345	47,284
Profit (Rs)	21,889	7,917
Pay back period (Year)	0.91	1.81
Benefit:cost ratio	1.55	1.20

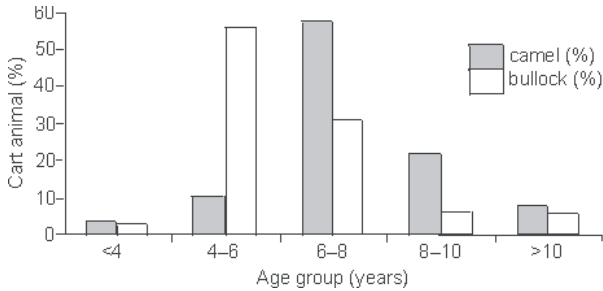


Figure 3: Various age group of cart animal

Shoeing was not required at all for camels due to the anatomical structure of the foot pad. Camels have soft elastic feet surrounded by thick skin, which is good for travel over sandy terrain. The total expenditure for both type of carting system was almost equal, but total earnings from camel carting were higher than in bullock carting. A similar pattern was found in the case of profit. The pay back period was almost double in bullock carting as compared to camel carting, whereas the Benefit:Cost Ratio was for a third of the time higher in case of camel carting as compared to bullock carting.

Conclusion

The idea of sustainability of agriculture and livestock production revolves around better Use of time, money, resources and family labour of the farmers. The main advantage of this study was to create awareness among the farmers regarding the advantages of camel carting over the bullock carting. To ensure a regular income and sufficient food for farmers and better living standards, it is necessary seek the enterprises which will provide more income and employment to the youth of farmer's family. Such enterprises include camel carting over bullock carting. The camel holds a practical value for cost effectiveness, sustainable, environmentally friendly and socio-culturally acceptable. In fact camels are the life-line of the rural population in many of the remote villages of the Thar desert. The study concluded that due to the relatively shorter pay back period and higher benefit : cost ratio camel carting was more profitable when compared with the bullock carting for the smallholder dry-land farmer in the hot arid Thar desert

References

- Amresh Kumar (1999) Potential Linked Credit Plan. National Bank For Agriculture and Rural Development, Bikaner Distt, Bikaner P-21.
- Bhakat Campak and Sahani, M. S. (2000). Camel carting: a subsidiary source of income of camel keepers in the hot arid Bikaner District of Rajasthan. *Indian Journal of Animal Production and Management* **16** (1): 7-9.
- Jain, S., Garg, R. and Bhatt, Y.C. (2000). AICRP on increased utilisation of animal energy with enhanced system efficiency. Paper Presented at Annual Workshop at AAI, Allahabad: April 10 -11, 2000.
- Loomba, N. P. (1992). Linear programming – an introductory analysis. Lehigh University. United Stated, New York.
- Robert, K.P., Danuiel, G.J., Chandra, B. and Kinsey, E. (1997). Camels for socioeconomic development in India and Tanzania. *Journal of Camel Practice and Research* **4** (2): 119 -121.
- Saley, M. (1993). Survey of draught camel for carting in an Indian desert town Bikaner and investigation of draught performance of Bikaneri camel, NRCC, Bikaner, India: 66 pp.

(b) India**Blood gases, acid-base and physiological indices in donkeys as pack animal*****Yash Pal, S. Kumar and A. K. Gupta****National Research Centre on Equines, Haryana, India***Abstract**

In India, donkeys are mainly used as pack and cart animals for transport of bricks at brick-kilns, transport of clothes by washermen, and pots by pottermen and transport of goods over short distances. Five apparently healthy adult donkeys were used as pack animals to study the effect of pack load on the donkeys. Donkeys were packed after proper training with a load equal to 50% of their body weight and were used under two different work schemes i.e. continuous work (4 hour) and work-rest cycle (2 hour work followed by 1 hour rest and again 2 hour work). Rectal temperature (RT), pulse rate (PR) and respiration rate (RR) were recorded just before work (0 hour) and after the completion of each work and pause. Venous blood was collected for assessment of blood gases and acid-base status before and after work. Values of RT, PR and RR were significantly higher just after the work than the control values during both work-rest cycle and continuous work, however, percent change in these physiological responses were appreciably higher in donkeys under continuous work as compared to work-rest cycle. Further, certain fatigue symptoms *viz.* unwillingness to continue operation, legs uncoordinated and excitement were observed only in the animals working continuously for 4 hours. The donkeys exhibited a fatigue score of 10 and 2 out of 16 point score during continuous and work-rest cycle, respectively. This study revealed that for 50%

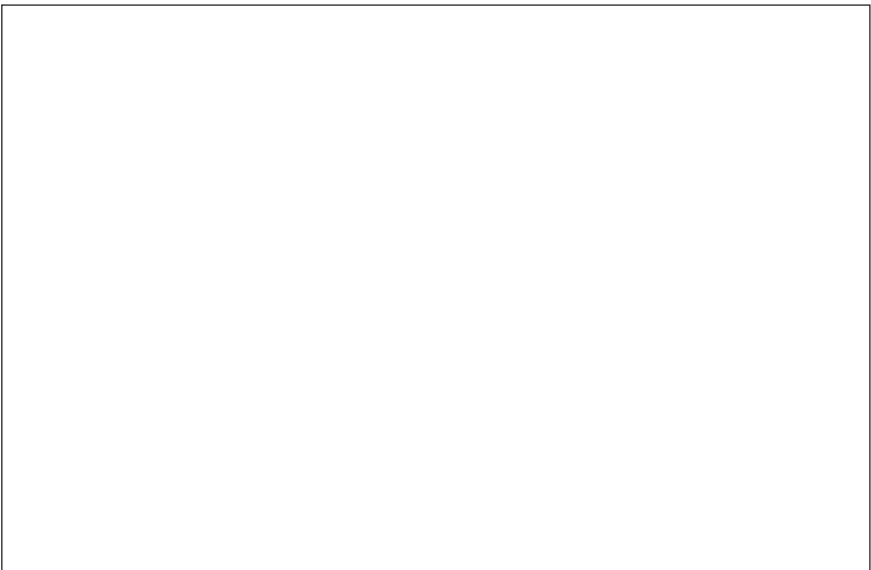


Plate 10: Pack donkey working in a brickkiln, Delhi, India (A.Pearson).

pack load, work-rest cycle seems to be better than continuous work as the intermittent rest in between work reduced the stress on the animals.

Introduction

The overall population of equids has decreased over the last two decades in India, however the population of donkeys has remained almost constant during this period (Livestock Census, 1992). This illustrates the continued value of the donkey as a draught animal, in spite of mechanisation of agriculture and allied fields. A donkey, being the work animal, is mainly employed in transport of goods over short distances either as a pack animal or in pulling a cart. In India donkeys are mainly used by brick kiln owners (Plate 10), petty contractors, pottermen, marginal farmers, nomadic herders or Dhobis since these animals can be more economical for short distances than other light transport vehicles. Beside this, the donkey is preferred over other work animals due to its docile nature, as even ladies can also handle and put the animal to work easily (Birthal *et al.* 1999). Many owners often being the poorest of the poor, having a large and illiterate family, use them extensively to earn a livelihood without caring for their health. The people often provide them with a meagre quantity of feed and fodder.

Keeping the above in view, this experiment was planned to study both continuous work and work-rest working practices. The aim was to establish what practise can achieve optimum and sustainable work on regular basis, without adversely affecting the health of the animal or putting undue stress to the animal.

Material and Methods

Animals. Five apparently healthy adult female donkeys with average body weight of 131 ± 15.0 kg were used in the experiment. The animals were maintained under similar and standard feeding conditions.

Feed and fodder. All the donkeys had free access to drinking water except during working hours. One kg of concentrate feed was offered to each donkey in the morning after recording their physiological indices and after collecting the blood samples. After consumption of feed, these donkeys were used under both the work plans. After completion of work, fodder was made available *ad libitum* along with water.

Experimental plan. Prior to investigation, the donkeys were trained for a period of one month with a load equivalent to 50% of their body weight, under two different work schemes, *i.e.* continuous work and work-rest cycle. During this training period, various physiological responses were recorded occasionally so as to acclimatise them and to rule out any fluctuation in these parameters due to anxiety during the experimental period.

- (a) **Work scheme:** All the donkeys worked under the following continuous work and work rest cycle plan for three weeks each. The donkeys were used for work on alternate days.
- (i) **Continuous work scheme:** The donkeys carried load equivalent to 50% of their body weight for a continuous period of 4 h or until the onset of fatigue, which ever was earlier. Mean maximum and minimum environmental temperature during the experiment were 37.1 ± 0.25 and $24.9 \pm 0.22^\circ\text{C}$, respectively while relative humidity at 8.30 and 14.30 hr IST was 71.5 ± 2.0 and $46.3 \pm 1.0\%$, respectively.
- (ii) **Work-rest cycle scheme:** The donkeys worked continuously for 2h followed by 1h rest and again 2h work carrying same load. During rest period, the load was

removed from the donkeys and they were in shade. Mean maximum and minimum environmental temperature during the experiment was 40.9 ± 0.74 and $22.2 \pm 0.85^\circ\text{C}$, respectively while relative humidity at 8.30 and 14.30hr IST was 49 ± 2.9 and $16.8 \pm 1.7\%$, respectively.

- (b) **Pack load:** The form of packing involved two sacks slung either side over the back of the donkey. The loads were evenly balanced with similar weight i.e. bricks on either side of the donkey. The donkeys walked at a normal speed of $0.97\text{--}1.11$ m/s during the experiment on a tar road. The speed of travel was observed by noting down the time taken to cover each round of fixed distance during the entire working period.
- (c) **Physical and physiological observations:** Physical changes in animals behaviour *viz.* unwillingness to continue operation, legs uncoordinated, frothing, excitement, sweating and tongue protrusion were recorded as seen. Physiological parameters such as rectal temperature (RT), pulse rate (PR) and respiration rate (RR) were recorded daily early in the morning before feeding and watering and also after 1hr of rest after completion of the experiment. RT was recorded using a clinical thermometer, PR was taken by palpation of the maxillary artery and RR was measured by counting the abdominal movements per minute. Physiological observations were also recorded just after the completion of work under both the schemes.
- (d) **Collection of blood sample and analysis:** Blood samples were collected directly from the jugular vein into heparinised vacutainer tube throughout the experiment from all the donkeys after taking physiological observations in the morning and also after completion of work. The tubes were brought to the laboratory in an ice bath and blood acid-base status and gases were estimated within half an hour using an auto blood gas analyser (Eschweiler, ECO, 2000). Average values of all physical, physiological indices and blood gases taken in the morning at the start of experiment were taken as normal or zero hour values for further comparison with those taken after work or rest.
- (e) **Assessment of stress:** The stress to the animal was accessed using a fatigue score card (Table 5) developed for donkeys (Verma *et al.*, 1993).
- (f) **Statistical analysis:** Data collected during the experiment from all the donkeys were pooled for each parameter under each work scheme and results were analysed statistically using the 't' test (Snedecor and Cochran, 1967).

Results and discussion

Physical and physiological indices

All the donkeys remained healthy through out the period of experiment and maintained their weight indicating that the animals were maintained and used properly. The donkeys working under continuous work scheme frequently exhibited the fatigue symptoms *viz.* uncoordination of legs, unwillingness to continue operation and excitement, while such symptoms were not noticed in the work-rest cycle group.

Under the continuous work scheme, various physiological indices *viz.*, RT, PR and RR recorded at 0 hour, *ie* before the start of the experiment, were $36.7 \pm 0.07^\circ\text{C}$, $37.5 \pm 0.95 \text{ min}^{-1}$ and $27.3 \pm 1.10 \text{ min}^{-1}$, respectively and these were used as control or zero hr values for further comparison (Figure 4a). After a continuous work of 4 h these

values increased significantly ($P<0.05$) to $38.0\pm 0.07^{\circ}\text{C}$, $69.5\pm 1.61\text{ min}^{-1}$ and $57.6\pm 1.61\text{ min}^{-1}$, respectively. Such increase in physiological responses in response to work had also been earlier reported in donkeys (Maurya, 1992; Pal *et al.*, 2002) and in buffaloes (Kapoor and Upadhyay, 1993). Per cent change noted in RT, PR and RR after continuous work was 3.46, 85 and 110, respectively. Similar results were reported in donkeys by Anon (1988), where body temperature and pulse rate varied from 0.5 to 3.3 per cent and 9.4 to 41.7%, respectively as the draught increased. A significant ($P<0.05$) decrease in physiological responses was observed an hour post-work, but these values were significantly ($P<0.05$) higher than the control values. However, on the next morning all the donkeys attained their normal physiological levels.

Table 5: Fatigue score card for donkeys.

Parameters	Score scale			
	1	2	3	4
Increase in pulse rate (min^{-1})	$P_0 +15$	$P_0 +20$	$P_0 +40$	$P_0 +45$
Increase in respiration rate (min^{-1})	$R_0 +15$	$R_0 +20$	$R_0 +40$	$R_0 +50$
Increase in rectal temp ($^{\circ}\text{C}$)	$T_0 +1$	$T_0 +2$	$T_0 +2.5$	$T_0 +3$
Leg co-ordination	Occasional dragging of feet	Movement of legs unco-ordinated and frequent dragging of feet	No co-ordination between fore and hind legs and sometimes fall down	Unable to move because of unco-ordination
Frothing	Dribbling of saliva starting	Frequent dribbling of saliva	Continuous dribbling of saliva	Appearance of froth on upper lips
Excitement	Sudden neck movement	Disturbed	Perspiration	Heavy perspiration
Tongue protrusion	Occasional opening of mouth	Occasional protrusion of tongue	Frequent protrusion of tongue	Continuous protrusion of tongue

Note: When the total score is 16, the donkey is said to be severely fatigued.

Under work rest work scheme, the control (0 hr) values of RT, PR and RR were $37.2 \pm 0.04^{\circ}\text{C}$, $43.8 \pm 0.83\text{ min}^{-1}$ and $28.0 \pm 1.21\text{ min}^{-1}$, respectively. After a work of 2h, these values significantly ($P<0.05$) increased to $37.5\pm 0.05^{\circ}\text{C}$, $58.3\pm 1.43\text{ min}^{-1}$ and $35.6\pm 1.55\text{ min}^{-1}$, respectively (Figure 4b). After a rest of one hour, there was a significant decrease in the pulse rate only, but this value was significantly higher than the control value. When these animals were again employed for a period of 2h, the RT, PR and RR increased to a value of $37.8\pm 0.05^{\circ}\text{C}$, $61.5\pm 1.82\text{ min}^{-1}$ and $40.9\pm 1.48\text{ min}^{-1}$, respectively. A significant decrease in physiological responses was observed an hour post-work as compared to the values of final work, but these values were significantly ($P<0.05$) higher than the control values. Per cent change as compared to control in RT, PR and RR was

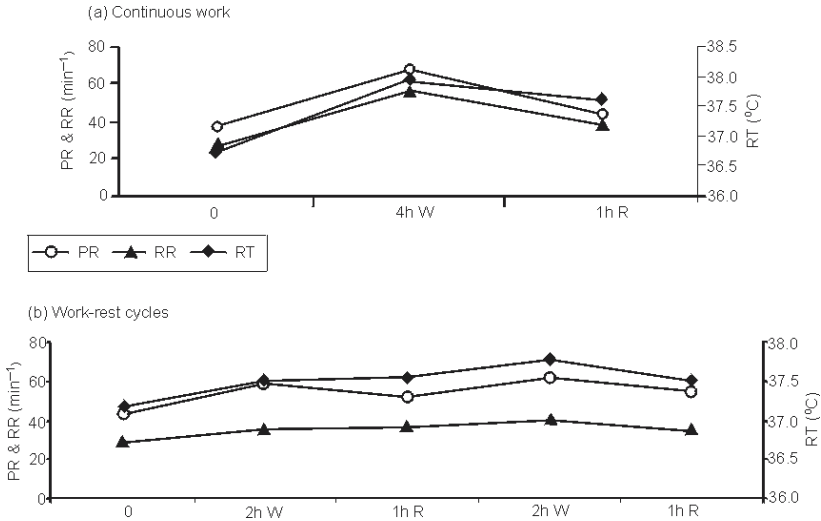


Figure 4a,b: Physiological responses during (a) continuous work and (b) work-rest cycle (PR, pulse rate; RR, respiration rate; RT, rectal temperature).

2, 51 and 46, respectively. By the next morning the donkeys exhibited normal levels of all the physiological responses.

In both types of work schemes, PR, RR and RT decreased significantly during rest periods and post-work rest periods in both types of work, but these values were significantly high than the control values indicating that donkeys need more rest to bring down the physiological responses to its normal level. However, all the physiological responses recorded in the next morning were in normal range indicating that donkeys were able to dissipate heat gained during work by the next morning (Pal *et al.*, 2000). All these physiological adjustments during heavy workload particularly during summer are associated with a marked increase in the metabolic rate to provide adequate energy for muscular contraction and to dissipate extra heat. The body temperature attained by donkeys during work was also influenced by the ambient conditions. The temperature rise during work has been described as physiologically essential to increase the rate of chemical process, to change internal friction resistance in muscles and to enhance supply of oxygen to the working muscles (Astrand and Rodhal, 1970). On the basis of physical and physiological observations recorded under both the work schemes, it is clear that donkeys under continuous type of work were under more stress than work rest cycle scheme.

Acid-base balance and blood gases

Among the blood gases and acid base indices, values of all the parameters except base excess (BE), in the work rest scheme, increased significantly ($P < 0.05$) as compared to their control values under both continuous work plan and work rest work scheme (Table 6).

Acid-base balance regulation is closely linked to fluid and electrolyte balance. Their imbalances are often casually related to acid-base alterations and vice versa. The increase in pO_2 values in venous blood of horses during exercise has been observed by Gillespie *et al.* (1964) and Rose *et al.* (1979) and in working bullocks (Upadhyay and Madan, 1985). The gas carrying capacity of blood particularly in terms of pO_2 was significantly affected in donkeys of both the group in spite of the fact that blood hemoglobin levels remained unaltered. The values of pCO_2 increased as compared to control values. An increase in standard bicarbonate and (BE) as observed in this study is in agreement with the earlier report in horses during steeplechase and roads and tracks competition (Rose *et al.*, 1980). Standard bicarbonate and BE are better indices than bicarbonate of disturbances of acid-base balance during exercise, as these will account for variations in pCO_2 . Both respiratory and metabolic alkalosis had been observed in exercised animals, as the deviation in acid-base components recorded in response to exercise are the characteristics of mixed disturbance composed of respiratory and metabolic alkalosis (Berkson, 1967).

Table 6: Effect of duration of work under different schemes on blood gases and acid base status in donkeys.

Parameters	4 h Continuous work (load of 50% BW)		2 h Work–1 h Rest–2 Work (load of 50% BW)	
	before work (n = 25)	after work (n =25)	before work (n =25)	after work (n =25)
pO_2 (mmHg)	58.60	69.34*	37.44	49.67*
pCO_2 (mmHg)	38.70	48.04*	34.18	43.29*
pH	7.371	7.361	7.432	7.392*
HCO_3A (mmol/l)	21.77	26.34*	22.31	25.46*
HCO_3S (mmol/l)	22.12	24.57*	23.89	24.73
O_2 CT %	18.12	18.82*	14.66	17.02*
O_2 Sat (%)	89.25	92.54*	72.34	83.84*
BE (mmol/l)	-2.54	0.82*	-0.63	0.93
TCO_2 (mmol/l)	22.74	27.55*	23.0	26.54*
Hb (g/dl)	11.4	11.8	11.7	12.0
PCV (%)	32.2	34.3	33.0	35.1

n denotes the number of observations

* denotes significant difference in values work each work scheme before and after completion of work.

A concomitant increase in total CO_2 altered pCO_2 indicating reduced elimination of CO_2 in expired air due to lower respiration rate. The mean RR of donkeys in continuous work group was higher after exercise than that of work-rest cycle group (57 vs 41). The changes in BE, blood bicarbonate and standard bicarbonate observed in this study indicate donkeys doing continuous work developed mild alkalosis due to respiratory and metabolic changes. Respiratory alkalosis in the exercised animals may be due to the higher respiratory frequency (Rana *et al.*, 1978), but such higher respiration rate was not seen in our study. The metabolic alkalosis in exercised animals may be an attempt by the body to neutralise the acids produced during exercise.

Fatigue score

On the basis of fatigue score card for donkeys (Table 5), the donkey is said to be fatigued when the total score reaches 16 (Verma *et al.*, 1993). Fatigue score in this experiment was calculated on the basis of physical observations and physiological values and it was observed that the donkeys attained a fatigue score of 10 and 2 out of 16 under the continuous work plan and work-rest cycle, respectively indicating the donkeys are more than half fatigued during continuous work. Increments in heart rate along with other physiological reactions and behavioural manifestations in cattle and buffaloes have also been interpreted in terms of fatigue earlier (Upadhyay and Madan, 1985; Martin and Teleni, 1989).

In general this study revealed that work-rest cycle was better than the continuous work scheme from a work output point of view as it causes less stress to the donkeys as indicated by fatigue score and acid-base status.

Acknowledgement

The authors express their gratefulness to the Director, National Research Centre on Equines, Hisar for providing necessary facilities for carrying out the study.

References

- Anonymous (1988). Annual report. AICRP on 'Increased utilization of animal energy with enhanced system efficiency', College of Technology and Agricultural Engineering, Udaipur, Rajasthan.
- Astrand, P.O. and Rodhal, K. (1970). *Textbook of Work Physiology*. 1st ed. McGraw Hill, New York.
- Berkson, R. P. (1967). *Acid-base Physiology in Medicine*. London Company, West Lake, Ohio.
- Birthal, P.S., Arya, S.N., Pal, Y. and Yadav, M.P. (1999). Socio-economic issues in equine husbandry: a study in Haryana and Delhi. NRCE, Hisar (India), pp 44.
- Gillespie, J. R., Tyler, W. S. and Eberly, V. E. (1964). Blood pH, O₂ and CO₂ tensions in exercised control and emphysematous horses. *American Journal of Physiology* **207**: 1067–1072.
- Kapoor, R. and Upadhyay, R.C. (1993). Physiological responses and acid-base status of rural working buffaloes. *Indian Journal of Dairy Science* **46**: 227–229.
- Martin, D. and Teleni, E. (1989). Fatigue in buffaloes on different work loads. *Draught Animal Power Project Bulletin* **8**: 2–6.
- Maurya, N.L. (1992). Draughtability of donkeys. *Karnataka Journal of Agricultural Science* **5**(2): 145–151.
- Pal, Y., Gupta, A.K. and Yadav, M.P. (2000). Heat tolerance in donkeys and mules. *Annals of Arid Zone* **39**: 461–464.
- Pal, Y., Gupta, A.K. and Kumar, S. (2002). Draughtability studies in donkey as pack animal. In X International Congress of Asian Austral Asian Association of Animal Production to be held in New Delhi, September 2002.
- Snedecor, G.W. and Cochran, W.G. (1967). *Statistical Methods*. 6th edn. Oxford and IBH Publications Company, New Delhi.
- Rana, R.D., Singh, N., Galhotra, M.M., Nangia, O.P. and Ahmad, A. (1978). Physiological responses to exercise in buffalo males. *Indian Journal of Dairy Science* **31**: 338–340.
- Rose, R.J., Ilkiw, J.E. and Martin, I.C.A. (1979). Blood-gas, acid-base and haematological values in horses during an endurance ride. *Equine Veterinary Journal* **11**: 56–59.
- Rose, R.J., Ilkiw, J.E., Samson, D. and Backhouse, J.W. (1980). Changes in blood gas, acid-base and metabolic parameters in horses during three-day event competition. *Research Veterinary Science* **28**: 393–395.
- Upadhyay, R.C. and Madan, M.L. (1985). Studies on blood acid-base status and muscle metabolism in working bullocks. *Animal Production* **40**: 11–16.
- Verma *et al.* (1993). Cited in Srivastava, N.S.L., 1993. Status of research on engineering aspects of draught animal power. *Journal of Rural Energy* **2** (2–4): 15–32.

(c) Vietnam

Effect of urea-molasses-mineral supplementation on digestibility of feed by swamp buffaloes

Nguyen van Thu¹

Dept. of Animal Husbandry, Cantho University, Vietnam

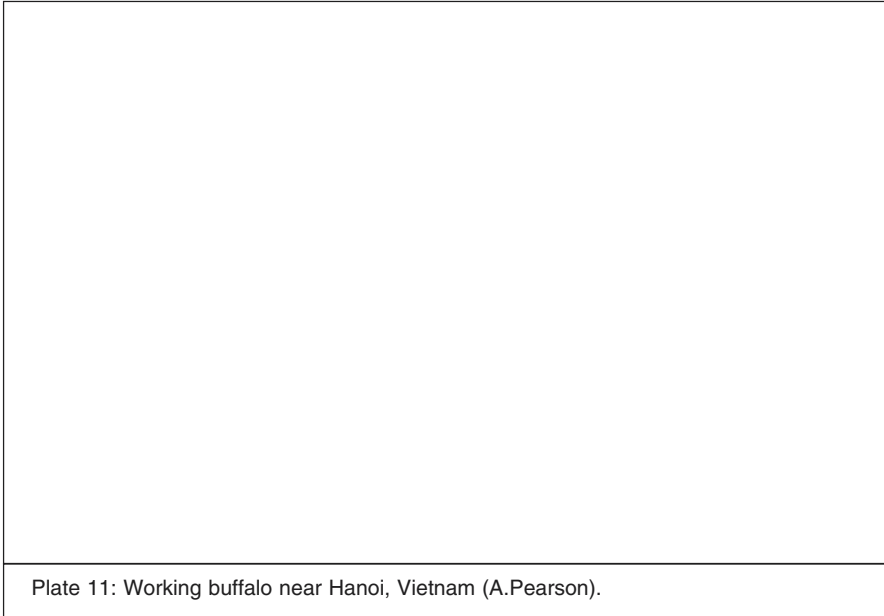
Abstract

Two experiments were carried out in young swamp buffaloes to investigate effect of supplementation of urea-molasses-mineral mixture on feed digestibility *in vivo*, *in situ* and *in vitro*. In Experiment 1 four young buffaloes were used. The animals were all fed a basal diet of rice straw. The treatments were: no supplements (R), molasses-urea mixture with 265 g molasses, 53.2 g urea, 120 g whole soya bean, 26.6 g salt, 26.6 g bone meal and 2.1 g trace minerals (RMUS), the same mixture without the soya bean (RMU), and the mixture without urea (RMS). In Experiment 2, 12 buffaloes were allocated in a factorial design experiment, the first factor was roughage including rice straw and maize stover, and the second one was the supplementation of the mixture used for Experiment 1, at 180 g/day. In *in situ* and *in vitro* digestibility studies, incubated rice straw was used with or without the supplementation. These mixtures were given once daily at 7:00 h and rumen fluid was collected 3 h post-feeding for measuring rumen parameters and *in vitro* digestibility studies.

In Experiment 1, results showed that ruminal pH was similar for the different diets, while NH₃-N was higher ($p < 0.001$) for the RMUS and RMU diets compared to the R and RMS diets. The bacteria and protozoa populations were higher ($p < 0.05$) for the RMUS diet compared to the others. Total volatile fatty acid concentrations differed among the treatments ($p < 0.05$) and were 92.7, 123, 113 and 95.5 mM for the R, RMUS, RMU and RMS diets, respectively. No differences were found among treatments in either *in sacco* or *in vitro* rice straw degradation. However, improvements ($p < 0.01$) were found in *in vivo* dry matter, organic matter and neutral detergent fibre digestibility in the supplemented diets. Findings in Experiment 2 were similar to Experiment 1 in pH, NH₃-N concentration and feed digestibility as effected by supplementation. Rice straw DM, NDF digestibilities were higher than these of maize stover. However no difference was found in digestibility of incubated rice straw with or without supplemented mixture for both *in situ* and *in vitro* techniques. Supplementation with the urea-molasses-mineral mixture improved ruminal NH₃-N, rumen microbial populations and feed digestion of swamp buffaloes. However, *in situ* and *in vitro* techniques were not able to detect the improvements of rumen degradability of rice straw due to the supplementation. Results also suggest that soybean meal could be combined with urea to improve buffalo rumen function.

Introduction

Rice straw and maize stover are roughages with a low nutrient content and low digestibility and usually fed to many draught buffaloes (Plate 11) as a main diet during the dry season in many Asian countries. These diets result in low performance and poor health. It has been suggested that urea-molasses-mineral block supplementation can improve rice straw digestibility by increasing the rumen microbial population (Sansoucy, et al., 1995). However, positive results of this strategy on digestibility have not been reported. Supplementation of rice straw with urea-molasses cake (a small soft block)



made from urea, molasses, coconut meal, rice bran, and minerals have shown positive effects on performance of working and lactating buffaloes (Thu and Udén, 2000). However, effects of each of these components on ruminal parameters and feed intake of buffaloes have not been apparent (Thu and Udén, 2001). This suggests that the combination of molasses, N and minerals in the cake would have their main effects on rumen function.

Supplementing cattle with rumen undegradable protein improves performance, presumably by providing more intestinally absorbable protein, although an alternative strategy is to increase microbial production in the rumen by increasing intake of fermentable organic matter. Besides non-protein N, fibre digesting organisms also use peptides and amino acids for growth. Cellulolytic bacteria require polypeptides or true protein for optimal growth and digestibility of cellulose. Therefore supplementation of rice straw and maize stover diets with a urea-molasses-mineral mixture that includes degradable protein may increase their digestibility by stimulating rumen microbial growth.

The objective of this study was to investigate the possibility of increasing the rumen activities and feed digestibility, by supplementing rice straw or maize stover with urea and/or soybean in molasses-mineral mixtures to swamp buffaloes.

Materials and methods

Animals and feeding

Two experiments were carried out at the experimental farm of Cantho University in Vietnam in 1998 and 2000. In Experiment 1, four rumen fistulated young swamp buffaloes were used in a 4×4 Latin square design experiment. The animals were all fed

a basal diet of rice straw. The treatments were: no supplement (R), urea-molasses mixture with 265g molasses, 53.2 g urea, 120 g whole ground soya beans, 26.6 g salt, 26.6 g bone meal and 2.1 g trace minerals (RMUS), the same mixture without soya bean meal (RMU) and the same mixture without urea (RMS). Crude protein (CP) supplied was 220, 164 and 66 g/d for the RMUS, RMU and RMS diets respectively (see Thu and Udén, 2000). For the RMUS, soya bean protein N contribution to the total N content of the mixture was approximately 27%, and the CP and metabolisable energy ratio (g/MJ) was 57.5 (NIAH, 1995). Low-fibre soya bean meal was specially produced from soya beans, which were roasted and the cortex and germ removed before grinding. In Experiment 2, 12 buffaloes were allocated in a factorial design experiment, the first factor was roughage including rice straw and maize stover, and the second one was the supplementation of the mixture of Experiment 1, but it was higher in amount of 180 g/d. In *in situ* and *in vitro* digestibility studies, incubated rice straw was used with or without the supplementation. Each experimental period was three weeks, including one week for adaptation. The supplement mixtures were fed in a liquid form once daily at 7:00 h, while the rice straw was fed twice a day at 7:15 and 14:15 h.

Sampling and chemical analysis

Samples of rumen contents were collected 3 h post-feeding by suction through a tube of about 1 cm internal diameter to measure rumen pH, ammonia N ($\text{NH}_3\text{-N}$), protozoa and total bacteria populations. Rumen pH was measured by pH meter and $\text{NH}_3\text{-N}$ was analysed according to AOAC (1980). For counting protozoa, the preparation of the rumen content samples used a 0.2mm deep chamber under 100 × magnification. Total bacteria populations were counted in a Neubauer chamber under 1200 × magnification after preparation of rumen content samples. Analysis of total VFA was by a distillation method.

Feeds offered and refusals were collected daily and pooled weekly for analysis of DM to calculate feed intake. Organic matter (OM), CP, neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were also analysed. Rice straw samples were dried at 55°C overnight and ground to pass a 1mm sieve for rumen incubations. *In situ* incubations were made at 0, 12, 24, 48, 72 and 96 hours in duplicate to measure feed degradability. Rice straw samples were also used to determine DM, OM or NDF degradability *in vitro* at 0, 24, 48, 72 and 96 h using rumen fluid from the buffaloes of the corresponding treatments. *In vivo* DM, OM and NDF digestibilities were estimated by total faecal collection for 7 d beginning 2 d after the start of feed intake recording.

Results

Experiment 1

The low NDF and ADF values for soybean meal were probably due to the absence of cortex and germ in the feed (Table 7).

Rumen pH was similar for the different diets (Table 8), while $\text{NH}_3\text{-N}$ (mg/100ml) was higher ($P<0.05$) for the RMUS and RMU diets compared to the R and RMS diets. The bacteria and protozoa populations were highest on the RMUS diets ($P<0.05$) compared to other diets. The rumen VFA concentration (mM) was highest for the RMUS diet, lowest for the R diet and intermediate for the RMU and RMS diets.

Table 7: Chemical composition of rice straw, whole soya beans, bone meal and "B" molasses (a DM basis) in Experiment 1.

Feed	DM	CP	NDF	Analyte ^b			
				ADF	ADL	EE	Ash
Rice straw	80.9	5.8	74.4	46.3	10.6	1.3	10.5
Soya beans	93.0	45.7	3.4	1.6	1.2	17.1	2.7
Bone meal	91.0	23.0	ND ^c	ND	ND	4.1	35.7
'B' molasses	78.1	3.56	ND	ND	ND	ND	7.5

^a 'B' molasses: molasses after the second sugar extraction

^b DM: dry matter, CP: crude protein, NDF: neutral detergent fibre, ADF: acid detergent fibre and EE: ether extraction, ADL: acid detergent lignin

^c ND: Not determined

Table 8: pH, ammonia N, protozoa and bacterial populations as well as total volatile fatty acid (VFA) concentrations of rumen fluid of young swamp buffaloes fed rice straw with or without molasses based supplements in Experiment 1.

	Diet ^a				SE
	R	RMUS	RMU	RMS	
PH	7.10	6.99	7.07	7.06	0.093
NH3-N (mg/100ml)	5.71 ^a	19.1 ^b	18.2 ^b	5.78 ^a	4.187
Bacteria (x10 ⁸)	7.96 ^a	10.5 ^b	9.09 ^a	8.37 ^a	0.512
Protozoa (x10 ⁻⁵)	3.59 ^a	5.04 ^b	4.51 ^a	4.31 ^a	0.032
Total VFA (mM)	92.7 ^a	123 ^b	113.5 ^{ab}	95.5 ^{ab}	0.64

^{a, b} Means with different letters within the same rows differ significantly at the 5% level

^a R: no supplement, RMUS: 265g molasses, 53.2g urea, 120g whole soya beans, 26.6g salt, 26.6g bone meal and 2.1g trace minerals, RMU: RMUS without soya beans and RMS: RMUS without urea

Table 9: Model parameter values for *in sacco* dry matter (DM) and *in vitro* organic matter (OM) degradation of rice straw as affected by supplements fed to donor buffaloes eating rice straw in Experiment 1.

Parameter ^b	Diet ^a			
	R	RMUS	RMU	RMS
<i>In sacco</i> DM digestibility				
A	11.2±0.28	11.4±0.34	11.4±0.21	11.0±0.26
B	53.4±2.52	54.4±3.46	49.4±1.92	52.7±2.34
C	0.020±0.002	0.018±0.002	0.023±0.002	0.021±0.0023
<i>In vitro</i> OM digestibility				
A	19.5±0.24	19.6±0.14	20.2±0.21	20.4±0.07
B	53.5±4.78	51.8±3.69	54.1±3.60	52.9±2.23
C	0.018±0.004	0.020±0.003	0.017±0.002	0.021±0.0018

^a R: no supplement, RMUS: 265g molasses, 53.2g urea, 120g soybean meal, 26.6g salt, 26.6 g bone meal and 2.1g trace minerals, RMU: RMUS without soybean meal and RMS: RMUS without urea.

^b Parameters of the model: $y = a + b(1 - e^{-ct})$ fitted to the data, where 'a' represents the immediately soluble fraction, 'b' represents the potentially degradable fraction and 'c' represents the fractional degradation rate (h^{-1}).

In situ and *in vitro* rice straw digestibility showed no differences among treatments (Table 9) by test for curve parallelism (common rate 'c') or curve displacement (common a and/or b) in the model $y = a + b(1 - e^{-ct})$. However, there were significant improvements ($P < 0.01$) of *in vivo* DM, OM and NDF digestibility in the supplemented diets (Table 9). Values were numerically higher for the RMUS diet as compared to the RMU and RMS diet, but not significantly so ($P > 0.05$). Assuming that the supplements were 100% digestible, from the *in vivo* calculation rice straw DM and OM digestibilities were also found to be significantly ($P < 0.01$) higher for the supplemented diets compared to the R diet (Table 10).

Table 10: *In vivo* digestibility of young swamp buffaloes fed rice straw and supplemented with different molasses based mixtures.

	Diet ^A				SE
	R	RMUS	RMU	RMS	
<i>Total digestibility (%)</i>					
Dry matter	48.6 ^a	62.1 ^c	58.4 ^b	60.9 ^c	1.81
Organic matter	52.2 ^a	66.1 ^c	62.5 ^b	63.2 ^b	1.72
Neutral detergent fibre	59.1 ^a	64.3 ^b	62.2 ^b	63.9 ^b	0.84
<i>Rice straw digestibility (%)^C</i>					
Dry matter	48.6 ^a	54.9 ^b	52.1 ^b	54.4 ^b	0.90
Organic matter	52.2 ^a	58.2 ^b	55.6 ^b	57.6 ^b	0.86

^{a, b} Means with different letters within rows differ significantly at the 5% level.

^A R: no supplement, RMUS: 265g molasses, 53.2g urea, 120g soybean meal, 26.6g salt, 26.6 g bone meal and 2.1g trace minerals, RMU: RMUS without soybean meal and RMS: RMUS without urea.

Experiment 2

Crude protein of maize stover was higher than that of rice straw and urea-molasses-mineral (UMM) supplementation to maize stover and rice straw increased their CP content about 3% and NDF content from 4.7–6.1%. There was a reduction of ADF and lignin when UMM supplemented (Table 11).

Table 11: Chemical composition of roughages and urea-molasses-mineral mixture (UMM) used in Experiment 2 (%DM).

Feed	DM	OM	CP	NDF	ADF	Lignin	Ash
Maize stover	73.4	90.2	9.0	66.9	42.8	14.4	9.8
Maize stover + UMM	71.8	89.7	12.6	60.8	37.6	12.7	10.3
Rice straw	80.8	81.7	4.8	67.0	41.8	12.3	18.3
Rice straw + UMM	74.4	80.5	7.80	62.3	40.8	11.6	19.5
Urea-molasses-mineral mixture (UMM)	76.0	79.9	46.1	11.2	1.6	-	20.1

Table 12 showed that no difference of pH values between rice straw and maize stover or UMM supplement and no supplement. Ruminal NH₃-N was significantly higher in maize stover diet and in UMM supplemented diets. DM, OM and NDF digestibility of rice straw diets were higher than these of maize stover ($p < 0.01$). UMM supplementation increased dietary DM, OM and NDF digestibility ($p < 0.01$) and there was an interaction between roughage and supplementation ($p < 0.05$).

Table 12: Effect of roughage consumed and urea-molasses-mineral supplementation on rumen parameters and total feed digestibility *in vivo* (%) in Experiment 2.

	Roughage consumed (RC)		Supplement (S)		Significance level		
	Rice straw	Maize stover	Yes	No	R	S	R*S
PH	7.03	7.14	7.12	7.05	ns	ns	ns
NH ₃ -N (mg/100ml)	16.0	19.0	23.5	11.4	***	***	ns
DMD	52.2	43.1	52.7	42.6	**	**	*
OMD	56.1	46.8	56.2	46.7	**	**	*
NDFD	64.9	42.0	61.8	45.1	***	***	***

ns non-significant, * significant difference at 5%; ** significant difference at 1%, *** significant difference at 1%

DMD dry matter digestibility, OM organic matter digestibility, NDFD neutral detergent fibre digestibility.

The results showed that there were significantly higher DM rice straw digestibilities *in situ* and *in vitro* in the rice straw compared to maize stover diets at different incubated times. Similarly, *in situ* and *in vitro* NDF rice straw digestibilities were also higher in the rice straw diets ($p < 0.01$). However, effect of UMM supplementation on rice straw DM digestibility was not apparent. At 12 and 24 h incubation there were a significantly higher in supplemented diets, but after that no difference was found up to 96 h in *in situ* technique. While in *in vitro* technique there was no significant difference of rice straw DM and NDF degradabilities at different incubation times. There were similar DM and NDF degradable values ($p > 0.05$) in both *in situ* and *in vitro* technique between incubated rice straw with or without UMM.

Discussion

Rumen pH, NH₃-N concentration, microbial growth and VFA production

The results of rumen fluid pH of the present study are similar to those of Wanapat *et al.* (1991) when rice straw-fed cattle and buffaloes were supplemented with urea-molasses blocks. They found that the rumen pH condition (around 7) of the buffaloes was optimum for microbial activities in all treatments. Wanapat *et al.* (1991) found that supplementation of swamp buffaloes and beef cattle with a high quality feed block that included molasses, urea, cassava, oil seed meals, minerals, and sulphur markedly enhanced ruminal NH₃-N concentration at 0 h, 3 h and 6 h post-feeding. In the present study, the higher NH₃-N concentration for the RMUS and RMU diets was likely due to the urea in the supplements. By infusing NH₄HCO₃ to manipulate the rumen NH₃-N concentration of swamp buffaloes, Wanapat and Pimpa (1999) concluded that the optimum rumen NH₃-N concentration in swamp buffaloes is higher than 13.6 mg/100ml for microbial protein synthesis, digestibility and rice straw intake.

Pimpa *et al.* (1996) showed that increasing the rumen NH₃-N concentration in swamp buffalo increased total bacteria and protozoa populations. Increases in rumen bacteria and protozoa populations were also found when rice straw and grass-fed swamp buffaloes were supplemented by a urea-molasses cake (Thu and Uden, 2001). The principle cellulolytic bacteria species utilise ammonia as the main source of nitrogen, whereas for microbes utilising sugars or starches there is an apparently high requirement for preformed amino acids and peptides. Maeng *et al.* (1989) concluded

that in continuous culture, the optimum ratio of non-protein N for rumen microbial growth was 75% urea N plus 25% amino acid N. In the present study, a combination of protein N from soybean (27% total N of the supplement), NPN from urea and a readily available energy source in the form of molasses of the RMUS diet supported increased microbial growth compared to the R, RMU and RMS diets. Chowdry and Huque (1998) found that microbial protein synthesis was better in the combination of urea and molasses than that of urea and rice soup. Thus, in the present study energy from molasses and N from urea and soybean of the supplements may be available for microbial protein synthesis. Yan *et al.* (1997) also found that when a diet contained a high concentration of molasses (248g/kgDM), supplementation with urea and soybean meal increased intake and milk production in dairy cows.

Fadel *et al.* (1987) indicated that supplementing molasses, urea and starch increased total VFA concentration of rumen fluid in cattle. Total VFA concentration in rumen fluid is also increased when lambs consumed urea-molasses blocks with or without additional by-pass protein (Sansoucy *et al.* 1995). Similarly, in the present study the RMUS diet enhanced the rumen fermentation as compared to the R due to the additional protein N supplementation. Leng and Nolan (1984) stated that, depending on the efficiency of utilisation of ATP, the carbohydrate converted to microbial cells could approach the amount fermented to VFA. Thus, in the RMUS diet of Experiment 1 the microbial populations increased with increasing availability of the substrates in the form of readily fermentable carbohydrates and through an enhanced fibre utilisation. The latter was evidently brought about by the additional nitrogen supply of the supplementation.

Feed digestion

Pearce (1973) observed that lick blocks were more effective when the quality of the basal ration was poor. In the present study the animals were fed low quality rice straw. There were significant improvements of DM, OM and NDF diet digestibility as well as of DM and OM rice straw digestibility for the supplemented diets compared to the unsupplemented diet *in vivo* (Tables 10 and 12). These may be attributed to the increases of microbial populations caused by supplemented nutrients. Increases in nitrogen supply or sparing effects of the branched amino acids have led to increases in the numbers of cellulolytic bacteria and fibre digestion. Protozoa may also be responsible for an efficient fibre digestion by themselves or by a higher growth rate of cellulolytic bacteria in presence of protozoa which increases ammonia level in the rumen liquid.

In the present study there were no significant *in situ* digestibility differences observed among the treatments, despite significant increases *in vivo* digestibility. These results agree with those reported by Khalili *et al.* (1993). The lack of effects of supplements on *in situ* degradability is possibly explained by a lower microbial activity and pH in the bag contents compared to in the rumen. Moreover, the variability of results *in situ* reported in the literature, may also have been caused by different bag porosities affecting the movement of rumen fluid and micro-organism across the bag. The similar lack of treatment effects using the *in vitro* technique may be attributed to the nutrients supplied by the *in vitro* medium, which included a nitrogen source from trypticase. Garg and Gupta (1991) found that *in vitro* studies were unable to demonstrate any fermentation or digestibility effects of supplementing straw fed donor cows.

Conclusions

Supplementation with a complete mixture including urea, molasses, soybeans and minerals improved rumen environment and feed digestion in swamp buffaloes fed rice straw or maize stover. However, *in situ* and *in vitro* methods were not able to detect improvements of rumen degradability of rice straw due to the supplementation. No differences were found in rumen VFA concentrations, digestibility of swamp buffaloes among the diets of the complete mixture and the mixture without soybean or urea component. The experimental results also suggest that ground soybeans may have a combined effect with urea to enhance rumen microbial population and rumen function.

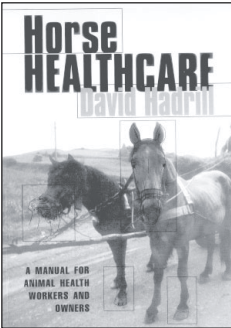
Acknowledgements

Financial support of this work was provided by SAREC/SIDA. The authors would like to thank the Department of Animal Husbandry, Faculty of Agriculture, Cantho University, Vietnam and the Department of Animal Nutrition and Management, Swedish Agricultural Sciences, Sweden for use of their facilities. The authors also would like to thank Dr. Brian Ogle and Mr. Börje Ericson for their kind help.

References

- AOAC. (1980). *Official Methods of Analysis*. 13th edn. Association of Official Analytical Chemists. Washington, DC.
- Chowdry, S.A. and Huque, K.S. (1998). Effect of molasses or rice gruel inclusion to urea supplemented rice straw on its intake, nutrient digestibilities, microbial N yield, N balance and growth rate of native (*Bos indicus*) growing bulls. *Asian-Aus. J. Anim. Sci.* **11** (2), 145–151.
- Fadel, J.G., Udén, P. and Robinson, P.H. (1987). Effect of nitrogen and energy supplements on intake and digestion of oat straw by non-lactating cows. *J. Agric. Sci. Camb.* **109**, 503–511.
- Garg, M.R. and Gupta, B.N. (1991). *In vitro* gas production as a measure of comparative ruminal microbial activity of animal fed straw based diet supplemented with either concentrate mixture or urea-molasses-mineral block licks. *Indian J. Anim. Nutr.* **8**, 195–200.
- Leng, R.A. and Nolan, J.V. (1984). Nitrogen metabolism in the rumen. Symposium: Protein nutrition of the lactating dairy cow. *J. Dairy Sci.* **67**, 1072–1089.
- Maeng, W.J., Chang, M.B., Yun, H.S. and Choi, I. (1989). Dilution rates on the efficiency of rumen microbial growth in continuous culture. *Asian-Aus. J. Anim. Sci.* **2** (3), 447–480.
- Pearce, J. (1973). Nutrient blocks for cattle. *Agric. N. Ireland* **48**, 288–290.
- Pimpa, O., Wanapat, M., Sommart, K., Uriyapongson and Paker D. (1996). Effect of levels of NH₃-N on straw intake, digestibility and microbial protein synthesis in swamp buffaloes. In Proceedings of The 8th AAAP Animal Science Congress, October 13-18 1996, Tokyo, Japan. Vol.2, pp. 146-147.
- Sansoucy, R., Aart, G. and Leng, R.A. (1995). Molasses/urea blocks. In proceedings of the first FAO Conference on tropical feeds and feeding system. FAO animal production and health paper, 1995. <http://www.fao.org/WAICENT/FaoInfo/Agricult/ECONF95>.
- Thu, N.V. and Udén, P. (2000). Effect of work and urea-molasses cake supplementation on live weight and milk yield of Murrah buffalo cows. *Asian-Aus. J. Anim. Sci.* **13** (9), 1329–1336.
- Thu, N.V. and Udén, P. (2001). Effect of Urea-molasses cake supplementation of swamp buffaloes fed rice straw or grasses on rumen environment, feed degradation and intake. *Asian-Aus. J. Anim. Sci.* **14** (5), 631–639.
- Wanapat, M., Sommart K., Ajsuk, P., Wachirapakorn, C. and Toburan, W. (1991). Effect of high quality feed block supplementation on intake, rumen fermentation characteristics in ruminants fed rice straw-based diets. Presented at the Regional workshop by Making Better Use of Local Feed Resources, Nov. 25–30, 1991, Hanoi, Vietnam.
- Wanapat, M. and Pimpa, O. (1999). Effect of ruminant NH₃-N levels on ruminant fermentation, purin derivatives, digestibility and rice straw intake in swamp buffaloes. *Asian-Aus. J. Anim. Sci.* **12** (6), 904–907.
- Yan, T., Robert, D.J. and Higginbotham, J. (1997). The effects of feeding high concentrations of molasses and supplementing with nitrogen and unprotected tallow on intake and performance of dairy cows. *Anim. Sci.* **64**, 17–24.

SHORT NOTES AND NEWS



■ **Books** – Joy Pritchard writes from Brooke Hospital for Animals, 21 Panton Street, London, Sw1Y 4DR, UK (fax +44 (0)207930 2386, email: info@brooke-hospital.org.uk to remind anyone who would like a copy of HORSE HEALTH CARE, by David Hadrill (see DAN 36 page 40–41) to contact Brooke Hospital at the address above and they will be sent a copy. Libraries and people in developing countries involved in training and education or promotion related to working horses (and donkeys) are particularly encouraged to obtain copies.

■ **Web sites** – Several people have sent in details of websites they have found useful for draught animal power activities:

- <http://www.fao.org/act-network> for information from the African Conservation Tillage network (ACT).
- <http://www.worldagroforestrycentre.org> for the new ICRAF home page for plenty of information and training materials on agroforestry.
- <http://www.conferencia.uncnet.br> for the First Virtual Conference on Organic Beef Cattle Production. Included are papers on crop/livestock interactions and social and sustainable issues in smallholder farming systems.
- <http://www.albc.org> for the American Livestock Breeds Conservancy
- <http://www.haras-nationaux.fr> for information on the 28th Meeting on Equine Research organised in France by Les Haras Nationaux.
- <http://www.iscowp.com/resources/resources.html> for information on an animal-drawn stationary power unit 'Gita-nagari's ox power unit' and for information on ox-training.
- <http://perso.libertysurf.fr/hippotese> This is the website of the association Hippotese
- <http://bievre.attelages.free.fr> This is the website of an association of people using animaldrawn vehicles , mainly in France.
- <http://www.cowindia.org> for information on 'improved' yoke designs for oxen from India and for the 'Kamdhenu Bullock drawn tractor'.
- <http://intsormil.unl.edu> This is the website of the International Sorghum and Millet Collaborative Research Support Programme.
- <http://www.itdg.org> who are promoting donkeys for transport to help women in east Africa. Search on 'donkeys' or 'rural transport' to obtain news of the various projects.

■ **Rural Heritage News** – Gail Damerow, the Editor, writes to say they have added a number of new books to their online bookstore. New offerings include:

- Hoof Care for Horses
- Hand-Rearing Wild and Domestic Animals
- Farm Animals in the Making of America
- Horse Housing
- Pole Building Projects

If you are interested in ordering any of the books online their website is: <http://www.ruralheritage.com>

LETTERS TO THE EDITOR

■ **Honduras – request for information on mules and donkey breeding and husbandry.** Dr Abraham Arce, a veterinarian from Honduras is looking for information and training materials particularly in Spanish on husbandry of donkeys and mules. He writes:

“Here in Honduras especially in the west and north a cross between donkey stallions and local crossbred horse mares has been practised for many years. The United Fruit Company brought donkeys from Kentucky, USA, as stallions to cross them with local mares with the objective to produce mules for the haulage of bananas.

In Saint Barbara which is in the west of Honduras other crosses are carried out. A Quarter horse stallion from Texas has been crossed with female donkeys to obtain hinnies. These animals work well in the mountainous areas where there is much steep land.

In addition the government is using oxen and mules for the maintenance of rural roads due to the petrol crisis. The use of and the maintenance of tractors and levellers on steep land are extremely expensive due to the cost of petrol and diesel and repairs following breakage of machinery. Also the training of the workers to operate specialised equipment is expensive plus payment of salaries.

In some regions of the country where there is flat arable land the farmers have eliminated tractors and specialised farm machinery and returned to use draught animals (oxen and mules), and simple ploughs and drills for the cultivation of land for the production of cereals and vegetables. Buffalo are also widely used in Honduras for agricultural production in low-lying wet areas.

I would like to inform you that an increasing interest has been shown in draught and pack animals by both the private and government sectors of Honduras (donkeys, mules and oxen). For that reason I would be very pleased to receive information concerning donkey and mule breeding, management and production.

I would be interested to obtain information about:

- Breeds, selection and culling of breeding stock
- Breeding systems
- Management and feeding
- Nutrient requirements
- Common diseases and parasites.”

Contact details: Dr A. Arce, El Hatillo, Apartado Postal 9376, Tegucigalpa, Honduras, Central America.

■ **UK – INASP Development of a rural development directory.** Pru Watts-Russell, Programme Officer of INASP (the International Network for the Availability of Scientific Publications) has written with details of the Network. Several of the organisations and networks working with draught animal power will feature in the new directory:

“INASP is a co-operative network of partners. Its aim is to improve world-wide access to information and knowledge. In particular its mission is to improve the flow of information within and between countries, especially those with less developed systems of publication and dissemination.

One of the ways we have done this among others is by publishing the INASP Directory of organisations and networks in Rural Development. This publication is now out of date and we are in the process of revising it. It is our intention that not only will

the Directory be published in hard copy but it will also appear in CD ROM format and be included on our website.

Our main interest is in the dissemination of information between/by network partners and the means by which this is achieved.

For full information about INASP and its activities I suggest you might like to refer to the INASP website <http://www.insap.info>. A more general publication entitled the INASP Directory is already accessible from the homepage.”

■ **South Africa – Recipe of an Extension Officer.** L. Nimrod Mdledle an Extensionist based at the Animal Traction Centre, University of Fort Hare, Private Bag X1314, Alice 5700 (Tel: 040 6022125) has sent in the following important recipe which many of you will relate to!



RECIPE OF AN EXTENSION OFFICER

by L.N. Mdledle

1. **Ingredients:** Take 55-75 kg of professional agriculturist (do not exceed this quantity as the end product will not be issued with a uniform larger than size 42). Place in any village or district.
2. **Add:**

<ul style="list-style-type: none"> 1 enquiring mind, neatly diced 1 heaped tablespoon of knowledge A huge sense of humour A pinch of agricultural experience 2 packets of positive attitude 10 kilos of commonsense 999 grams of good grooming 500 grams of communication skills 	<ul style="list-style-type: none"> a dash of adaptability A large packet of patience 2 kilos of team spirit A dollop of stamina 2 tubes of friendliness A sachet of assertiveness 5 kilos of kindness
--	--
3. **Method:** Mix all the ingredients well and allow to stand in an orientation bowl for approximately 1 week. Allow to rise in a ward warmer until mixture rises over the top of the orientation bowl for approximately one month. Do not stir the mixture as it could cause the product to flop. Bake in a village health service oven at 35°C until golden brown. Allow to cool off in the field. Serves many farmers and relatives and lasts very well particularly if served in the village of preference and if appreciated by management.

MEETING REPORTS

EAAP CONFERENCE

53rd Annual Meeting, Cairo, Egypt

A scientific session was held as part of this large conference during the afternoon of Tuesday 3rd September 2002 on 'The use of draught animals in semi-arid farming systems', under the auspices of the Commission on Horse Production. The session was well attended. Three papers covered some of the various ways in which projects have been carried out to help smallholder farmers improve their farming systems through



better use of work animals. Other papers dealt with the ability of the camel and the donkey for work in pastoral and smallscale mixed farming systems. An interesting paper was given on the potential of the Libyan Magrabi camel as a milking animal. Papers on working animals were also given in some of the other sessions organised by the Commissions on Cattle Production and on Animal Management and Health, as well as in the free communications session of the Horse Commission. The papers given, in the session on draught animals, and those from other researchers undertaking scientific studies on draught animal management and production who have offered papers, will be published in a small book by the European Association of Animal Production.

People attending the session entitled 'Egyptian horse production' had the opportunity to visit to the El Zahraa Stud in Cairo. This is one of the oldest studs for breeding Arab horses in the world, which was established in 1898.

For further information about EAAP activities and commissions see their website: <http://www.eaap.org>.

4th INTERNATIONAL COLLOQUIUM ON WORKING EQUINES, SYRIA

This meeting report is by Kirstie Dacre, Dept of Veterinary Clinical Studies, Easter Bush Veterinary Centre, Roslin, Midlothian, EH25 9RG, Scotland.

The 4th International Colloquium on Working Equines was held under the patronage of His Excellency Dr. Mohammad Mustafa Miro, Prime Minister of the Syrian Arab Republic, at Al Baath University Veterinary School, Hama, Syria from 20–26th April 2002. These Colloquia are held once every four years with the aim of sharing information between people whose aim is to improve the productivity and welfare of the estimated 100 million working equines worldwide, and the one billion people estimated to be directly dependent upon them.

The Colloquium was principally funded by the four main U.K. charities involved in improving the welfare of working equines; Society for Protection of Animals Abroad (SPANA), International League for Protection of Horses (ILPH), Donkey Sanctuary Worldwide and Brooke Hospital for Animals (BHA). These, and other donors including universities and research establishments, brought together a core of veterinarians, scientists, educationalists and engineers from all over the world to share a wealth of experience and knowledge of working equines. People attended from Mexico and Venezuela, India, Pakistan and China as well as from many of the African countries and some European ones.

Keynote lectures centred on recent developments in the role and health care of the working equine, implementation and monitoring of extension and development projects and educational programmes in developing countries. Some contributors described the difficulties of improving welfare standards within the practical limitations of the owner and BHA for example demonstrated that often small, workable (but not ideal) changes were far more successful than idealistic improvements. The importance of finding the source of failure of projects was also highlighted. Recent experiences of educational programmes in schools in developing countries were described. Children are introduced to the concept of animals and the environment in a more positive way such that hopefully, in the future, animals are treated more humanely. SPANA for example now runs their educational programmes or clubs in several countries, including Morocco and

Jordan, and these have proved so popular with the children that expansion of the programme is planned. KENDAT too are hoping to expand their child education programme in Kenya.

Other lecture topics presented by participants of the organisations from many countries included; methods of improving farriery, harnessing, ploughing and traction; research studies on diseases of local importance including respiratory disease, dental disease in debilitated equines, trypanosomiasis, babesiosis and lacrimal histoplasmosis; improving nutrition of the working equine and parasitology. Posters were also on display throughout the conference detailing research studies undertaken and projects currently being used to improve animal welfare in developing countries.

SPANAs has been working in conjunction with Al Baath University in Syria since 1994 and currently has three mobile clinics, under the supervision of Dr Darem Tabbaa, that provide free veterinary care for working equines. On the second morning of the conference, field visits accompanying these mobile clinics to local areas where organised to look at the use, type, health and management of working equines in Syria. Not surprisingly, in general, the working equines were in better health than in many poorer countries however poor farriery, poorly fitting harnesses and lack of basic animal husbandry were common. Cases seen included a foal undergoing treatment for a wolf bite wound, several coughing working equines, routine worming treatments, reported intermittent colic (thought most likely due to parasitism) and ocular disease.

An afternoon of practical demonstrations at Al Baath University proved very popular with the delegates (Plate 12). These included cart building, equine dental examination

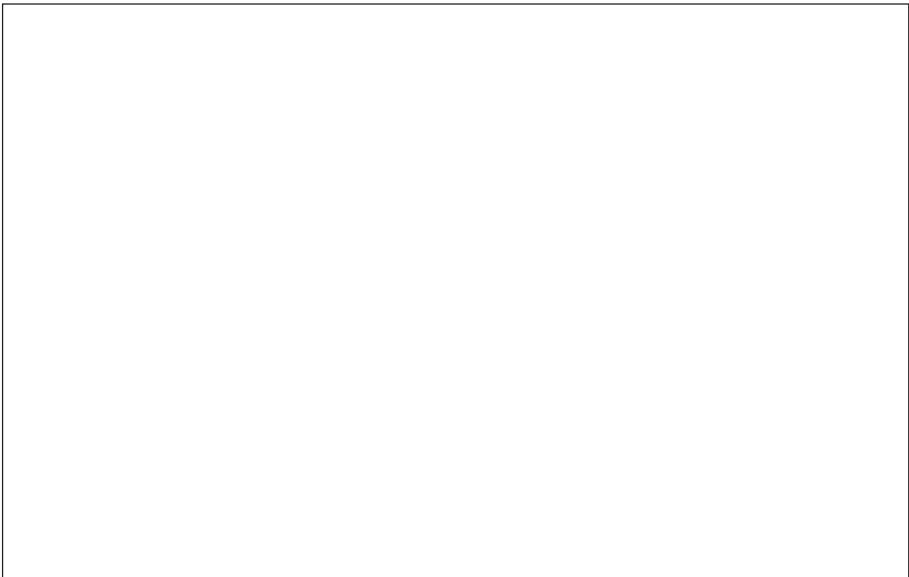


Plate 12: Demonstration of dental techniques at the Syrian meeting, AlBaath University (A.Pearson).

and treatment (a major contributing cause of debilitation in working equines), a technique for performing bronchoalveolar lavage using minimal equipment as a diagnostic aid in respiratory disease and cytological analysis of these samples. From Mali a harness made by women using scrap material from the local rubbish dump and from Pakistan a modified padded saddle for donkeys and ponies were demonstrated., A donkey was used to demonstrate the harness, hitching and use of a lightweight-high hitch donkey plough in the veterinary hospital garden!

During the evenings informal discussion groups were held on farriery, harnessing, dentistry and alternative therapies, as a further opportunity to learn from each other's experiences, successes and failures and therefore develop strategies for improving welfare. Videos on topical issues were also available for optional evening viewing. On the last day of the Colloquium people worked in small groups representing different geographical regions to prepare summary material learnt over the preceding few days which was to act as guidelines for future projects and training materials.

Improving welfare in developing countries is a slow process, however it is clear that real progress is being made. The Colloquium provided the opportunity for exchange of the wealth of knowledge that has been gained in recent years and highlighted areas of particular success that will hopefully provide a brighter future for the working equines of the world. The 5th International Colloquium on Working Equines is to be held in Ethiopia in 2006.

Acknowledgements

Kirstie Dacre would like to thank Universities Federation for Animal Welfare (UFAW) and VETAID for their generous assistance and kind sponsorship of her attendance at the Colloquium.

AN INTERNATIONAL WORKSHOP ON MODERNISING AGRICULTURE – Visions and Technologies for Animal Traction and Conservation Agriculture

Uganda
Network for
Animal
Traction and
Conservation
Agriculture



The workshop, held in the Sunset Hotel and Conference Centre Jinja, Uganda from 19–25 May 2002 had two main themes:

- modernising agriculture through improved animal traction and rural transport services, and
- enhancing supply of conservation agriculture knowledge and equipment for increased adoption of conservation farming in Africa.

The convenors were The Uganda Network for Animal Traction and Conservation Agriculture (UNATCA) in collaboration with the Animal Traction Network for Eastern and Southern Africa (ATNESA), Food and Agriculture Organisation of the United Nations (FAO) and Africa Conservation Tillage Network (ACT) and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)

Almost 150 people from 21 countries attended the workshop. The main focus was on the use of draught animal power in conservation agriculture. There was a large

contingent of people from Brazil, one of the countries which is at the fore-front of development of equipment for conservation tillage. There was a special event (at the Source of the River Nile showground) where a wide range of local and international tractor, animal and hand conservation tillage implements and other related inputs were exhibited. Brazilian animal-drawn equipment was demonstrated alongside local equipment and equipment from elsewhere in Africa. Implement manufacturers, and other input suppliers, researchers and developers attended the workshop.

A whole day was devoted to field visits including visits to research and training institutions, implement manufacturers, farms and farming communities within Uganda (Plate 13). There were 18 invited papers covering the implications of conservation agriculture on policy, equipment supply, draught animal management, other livestock, transport, training and skill development at the farm level, and the role of artisans, credit and micro-enterprises.

It is hoped to bring out the proceedings of the workshop and its recommendations shortly. Please contact the people listed below for a list of participants (Secretariat) and any further information concerning the Workshop.

■ *Workshop Secretariat*

Engineer Wilfred R. Odogola
Agricultural Engineering and Applied
Technology Research Institute
P.O. Box 7144, Kampala Uganda.
Tel +256-41-566161, Mobile: 256-77-220010
Fax: 256-41-566049/567649
Email: aeatri@starcom.co.ug

■ *ATNESA Link*

Dr. Pascal G. Kaumbutho
ATNESA Chairman
P.O. Box 61441, Nairobi. Kenya.
Tel/Fax: +254-2-766939
Mobile +254-72-308331
Email: KENDAT@africaonline.co.ke
Webpage: <http://www.ATNESA.org>

Plate 13: Farmers near Jinja, Uganda demonstrating their weeding techniques at the ATNESA/ACT workshop (A. Pearson).

■ *FAO Link*

Theodor Friedrich
 FAO, Agricultural Engineering Branch AGSE
 Viale delle Terme di Caracalla, 00100
 Rome/Italy
 Tel: +39-065705-5694, Fax: +39-065705-6798
 Email: theodor.friedrich@fao.org
 Webpage: <http://www.fao.org/ag/ags/AGSE/Agse.htm>

■ *ACTLink*

Martin Bwalya
 ACT Secretariat,
 c/o IES University of Zimbabwe
 P.O. Box MP 167, Harare Zimbabwe
 Tel: +263-4-334395
 Email: actsecre@africaonline.co.zw
 Webpage: <http://www.FAO.org/act-network>



THE AMERICAN LIVESTOCK BREEDS CONSERVANCY: Ox Training Workshop

A report by Don Bixby

Technical Programs Director of the American Livestock Breeds Conservancy

On the job training!

One of the best methods of breed conservation is to keep the breeds employed and economically viable. Many of the historic American cattle breeds were selected for draught work as well as for meat and milk. For some breeds, like the Devon, draught work is one of the major attributes of the breed.

Working steers have a role to play in small scale farming and logging, living history, and for companionable enjoyment. To provide a broader opportunity for steers to be employed as working representative of their breed, rather than on a bun, an ox-training workshop was held in at Hancock Shaker Village in Western Massachusetts on



Plate 14: Participants and oxen on the ALBC oxen workshop in USA (D.Bixby).

September 21. The beautiful historic site was home to a Shaker community from 1835 to 1960. With dozens of restored original buildings, herb beds and gardens, the 1,200 acre site was perfect for the gathering of 30 eager oxen enthusiasts.

The workshop was fully subscribed six weeks before the event, and was the second sponsored by American Livestock Breeds Conservancy and led by Drew Conroy from the University of New Hampshire, member of the ALBC board of directors, and internationally recognised oxen specialist.

The workshop was focused on training the trainer and the animals. Conroy began by explaining the construction and purpose of the yoke, and fitting the yoke and bows. Yoking the teams was demonstrated before heading off to the field. Participants began by driving well-trained teams under close supervision in a course set out with traffic cones. This exercise introduced participants to the commands and manner in which the animals respond to visual and vocal cues. We were all surprised at the importance of non-verbal communication and the differences in how the teams had been trained to respond to the body language of the drivers and the position of the whip. Colourful video tapes from New England, Michigan and West Africa provided fascinating exposure to a wide range of working styles and topics related to working cattle.

A eye-catching array of teams included Randall Linebacks, Dutch Belted (Plate 14), Shorthorn, Devon, Highland, and Holstein. Student participants came from Connecticut, Illinois, Maine, Massachusetts, New Hampshire, New York, Pennsylvania, Vermont and Virginia. Two 4-H members also joined the workshop and contributed their enthusiasm to the weekend. With a standby list of eleven people, glowing evaluations, and requests for a “second helping” we will consider repeating this type of workshop sometime in the future.

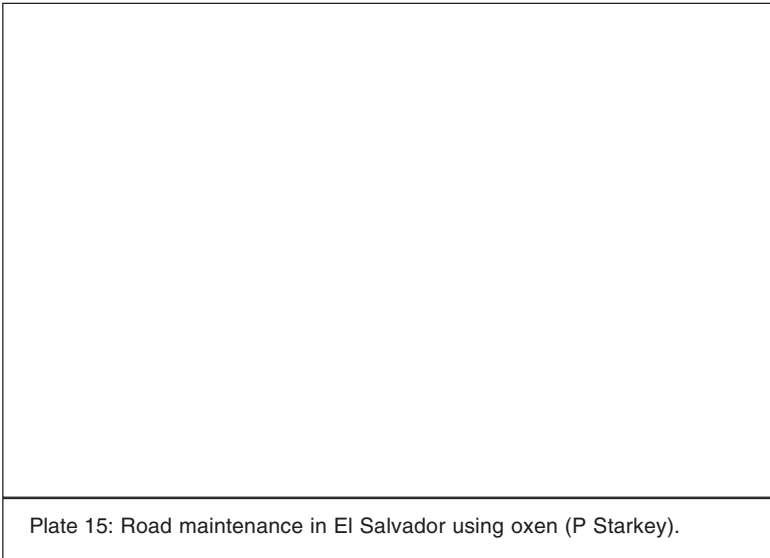


4TH LATIN AMERICAN WORKSHOP ON ANIMAL TRACTION, EL SALVADOR

This report has been sent in by Paul Starkey

RELATA (Red Latinoamericana de Tracción Animal) is the Latin American animal traction network, with Spanish as its working language. It held its fourth international workshop from 20–22 March 2002 in El Salvador. The influential Promech and Fomenta animal traction programmes worked in Central America (mainly Honduras, Nicaragua and El Salvador) in the 1980s and 1990s, with funding from Swiss Development Cooperation. With assistance from Fomenta, the RELATA network was launched during the first international workshop in Nicaragua in 1995. This was followed by the international workshops in Honduras (1997) and Bolivia (1999). Initially RELATA was hosted by the Fomenta programme in Nicaragua. As the long-term external funding for Fomenta declined, RELATA was established as a non-governmental organisation, based in Nicaragua with cooperating offices in other Central American countries. This present workshop was the first to be arranged by the secretariat of the newly ‘independent’ network.

The workshop succeeded in bringing together more than one hundred people interested in animal traction in Central America. The organisers would have liked there



to have been more participants from elsewhere in Latin America, but several interested colleagues in Mexico and South America were unable to obtain sponsorship, and the Cuban delegates were denied visas. The event was run using a fairly traditional conference methodology, involving two days taken up mainly with paper presentations, followed by an optional field visit to a research station. Although there was a short time for panel discussions and group work, most detailed 'networking' discussion took place during the refreshment breaks that were lively and stimulating.

The workshop concentrated on four themes: animal management, small businesses supporting animal traction, the use of animal power in road maintenance, and the value of complementary appropriate technologies (not necessarily involving animal power). Naturally, there was much to share and learn in all areas. The various organisations working with animal traction in the region have much experience, with an impressive range of technologies and publications (all in Spanish). RELATA's colour magazine 'El Yuntero' is attractive and informative.

Many people were impressed by the value and importance of animal power for local road construction and maintenance, with examples from Peru as well as Central America. Animal-powered graders, rakes, tipping carts and water sprinklers were demonstrated to be highly effective. The high power requirement for graders can be overcome using teams of animals. The existing problems of small rural roads are not unique to Latin America. Given the relatively high proportion of national budgets allocated to transport, there should be much scope for benefiting road users and rural communities in many countries by contracting farmers to assist with road maintenance (e.g. Plate 15).

FORTHCOMING EVENTS



TAWS

The next TAWS workshop is planned for **Thursday, 24 April 2003 at Silsoe Research Institute, Wrest Park, Silsoe, Bedford MK45 4HS**. The workshop will aim to bring together a wide range of people concerned with working animals and their welfare. It will provide a stimulating and conducive environment to exchange ideas and information, and propose new initiatives and actions in this important field. Collaboration with the Tropical Agricultural Association has been suggested for this event.

Posters, exhibits and networking information welcome!

Overall theme:

**The challenge of improving transport animal welfare in the world:
ways forward**

With focus on:

- Welfare legislation and inspection: how to progress and succeed
- Ethno-veterinary, complementary and low cost treatment and management of working animals
- New developments on equipment for working animals (carts, packs, low-draft tillage)
- Methodology for sustainable animal welfare interventions and projects
- Students: potential to get involved in UK and overseas

Provisional programme

9.00	Coffee and networking
9.30	Keynote address
9.45	Introduction to Theme 1: Welfare legislation and inspection: how to progress and succeed
10.15	Introduction to Theme 2: Ethno-veterinary, complementary and low cost treatment and management of working animals
10.45	Coffee and networking
11.15	Introduction to Theme 3: New developments on equipment for working animals (carts, packs, low-draft tillage)
11.45	Introduction to Theme 4: Methodology for sustainable animal welfare interventions and projects
12.15	Introduction to Theme 5: Students: potential to get involved
12.45	TAWS administrative meeting
13.00	Lunch, posters and networking
14.00	Practical demonstrations (donkeys probably available)
15.00	Discussions and working groups on themes (tea available)
16.30	Presentations of group work and plenary discussion
17.00	Conclusions and determination of follow-up activities
18.30	Optional dinner

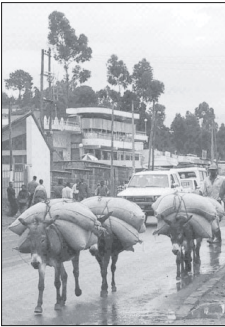
For further information contact:

TAWS Secretariat, Hardwick Court Farm,
Hardwick Lane, Chertsey, Surrey KT16 0AD
(Tel: 44 1932 564366; Fax: 44 1932 567837; email: info@taws.org)

The Fourth Latin American workshop was a valuable event. It reinforced the importance of, and potential for, networking activities and collaboration in the field of animal traction in Latin America. We wish the new RELATA well, and look forward to the fifth workshop.

- Further information can be obtained from: www.relata.org.ni and/or RELATA, Apartado Postal: RP-95, Managua, NICARAGUA (Tel./Fax: + 505 277-1685. Email: relata@relata.org.ni).

NEW BOOKS



Use and management of donkeys in peri-urban areas of Ethiopia

The work described in this report was undertaken in Ethiopia as phase one of a collaborative project between the CTVM and the Ethiopian Agricultural Research Organisation (EARO) funded by the DFID. Ethiopia has one of the highest populations of working donkeys in the world, many of them found in urban areas. An important objective of the work was to monitor the health status of the working donkeys, their management and factors influencing these within the study areas.

Surveys were conducted on donkey use and management in West Shewa zone, including Addis Ababa, East Shewa zone-I and East Shewa zone-II. Three woredas were selected from each zone based on the donkey population and their importance to the livelihood of the people. West Shewa zone represents a highland agro-ecology where mixed crop-livestock farming system is a major practice of the farmers and the topography is dominated by undulated terrain. East Shewa zone-I is characterised by high to mid altitudes with mixed crop-livestock farming systems and the topography ranges from flat to gentle slope. East Shewa zone-II zone is a low altitude plain located in the rift valley. It is characterised by agro-pastoral farming systems.

From each of the woredas, seven categories of respondents were interviewed:

- **Household non-donkey owners:** rural people who do not own donkeys.
- **Household donkey owners:** rural people who own donkeys.
- **Transporters:** urban and peri-urban dwellers who own and use donkeys.
- **Market arrivals:** people who arrive at the market on market days with something to sell or buy.
- **Market departures:** people who go back home from the market on the market days having brought or sold something.
- **Donkey traders:** individuals who buy donkeys from one place to sell in another.
- **People at meeting places:** people using donkeys were questioned on donkey health and management when they were at the market or grinding mills. Veterinarians also carried out physical assessment and body measurements of the donkeys being used by this group.

All participants were asked on the many difference aspects of management, and use. Constraints and opportunities were identified by the various groups to aid in identifying the interventions that owners and users would like to test in phase II of the project.

While the work reported was undertaken in Ethiopia and so has a strong African bias, it is hoped that the results will be useful to others working with donkey owners and users in other parts of the world, particularly where smallholder farmers are near to market opportunities but cannot capitalise on them effectively due to transport difficulties or where demand for animal-based transport systems is high. The book is 128 pages long, with many tables recording the observations and results of the interviews. It gives a detailed insight into the use and management of donkeys for transport.

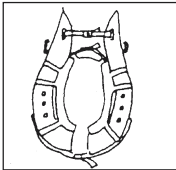
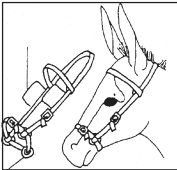
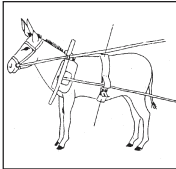
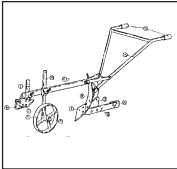
To obtain a free copy please contact: Dr R.A. Pearson or Dr D.G. Smith at CTVM, Easter Bush Veterinary Centre, Roslin, Midlothian, EH25 9RG, Fax +44 131 445 5099 or email: anne.pearson@ed.ac.uk. or dsmith4@staffmail.ed.ac.uk



Donkeys for Traction and Tillage

by Luurt Oudman

Agrodok series No 35



This book produced by Luurt Oudman, sponsored by RUMPTSTAD Agricultural Tropical Machinery from the Netherlands, is one in the AGRODOK series produced by AGROMISA whose aim is to exchange knowledge information on smallscale sustainable agriculture and related topics to strengthen self reliance of the target groups. The AGRODOK-SERIES is a series of low-priced practical manuals on small-scale and sustainable agriculture in the tropics. This book has an easily read style, is well laid out and has a good balance of drawing and pictures to illustrate key points. The main topics necessary to use donkeys for work are covered. Characteristics of donkeys, care, use as

a pack animal, training, harnessing and hitching are all covered. There are comprehensive sections on Equipment for transport, primary tillage, crop husbandry and a final chapter on maintenance of farming equipment. References and further reading list are provided with a useful section on email addresses and websites.

This book and others in the AGRODOK series can be obtained from AGROMISA P.O.Box 41, 6700 AA Wageningen, The Netherlands. Fax: 31 317 419178 email: agromisa@agromisa.org or CTA P.O. Box 173 6700 AD Wageningen, The Netherlands, Fax: 31 317 460067 email: cta@cta.nl

RUMPTSTAD ATM



RECENT PUBLICATIONS

- Astatke, A., Jabbar, M., Saleem, M.A.M. *et al.* (2002). Technical and economic performance of animal-drawn implements for minimum tillage: experience on vertisols in Ethiopia. *Experimental Agriculture* **38** (2): 185–196.
- Devendra, C. and Sevilla, C.C. (2002). Availability and use of feed resources in crop-animal systems in Asia. *Agricultural Systems* **71** (1–2): 59–73.
- Gee, M.R., Alldredge, J.R. and Light, D. (2001). Use of heart girth to predict body weight of working oxen in the Ethiopian highlands. *Livestock Production Science* **69** (2): 187–195.
- Huttner, K., Leidl, K., Pfeiffer, D.U. *et al.* (2001). The effect of a community-based animal health service programme on livestock mortality, off-take and selected husbandry applications – a field study in northern Malawi. *Livestock Production Science* **72** (3): 263–278.
- Lawrence, P.R. and Pearson, R.A. (2002). Use of draught animal power on small mixed farms in Asia. *Agricultural Systems* **71** (1–2): 99–110.
- Meas, S., Ohashi, K., Tum, S. *et al.* (2000). Seroprevalence of bovine immunodeficiency virus and bovine leukemia virus in draught animals in Cambodia. *Journal of Veterinary Medical Science* **62** (7): 779–781.
- Mulatu, E. and Kassa, H. (2001). Evolution of smallholder mixed farming systems in the Harar Highlands of Ethiopia: the shift towards trees and shrubs. *Journal of Sustainable Agriculture* **18** (4): 81–112.
- Natural, H.G. and Sumayao, B.R. (2002). Resource management in mixed crop-animal farming systems in a hilly land community in Batangas, Philippines. *Philippine Agricultural Science* **85** (2): 194–203.
- Rydberg, T. and Jensen, J. (2002). Comparison of horse and tractor traction using energy analysis. *Ecological Engineering* **19** (1): 13–28.
- Shrivastava, A.K. and Datta, R.K. (2001). Performance evaluation of an animal drawn puddling implements under controlled soil-bin conditions. *Journal of Terramechanics* **38** (3): 121–131.
- Singh, V. and Partap, T. (2000). Tractive performance of draught animals in mountain farming systems: a study of central Himalaya, India. *Indian Journal of Animal Science* **70** (6): 632–642.
- So, H.B., Kirchhoff, G., Bakker, R. *et al.* (2001). Low input tillage/cropping systems for limited resource areas. *Soil Tillage Research* **61** (1–2): 109–123.
- Stur, W.W., Horne, P.M., Gabunada, F.A. *et al.* (2002). Forage options for smallholder crop-animal systems in South-east Asia: working with farmers to find solutions. *Agricultural Systems* **71** (1–2): 75–98.
- Tanner, J.C., Holden, S.J., Owen, E. *et al.* (2001). Livestock sustaining intensive smallholder crop production through traditional feeding practices for generating high quality manure-compost in upland Java. *Agricultural Ecosystems and Environments* **84** (1): 21–30.
- Thomas, D., Zerbin, E., Rao, P.P. *et al.* (2002). Increasing animal productivity on small mixed farms in South Asia: a systems perspective. *Agricultural Systems* **71** (1–2): 41–57.
- Thorne, P.J. and Tanner, J.C. (2002). Livestock and nutrient cycling in crop-animal systems in Asia. *Agricultural Systems* **71** (1–2): 111–126.
- Wall, P.C. (1999). Experiences with crop residue cover and direct seeding in the Bolivian highlands. *Mountain Research and Development* **19** (4): 313–317.
- Wolde-Ghiorgis, W. (2002). Renewable energy for rural development in Ethiopia: the case for new energy policies and institutional reform. *Energy Policy* **30** (11–12): 1095–1105 (September).

CONTRIBUTORS TO DAN 37

C. Bhakat *et al.*
NRC on Camels
Post Bag 07, Bikaner 334001, India
email: dchatext@rediffmail.com
Tel: 91 151 230858 • Fax: 91 151 230183

Don Bixby
American Livestock Breeds Conservancy
PO Box 477, Pittsboro, NC 27312, USA
email: dbixby@albc-usa.org

Marina Martin Curran
present address: University of Edinburgh
School of Earth, Environment and
Geographical Sciences
Room 100, School of Agriculture
West Mains Road, Edinburgh EH9 3JG,
UK
email: m.curran@ed.sac.ac.uk
Tel: 44 131 535 4088 • fax: 44 131 667
2601

Kirstie Dacre
Department of Veterinary Clinical Studies
Easter Bush Veterinary Centre
Roslin, Midlothian EH25 9RG, UK
kirstie.pickles@ed.ac.uk

Fred Ochieng Oluoch
KENDAT, PO Box 61441
Nairobi, Kenya
email: Kendat@africaonline.co.ke

Luurt Oudman
Stoevenweg 10A, 8141 MP
Heino, The Netherlands
email: oudma001@wxs.nl

Yash Pal *et al.*
NRC on Equines
Sirsa Road, Hisar 125001, Haryana, India
email: yashnrce1@rediffmail.com

Vir Singh
Department of Animal Science, College of
Agriculture
GB Pant University of Agriculture and
Technology
Pantnagar 263145, Uttaranchal, India
email: drvirsingh@rediffmail.com

Paul Starkey
64 Northcourt Avenue
Reading RG2 7HQ, UK
email: P.H.Starkey@reading.ac.uk
Tel: 44 118 987 2152 • Fax: 44 118 931
4525

Nguyen van Thu
Department of Animal Husbandry
Faculty of Agriculture, Cantho University
Cantho City, Vietnam
email: nvthu@ctu.edu.vn
Tel: 84 71 835469 • Fax: 84 71 830814

Trevor Wilson
Bartridge House, Umberleigh
North Devon EX37 9AS, UK
email: trevorbart@aol.com