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☆ Draught Animal Power continues to be in the spotlight in the second six months of 2003. Two meetings have taken place in Africa, one in South Africa and one in Burkino Faso (report to follow). The first annual New England Ox drover's workshop was also held in October.

☆ Two new books are out: The Proceedings of the Fourth Colloquium on Working Equines, and A book on Working Animals in Agriculture and Transport. The latter is a collection of some current research and development observations from the European Association of Animal Production Technical Series.

☆ Several people have benefited from the exchange of information and ideas through the Draught Animal News 'Letters to the Editor' pages. Please continue to send in requests for information, queries or topics you would like to discuss.

☆ 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 Wipzip 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. Please send in articles and news, letters and comments to the editor, Dr R.A. Pearson, Draught Animal News, Centre for Tropical Veterinary Medicine, Easter Bush Veterinary Centre, Roslin, Midlothian, EH25 9RG, Scotland, UK (fax +44 (0) 131 651 3903; email anne.pearson@ed.ac.uk).

☆ The drawing on the front cover is by Archie Hunter, from a photograph of a camel and rider in North Africa.

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CONTENTS

RESEARCH AND DEVELOPMENT PROJECTS

1. AFRICA

(a) Ghana

The uses and management practices for draught animals in the Northern Zone of Ghana

K.T. Djang-Fordjour, G. Asare-Mantey, J.A. Bediako and E.O. Otchere
Faculty of Agriculture, University for Development Studies (UDS), Box 1350, Tamale, Ghana

Introduction

Draught animals in the study area are used primarily for work, transport, and leisure. They include the horse, ox, and donkey. Animal traction is potentially an appropriate technology, ecologically sustainable and socially accepted with no taboos. The supplementary and complementary connections between the crop sector and draught animals add to the importance of maintaining draught animals. Draught animals help propel farming business into a profitable enterprise. Animal power is used in different forms and for a variety of purposes all over the world. Due to the high cost of imported machinery, draught animals are highly recommended, but not wholly accepted for use in many areas of the northern zone of Ghana with the use of draught animals dating back to the early 1930's. The benefit of bullock traction was not considered to be labour saving for tillage, but rather as an important part of mixed farming as opposed to the prevailing separate production of livestock and crops. The level of feeding and management during the work season have had marked effect on the work animal. Some of the main limitations to effective use of draught power in the northern zone include:

(a) too few cattle for draught, especially for ploughing
(b) poor draught performance, and
(c) inappropriate equipment and harnessing for draught animals (Canacoo *et al,* 2003)

This study seeks to document the uses and management practises of draught animals in the Tolon-Kumbungu and West Mamprusi Districts of the northern region of Ghana.

Study methods

The study was carried out in 20 villages in the Tolon-Kumbungu District and West Mamprusi Districts. Ten farmers were randomly selected in each district. Both districts lie to the West and North of Tamale within longitude 1º and latitude 9º 21"N and

10º 00”N. This area is in the sub-humid zone where rainfall is seasonal, low, erratic, unimodal and poorly distributed. The rain begins in May, peaking in August, and averaged 950 mm per annum for the study period. The dry season which lasts for about 6–7 months results in severe reduction in both the quantity and quality of forage. Mean minimum and maximum temperatures for the zone are about 26ºC and 39ºC respectively. Vegetation in the study area is burnt annually and comprises of shrubs and grasses with too low nutritive value to support any serious livestock production.

A multi-stage sampling method was used to sample the villages. These two districts were the places where bullock traction technologies were prominent and also community livestock workers (CLW) kept accessible veterinary records. Sixty semi-structured questionnaires were administered to draught owners and the veterinary service division in the towns and villages. Laboratory analysis of samples for PCV and haemoglobin were undertaken in the Faculty of Agriculture laboratory, UDS, Tamale.

Findings

The average of of the farmers interviewed was 48 years comprising Moslems (73%), Traditionalists (23%), and Christians (3%). The mean household size was ten people and the average farm size ploughed in a year was 20 acres. Fifty-three farmers kept draught bullocks, 30% of farmers owned working donkeys, and 15% of farmers kept both bullocks and donkeys as draught animals.

A high percentage of farmers purchased their animals from the local weekly markets (65%) others (35%) inherited them from parents. Almost all the draught animal owners were men (98%) who used the animals (bullocks) in ploughing, ridging, harrowing, and transport (carting). The breeds of cattle used were West African Shorthorn (WASH), Zebu, and Sanga. Dark-brown and black and white breeds of donkeys were used for draught work. Donkeys were only used for transport (carting). Problems farmers encounter with draught animals included lack of feed in the dry season, inadequate hoof and teeth care, diseases and housing.

Reasons for breeds kept

There have been several reasons for the use of different breeds for work. The WASH is most common as a draught animal (45%) followed by the Zebu cattle (28%), followed by the Crossed Zebu cattle (3%) and Sanga 2%).

Reasons given by farmers for use of particular type of animals were as follows:

- The WASH has strong feet, straight legs, walks fast, has great strength, disease resistance, a good feeding habit, and can undertake hard/long periods of work.
- Zebu were said to be strong and hardworking, disease resistant, have straight backs and good horn formation.
- Crosses (WASH × Zebu) were said to have a straight back, good horn formation, broad hooves, good eye sight, and strong legs.

Almost all donkey owners provided shelter for their animals, to provide protection from rain and theft, but the bullocks were kept in open kraals.

Training and care for animals

Farmers took 2–3 weeks to train their animals. Farmers cleaned their animals daily or weekly especially the donkey. Farmers used kitchen knives (35%) and pocket-knives (65%) in trimming the hoofs of their work animals. Farmers (65%) always left their animals for grazing on free range with very little supervision. Supplementary feed and

water were given to draught animals. Most farmers (82%) stored crop residues such as millet/sorghum straw, soybean hulls, soybean leaves, cassava peels and leaves, cowpea straw, rice straw, and they were sometimes packed under sheds, in rooms or on top of buildings for future use by the animals. Water was provided for draught animals.

Problems of diseases and parasites

Table 1 gives the common diseases and parasites of draught animals in the study area (Table 1) and how farmers treated them.

Table 1: How farmers and Community Livestock Workers CLW's said they treated sick draught animals

Disease	No. respondents	Control
Septicaemia	37	Oxytetracycline
Chronic tick paralysis	43	Chloramphenicol
Dermatophilosis	48	Penicillin/Streptomycin, Pour-on*, Garlic + Neem seed, dirty engine oil + hot pepper
Trypanosomosis	23	Trypanocides
Piroplasmosis	35	Oxytetracycline
Babesiosis	14	Tetracycline, Bark of mango tree
Anaplasmosis (gall sickness)	30	Tetracycline
Fleas	41	Pour-on*, Garlic + Neem seeds
Ticks	53	Pour-on*, Garlic + Neem seeds Ivomec Inj.,
Mange	39	Dirty engine oil, Pour-on*, Garlic + Neem seeds
Lumpy skin disease	44	Dirty engine oil, Shea-butter cream
Intestinal Worms	67	Pawpaw leaves, Other herbs.

*Bayticol, Delvac DFF, E.C

Haemoglobin and PCV of draught animals

The mean (±sd) haemoglobin concentration (Hb) observed in this study was 11.5±0.8g/ and the PCV values were 32±7.1% for WASH bullocks. There were no significant (P>0.05) changes in haemoglobin (11.63 *vs* 12.38 g/dl) and PCV (32.8 *vs* 34.6%) levels before and after work. The haemoglobin and PCV values obtained in the present study compared favourably with the normal values reported for the bovine. of 11.5g/dl and 29% for haemoglobin and PCV% respectively. A low concentration of haemoglobin would indicate anaemia. The wide range in PCV of animals observed may be as a result of climatic conditions, effect of work, nutrition, age difference of animals.

The mean acreage ploughed using bullocks in the study area was 20 acres. This was as a result of high patronage of the use of draught animals and low cost of the services provided. With increasing awareness, more farmers are using work animals. Farmers paid between ¢30,00 and ¢35,000 for an acre of land ploughed with bullocks whilst the same size ploughed with a tractor cost ¢70,000 (1 US$S=¢7,000.00). Many

draught animals in the study area were weak at start of the rainy season due to poor feeding. Farmers had to wait for a month or more after the start of rains for the animals to regain their body condition and strength before being used for work. The delay in the initiation of ploughing at the onset of rains put pressure on farmers to overuse their animals. Farmers who started early accepted that they were overusing the animals but quickly added that they had to overcome the fast growing weeds on the fields.

The main problem confronting farmers in the study area was feed to maintain these animals during the dry season in order to use them during the onset of the first rains in May. There were poor housing infrastructure for animals resulting in high incidence of pneumonia and foot rot. High cost of drugs from the open market for treatment put farmers off calling for the services of veterinary personnel. Helminth infections had significant effects on draught animal management. Some farmers (16%) used traditional medicines to deworm sick animals. Also few farmers (15%) could mention two clinical signs of helminthosis in the donkey or ox. Diarrhoea was frequent and farmers (85%) observed diarrhoea at the start of the rains and whenever there was change in feed. Few farmers (10%) purchased mineral lick for their animals, however 'Sialla' a local mineral lick (Kabo, 2000) was used. Others (4%) did not use any mineral lick.

The results indicated that, lack of adequate quality feed during the dry season, poor management of bullocks, farmers' poor skills in handling bullocks, lack of farmers' associations to attract loans for work and lack of drugs for health care delivery were the main problems facing farmers in the use of draught animals.

Conclusions

This study has shown that the extent of draught animal utilisation varies depending on the environmental conditions prevailing and the social belief in the locality. The number of farmers having their own draught animals in the region is also quite appreciable. In almost all districts farmers used draught animals in one way or the other and individuals who do not have animals patronise draught animals belonging to other farmers. There was no association of draught animal farmers to enable them get more knowledge from the uses and management of the animals. Farmers appeared to be aware of the benefits of health management but they were mostly reluctant to invite the veterinary officers because of high cost of drugs. However in complicated cases, farmers were compelled to resort to veterinary personnel for attention. Farmers lacked knowledge about feeding and feed storage for dry season and proper shelter for their animals especially the bullocks. Government should extend to farmers support in the form of draught animal/farmer training, farmer associations to attract credits, technical advice on forage crops management, feed and feed storage and animal management. There is need to initiate routine draught animal prophylactic treatment and support the Veterinary Services to produce vaccines for the protection of animals against infectious diseases.

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(b) Morocco

Assessing the efficacy of an anthelmintic programme on the health and welfare of working equines in Morocco

Andrew G Wallace
Society for the Protection of Animals Abroad

Introduction

The Society for the Protection of Animals Abroad (SPANA) is a charity based in Great Britain providing veterinary and supportive care to animals living in less developed parts of the world. The charity currently works in eight different countries based around North and West Africa and the Middle East. In Morocco the charity's responsibilities includes care of the countries two million working equines, which are an essential part of the country's rural and urban economy (Plate 1). SPANA offers free veterinary care and husbandry advice through a network of 10 permanent clinics and 64 mobile clinics. The mobile clinics visit different souks (markets) each day to provide their services to the animals present.

A large part of the work undertaken at the souks is the intended prevention and treatment of gastro-intestinal parasitism through dosing with anthelmintic drugs. This project is a follow up study looking into the effectiveness of the anthelmintic programme currently performed by SPANA at the souks. It also gathered information on weight, age and reasons for presentation to the mobile units.

Parasitism in working equines has been shown to be a major source of ill health and the beneficial effects of an anthelmintic programme have been reported. Bliss *et al* (1985) showed extended

Plate 1. Donkey transporting goods in a Medina in Morocco (S Bayly)

parasitic control with a strategic use of anthelmintics (pyrantel and fenbendazole) in Greece. Khallaayoune (1991) demonstrated a significant reduction in the mean faecal counts of nematode eggs and an increase in body condition scores following anthelminthic (dichlorvos) dosing of donkeys in Morocco.

The species of helminths found in working equines is diverse and heavy. Khallaayoune (1991) showed donkeys in Morocco to be heavily infected with helminth parasites including *Tricchostrongylus axei* and *Habronema* species in the stomach, *Parascaris equorum* in the small intestines and *Strongylus vulgaris*, *Strongylus edentatus*, *Oxyuris equi* and small stronglyes in the large intestine. *Dictyocaulus arnfieldi* and *Setaria equina* were commonly found in the lung and peritoneal cavity respectively. Indeed verminous aneurysms due to the larvae of *S. vulgaris* were identified in 87% of donkeys necropsyed. Pandey (1980a, 1981) showed the seasonal pattern of *S. vulgaris* in Moroccan donkeys and horses, and found the overall mean percentage of arteries infected was 90.5 and 80 respectively. Pandey (1980b) showed *D. arnfieldi* infection to be present throughout the year in Moroccan donkeys with an annual incidence of 47.8%. The effects of high parasitic burdens can be severe. Among gastro-intestinal helminths, *S. vulgaris* is the most pathogenic in equines, causing unthriftiness, weakness, increased susceptibility to other infections and even death (Khallaayoune (1991).

Materials and methods

Anthelmintic programme

SPANA has been running an anthelmintic programme in the region of Marrakech since the 1930s. The routine preventative treatment for parasitism has evolved over the years but from four years prior to assessment the programme involved oral ivermectin (*Atlamec, Atlas Veterinaire*) given at a set dose of 15ml to donkeys and 30ml to mules and horses (roughly 0.2 mg/kg). Following the initial dose repeat treatments are given one month subsequently, and every three months thereafter for life. It is the responsibility of the animal's owner to present it for treatment when required.

Location of sampling

Routine daily visits to souks in the region of Marrakech were used for sample collection (Plate 2). For the assessment of anthelmintic treatment souks were split into a treatment group (frequently visited by SPANA) and a control group (not previously visited by SPANA). Five souks made up the treatment group of which one was visited twice. One souk was used for the control group and visited on three occations. All souks were located within a 50km radius of Marrakech, all in geographically similar areas. Samples were collected in the month of August during the countries dry season. Samples were taken at random from equines presented to the mobile clinic. The souks used in the treatment group had been routinely visited by SPANA's mobile clinic at least twice monthly over a varying period of years. All equines presented had been assessed by a veterinary surgeon and treated accordingly. The control souk had not been visited by SPANA for 22 years with the likelihood of other anthelmintic treatment being extremely low.

Sample collection

Ninety-seven donkeys, 49 mules, and 12 horses were sampled from those presenting at the clinic for treatment. Two parameters were chosen to estimate worm burdens

Plate 2. A souk (market) in the region of Marrakech, Morocco (A. Wallace)

(i) the number of eggs per gram (epg) in faeces, and (ii) the body condition score. Rectal faecal samples were used together with the modified McMaster technique to calculate the egg count. No species identification of the eggs was performed. Condition score was assessed subjectively using a scale from 1(emaciated) to 9 (obese) as outlined by Pearson and Ouassat (1996) for working donkeys in Morocco and adapted in this study for use in mules and horses.

Species, sex, age, reason for presentation and live weight were also recorded for analysis. Age was estimated by dental examination of incisor teeth. Liveweight was estimated using the most accurate field techniques available: for horses using a weightape, and for donkeys and mules by measuring heart girth and body length with predictions taken from nomograms specifically developed for use in working donkeys (Pearson and Ouassat, 1996) and mules (Kay, Pearson and Ouassat, in press) in Morocco.

Results

Eggs per gram and condition scores

Tables 2 and 3 show the results obtained for the mean number of eggs per gram (epg) and the mean condition scores for the treatment and control groups.

Statistical analysis using Kruskal-Wallis tests showed that both egg counts and condition score were not significantly different ($P>0.05$) for each of the three species when compared between SPANA visited and non-visited souks. No correlation was found between epg and condition score for each of the three species.

Table 2: The mean values of epg in the equids sampled in the souks around Marrakech

	SPANA visited souks				SPANA non-visited souk			
	Mean	SD[1]	median	n	Mean	SD	Median	n
Donkeys	1,058	914	850	62	1,509	1,525	800	35
Mules	1,253	2,140	300	36	877	1,333	200	13
Horses	27	49	0	7	200	292	100	5

[1]Sd, standard deviation

Table 3: The mean values of condition score for the equids sampled in the souks around Marrakech

	SPANA visited souks				SPANA non-visited souk			
	Mean	SD[1]	median	n	Mean	SD	Median	n
Donkeys	4.8	0.93	5	62	5.3	1.0	6	35
Mules	4.7	0.93	5	36	4.9	1.26	5	13
Horses	5.0	0.58	5	7	5.4	0.55	5	5

[1]Sd, standard deviation

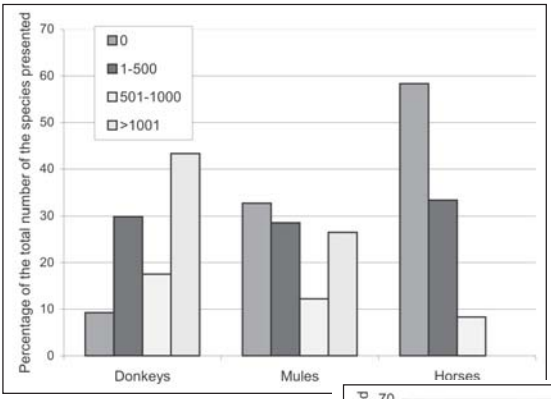


Figure 1: The distribution of epgs in the different species of equid sampled in the souks around Marrakech

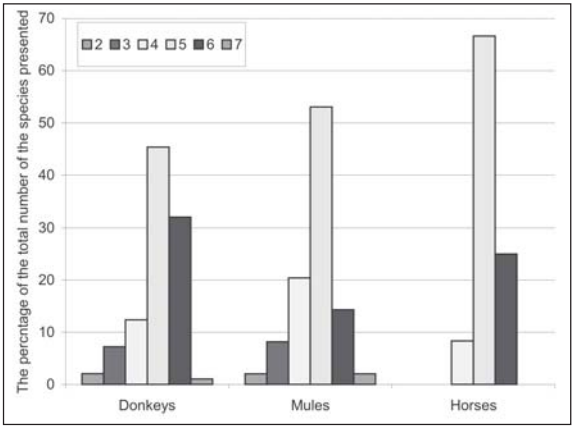


Figure 2: The distribution of body condition scores in the equids sampled in the souks around Marrakech

Weight

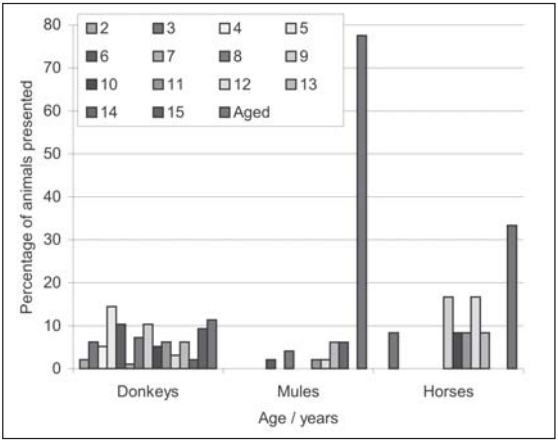
Table 4: Mean weights (kg) of equines sampled in the souks around Marrakech

	Overall				Male				Female			
	Mean	SD[1]	median	n	Mean	SD	median	n	Mean	SD	Median	n
Donkeys	152	24.8	152	97	152	25.8	154	64	152	23.1	152	33
Mules	227	31.8	227	49	228	28.9	227	12	227	33.0	227	37
Horses	292	48.0	280	12	301	47.1	285	10	248	24.7	248	2

[1]Sd, standard deviation

Age

Figure 3: The distribution of age in the equids sampled in the souks around Marrakech



Reasons for presentation for treatment

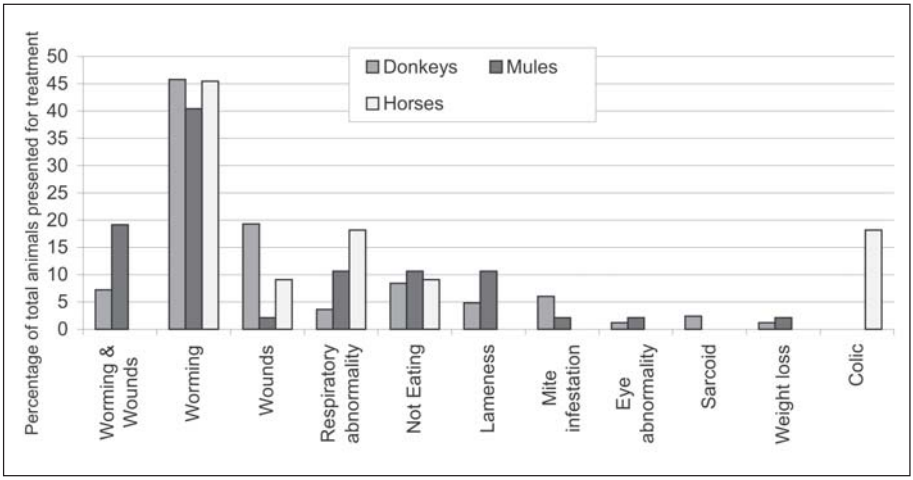


Figure 4: The reasons for presentation of equids for treatment at the mobile clinics in the souks around Marrakech

Discussion

Anthelmintic programme

It could be argued that the lack of correlation between epg and condition score would indicate a trend that does not show improvement to health status following anthelmintic treatment. However, it is the authors belief that the poor correlation is due to the effect of other contributing factors, such as nutrition and the amount of work, which have a major effect on the body condition. As such condition score of working equines is a poor indicator of parasitic burden in this environment.

The results show no statistically significant difference between helminthic parasitic burdens (estimated using egg counts of faeces and body condition score) of donkeys, mules and horses from souks routinely visited and a souk not previously visited by SPANA. Indeed the conditions scores of all equine species were higher in the newly visited souk and the mean egg counts found in the faeces of mules were lower in the previously untreated group. However, the mean epg of the SPANA visited souks was much less than the control group for donkeys and horses, indicating some effect of treatment. Two likely reasons for the lack of significant effect in the results are:

(i) Too few equines sampled in the treatment group had previously received anthelmintic treatment (as previous treatment was not assured).

(ii) The treatment was not having the desired effect to reduce gastro-intestinal parasites in the souks analysed.

Though it is possible that the some of the animals in the treatment group had not previously received an anthelmintic dose, the duration of time that SPANA has been visiting the souks and number of animals treated at each visit, should have resulted in sufficient treated animals being sampled. It therefore appears that the programme of anthelmintic control is not proving totally effective in its goal.

The programme's shortfall indicates a swift re-infection of helminths following treatment. This is enhanced by:

(i) The sharing of communal pastures with animals that are untreated with a high gastro-intestinal worm burdens is likely to give a high exposure to larval stages of the helminths and encourage rapid re-infection in the treated animals.

(ii) The efficacy of ivermectin against encysted helminth larval stages in the intestinal tract of the animals is low, thereby resulting in swift re-infection soon after treatment. Evidence of the low efficacy of ivermectin against 4th stage encysted larvae is well documented (Klei *et al.*, 1993; Xiao *et al.,* 1994), enabling re-emergence and re-infection once the therapeutic levels of the drug in the body have waned.

Thus the efficacy of the anthelmintic worming strategy employed by SPANA could be improved. The normal benefits associated with the treatment are not being met and so new dosing strategies should be sought.

Suggestions for possible changes to the anthelmintic programme are:

(i) Improved education of the importance of anthelmintic treatment thereby increasing the number of animals presented to the mobile units.

(ii) Shorter anthelmintics dosing intervals of ivermectin, reduced from 12 to 8 weeks.

(iii) Use of an anthelmintic that has improved efficacy against encysted larvae found in the mucosa of the gastro-intestinal tract.

(iv) Systematically treating all animals in a region through an entire grazing season to lower the level of pasture contamination.

Education of owners to the importance of anthelmintic dosing is the key to improve the health status of equines. Treatment is most easily performed when the animals are presented and this only occurs if the owners are aware of the need for and availability of wormers.

The current dosing interval of 12 weeks is greater than the period of effective parasitic control offered by ivermectin. A shorter period, such as 8 weeks (Intervet 3-year worming plan, 2002), would maintain lower adult worm burdens within the intestinal lumen, and thereby concurrently reduce the pasture larval contamination. The study by Bliss *et al* (1985) in Greece found only frequent dosing of working equines every 4 weeks were effective in reducing worm egg counts, though in this instance fenbendazole and pyrantel were used.

The reactivation of encysted cyathostome larvae in intestinal mucosa is major source of adult worm numbers. Ivermectin has been found to have a poor efficacy in eliminating these encysted larvae (Xiao *et al.,* 1994). Moxidectin, however, has been shown to have a reasonable efficacy against these larval stages (Bairden *et al.*, 2001) and has been shown to have a much greater control over encysted larvae than ivermectin (Xiao *et al.,* 1994; Monahan *et al.,*1996). Due to its persistent activity within the body moxidectin also has a longer duration of action than ivermectin (Demeulenaere *et al.,*1997; Mercier *et al.,*2001; Martin-Downum *et al.,* 2001) allowing prolonged control of nematode infection. However, financial factors must be assessed prior to switching to this preferable drug.

An ideal strategy would be to dose all animals in an equine population at similar times during a grazing season. This would both lower intestinal worm burdens and pasture larval contamination. This is supported by Khallaayoune (1991) who in his study of donkeys in Morocco found relatively high faecal egg counts during the summer months. He goes on to suggests improved parasitic control in a population of equines by systematically treating all donkeys in the same region. However, obvious practical and financial limitation must be overcome to make this feasible.

Though some research has been effective in providing evidence of the importance of anthelmintic dosing to over come gastro-intestinal worm burdens in working equines (Bliss *et al.,* 1985; Khallaayoune, 1991), further studies need to be performed to accurately determine the correct dosing interval and dosing frequency of specific anthelmintic drug types in working equines raised under smallholder farming conditions.

Weight

The mean liveweights of donkeys (152 kg), mules (227 kg) and horses (292 kg) with a strong similarity between sexes, provides information on the correct average drug dosages when seeking a mean treatment dose for a species.

Age

The age distribution amongst donkeys is relatively even, with a spread from 2 years to aged (over 15 years). The life expectancy of donkeys is low with only 11% of donkeys sampled being over the age of 15 years. Mules, however, are predominately much older with the vast majority (77%) being aged. This low life expectancy of donkeys is

consistent with surveys done in Mediterranean countries (Svendsen, 1991) and Morocco (Pearson and Ouassat, 1996) where few donkeys were found to be over 12 years of age. This is in stark contrast to those found in countries such as Britain where they have an average life expectancy of 37 years (Svendsen, 1991). The reasons behind this are numerous but are based around the fact that donkeys in the UK much less work, receive on the whole better veterinary care and are exposed to fewer tropical diseases. This contrast highlights the need for an effective anthelmintic programme to aid the health status of animals.

Reasons for presentation at the mobile clinics

The largest reason for presentation to the mobile clinics at the souks is for worming with 44% of all treatments. Worming and wound treatments combined accounts for 67% of the work performed, with respiratory abnormalities and a dysphagia the next largest reasons for presentation. Respiratory abnormalities and colic are more common in horses. This may be due to horse being kept in superior housing and being fed a greater amount of concentrated feeds, though this husbandry information was not gathered.

Conclusion

Despite the great efforts in using anthelmintics, the current worming programme employed by SPANA has shortfalls in reducing the overall worm burdens of working equines in regions of Morocco. Alterations to the programme with priority to encourage greater animal participation thereby reducing gastro-intestinal worm burdens leading to lower pasture larval contamination would greatly improve the health and welfare status of the animals involved. Further scientific studies into the correct dosing interval and frequency of anthelmintic treatments would be of great benefit to modify the programme currently used.

Acknowledgements

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2. LATIN AMERICA

(a) Mexico

Tracción animal, empleo y rentabilidad en la producción de maíz de México

Artemio Cruz León, César Adrián Ramírez Miranda[1] y José M. Omaña Silvestre[2]

[1] Desarrollo Rural Regional. Universidad Autónoma Chapingo, México.

[2] Colegio de Postgraduados. Montecillo, México.

Animal traction, use and profitability in Mexican maize production

Abstract

The profitability of four maize Mexican production technologies was analysed based on a survey covering 79% of the sown area. The analysis showed that the animal traction system had the highest unit costs. However the increase in production costs and the intensification of the use of the soil with tractor power did not have a positive effect on the benefit:cost ratio. This means that, if Mexico ceases to help small-farmer systems that depend on animal power or slash and burn, she will lose an opportunity to strengthen self-employment and food security.

Resumen

El análisis de la rentabilidad en los cuatro tipos tecnológicos con que se produce maíz en México, con base en una encuesta que cubrió 79% de la superficie sembrada, muestra que la tracción animal tiene los más elevados costos unitarios, pero también

[1] Profesores de la Maestría en Desarrollo Rural Regional. Universidad Autónoma Chapingo, México.

[2] Profesor Programa de Economía del Colegio de Postgraduados. Montecillo, México.

que el aumento de los costos de producción y la intensificación del uso del suelo mediante los tractores, no repercute directamente en la relación beneficio costo. Lo anterior significa que México al dejar de apoyar los sistemas campesinos con tracción animal o de roza, tumba y quema, pierde una oportunidad para fortalecer el autoempleo y la soberanía alimentaria.

Introducción

El maíz es el cereal que sustentó a la civilización mesoamericana y actualmente es la principal fuente de carbohidratos para millones de familias que lo producen bajo diferentes condiciones ambientales y tecnologías. En este trabajo se considera que la producción de maíz en México representa la diversidad tecnológica en el centro de orígen de esta planta, diversidad que puede ser aprehendida considerando el tipo de energía utilizada para realizar las diferentes prácticas agrícolas. De esta manera el maíz se obtiene mediante: (1) producción bajo roza, tumba y quema (RTQ) en la que se usa únicamente la fuerza del hombre, por lo que corresponde a la forma menos intensiva, realizada en el sur del país, en climas tropicales y con suelos restrictivos; (2) producción con empleo de animales de trabajo (*eg.* Plate 3), asociada a los sistemas extensivos de temporal y a economías campesinas autoconsuntivas, rasgo que comparte con la RTQ; (3) producción mixta que utiliza animales y tractor, forma que tiende a incrementarse debido a la migración campesina, y (4) producción con tractor como el sistema de mayor crecimiento en las últimas décadas.

Metodología

El análisis de rentabilidad para cada una de las formas tecnológicas permite un acercamiento a la problemática de la producción de maíz y aporta elementos para

Plate 3. Draught oxen ploughing in Mexico (A Cruz)

reflexionar sobre la pertinencia de canalizar mayor apoyo a los sistemas que hacen mayor uso de fuerza de trabajo. En este trabajo se utilizó la información de una encuesta levantada en todo el país por el Programa de Economía del Colegio de Postgraduados, la cual cubrió el 79% del total de la superficie sembrada con maíz en México (INEGI, 1994); en particular se recurrió a la base de datos para maíz, la que incluye información sobre los precios de los insumos utilizados y los volúmenes de producción obtenidos (Omaña, S., 1999). En el presente estudio se hizo el agrupamiento de las tecnologías de acuerdo al tipo de energía utilizada y se realizó el análisis de rentabilidad, a través de la relación beneficio/costo.

Resultados

Los datos de la encuesta muestran el amplio predominio de la tecnología del tractor, en términos de superficie sembrada, pues los dos sistemas en que este tipo de tracción está presente suman el 73% de la superficie (cuadro 5). Estos datos contrastan con lo reportado por el Instituto Nacional de Estadística Geografía e Informática que asigna a estos sistemas menos de la mitad de la superficie sembrada (INEGI, 1994). Los costos totales reflejan claramente la intensificación de la producción, pues se incrementan en los diferentes sistemas en relación directa con los insumos utilizados; por ello la producción con tractor, típica de las explotaciones comerciales, es la de mayor costo.

Las diferencias en los costos de producción de los sistemas que hacen uso del tractor y aquellos basados en la tracción animal y la fuerza humana, no se refelejan en la misma proporción en la relación beneficio-costo, pues en este indicador de la rentabilidad las diferencias son poco significativas.

Cuadro 5: Superficie sembrada, porcentaje y relación costo beneficio de la producción de maíz, de acuerdo al tipo de tecnología

Tipo de tecnología	Sup. Sembrada (ha)	Porcentaje	Costo total (Pesos por ha)	Relación beneficio-costo
RTQ	1 081 582	19.3	1 104.1	1.02
Con animales	424 037	7.6	1 630.1	.99
Mixto	1 373 169	24.5	2 090.7	1.05
Con tractor	2 702 054	48.9	2 175.8	1.11
Total	**5 580 849**	**100**		

Cuadro 6: Rendimientos, costos y jornales en la producción de maíz en México

Tecnología	Rend/ton/ha	Costos/ton	Jornales/ha	Jornales/ton
RTQ	3.70	305.4	40	10.80
Animales	3.11	520.5	30	9.64
Mixta	4.66	474.7	28	6.00
Tractor	5.08	475.2	23	4.52

En lo que se refiere a los rendimientos, éstos se incrementan de RTQ a la producción con tractor, reflejando el comportamiento de los costos de producción. El costo por tonelada resulta muy parecido en la producción mixta y de tractor, y es más elevado en la producción con animales de trabajo, como reflejo de los menores rendimientos

en este sistema. Destaca el hecho que corresponda a RTQ el costo por tonelada más bajo, lo que se debe a la baja cantidad de insumos y de capital incorporados, como característica de las tecnologías propias de las economías campesinas. También es notorio el mayor número de jornales utilizados por hectárea, mismos que siguen un comportamiento inverso a la tendencia de tecnificación de la producción.

Discusión

A partir de los datos presentados se observa que los costos son más altos en la producción con tractor , disminuyendo progresivamente hasta RTQ, tendencia que se observa para el caso de rendimientos, lo que se refleja en la relación beneficio costo. Sin embargo la mayor inversión no se refleja en mayores beneficios y eficiencia.

Salvo en la producción de maíz con animales los rendimientos se incrementan de RTQ a tractor. Destaca que los costos por tonelada son considerablemente más altos en todos los sistemas que en el de RTQ. El costo más elevado corresponde a la producción con animales, lo que resulta contrario a lo reportado por Starkey (1982). En lo que se refiere a la cantidad de jornales por hectárea, ésta va de 40 en RTQ a 23 en la producción con tractor, lo que coincide con los trabajos de Masera (1997) en cuanto a los jornales empleados para la producción de maíz con animales, mixta y con tractor. Mariaca *et al* (1995) reportan cantidades superiores, pero con la misma tendencia.

Las cantidades de jornales utilizados en RTQ son congruentes con el requerimiento de fuerza de trabajo humana para la tumba de árboles, misma que se encuentra ausente en cultivos de segundo año y siguientes. En cuanto a los rendimientos del trabajo, medido por la cantidad de jornales necesarios para la producción de una tonelada de maíz, se observa que se requiere más del doble de días de trabajo en RTQ que con el tractor (cuadro 6). Esto resulta importante para el caso de México, país con importante disponibilidad de mano de obra, en el que la tecnología predominante es la del tractor, pese a las evidentes ventajas de promover sistemas tecnológicos basados en la utilización masiva de dicha mano de obra, en el marco de economías campesinas capaces de garantizar el autoabasto de alimentos y aportar a la soberanía alimentaria del país.

Conclusiones

El análisis económico de la producción de maíz en México arroja importantes luces sobre la diversidad tecnológica de este cultivo y su relación con el uso de los recursos productivos.

El hecho de que las importantes diferencias en los costos de producción de los diferentes tipos tecnológicos no se vean reflejadas en la relación beneficio costo, que es el indicador de la rentabilidad, muestra que la mayor intensidad de utilización del suelo y la mayor asignación de capital no se corresponde directamente con los beneficios obtenidos por los productores que usan tractor o tracción mixta. Este hecho, desde el punto de vista macroeconómico significa que el mayor desgaste del recurso suelo, a través de la tracción por máquinas, no se compensa con mayores dividendos económicos.

En cambio, el predominio de los tractores en la producción de maíz contribuye a desplazar fuerza de trabajo humana de la producción de maíz. En esta circunstancia, la producción de maíz con animales de trabajo, pese a sus menores rendimientos, que

repercuten en los costos por tonelada más altos del conjunto de los tipos tecnológicos, debe ser valorada en términos de la utilización que hace de la mano de obra de las familias campesinas. Proporcionar empleo a una porción importante de la población rural debiera ser una prioridad en países como México, caracterizados por la creciente emigración campesina y la pérdida de la soberanía alimentaria.

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3. ASIA

(a) Vietnam

Link project on improved utilisation of animal power in sustainable agriculture in Vietnam

Mai Van Sanh

National Institute of Animal Husbandry (NIAH), Hanoi, Vietnam

Some of the poorest agricultural land in Vietnam is in the rain-fed hilly areas where tractor power is not easily affordable or accessible to the smallholder farmers who live there. A project on '*Improved utilisation of animal power in sustainable agriculture in Vietnam*' has been established in a collaborative project between the National Institute of Animal Husbandry (NIAH), Hanoi, Vietnam and the Centre for Tropical Veterinary Medicine (CTVM), University of Edinburgh, UK funded by the British Council.

The purposes of the Link project are:

- To help Vietnamese farmers to improve the management of draught animals (selecting, feeding, and training animals) and increase the draught capacity (comparison of different working practices) – through the development of research/ extension projects.
- To improving the knowledge and skill of research staff, extensionists and farmers on the effective use of animal power in sustainable agriculture.
- To promoting the development of the cattle and buffalo in hilly areas through the development of projects aimed at increasing the reproductive rate of the female animals.

- To contribute to the orientation of agro-mechanisation in the mountainous provinces – through the comparison experiments of the effectiveness of using animal draught power and tractors.

It is hoped that the results of the project will lead to:

- Better use of draught animal in small households, which will decrease the crop production cost, improve the net income of small farmers and also stimulate the development of the cattle and buffalo population.
- Using animal draught power should also contribute to maintenance of soil fertility and a healthy environment.

The main activities of the project will be concerned with exchange of the knowledge and experiences of staff between two Institutions and training programmes established for farmers. The training programmes in the project will provide more knowledge on management of animal power for the local staff and particularly for farmers.

The findings of the projects will also help the policy makers to develop the orientation of mechanisation in agriculture.

In the first year, two staff from NIAH, Vietnam have visited CTVM, UK to discuss the realisation of the project activities and prepare a project plan with UK partner. They also visited some Institutions related to Animal Science in Scotland to exchange research experiences. The purpose of the visit was also to develop training materials for draught animal farmers and update the knowledge of recent advances in draught animal power research relevant to Vietnam.

The visit was very successful, the agreement has been reached with UK partner on the topics and problems linked with the training courses for the staff of NIAH and for Vietnamese farmers. The visitors updated their knowledge on animal traction, especially the experiences in from other developing countries, learnt the ways and experiences of organising the training course for staff and for farmers. The materials (in English) for training courses of staff and farmers in Vietnam were prepared, ready for translation into Vietnamese. The first two training courses in Vietnam are planned for December 2003.

(b) India

An economic study of the use of draught camels and bullocks in farming in the Thar desert

Champak Bhakat, D. Chaturvedi and M. S Sahani
National Research Centre on Camel, Bikaner-334001, India

Introduction

Farming systems are the result of present day awareness regarding the concept of agriculture, which means an optimum exploitation of Plant–Animal–Human relationship. This awareness has raised the importance of draught animals in achieving total agricultural income particularly in the north–western Thar desert, where animal power is an inseparable part of agriculture. In India farming operations are carried out using manual, animal and mechanical power sources. Animal power contributes to about one third of the energy input in agriculture (Mishra, 1986). Eighty-four million draught animals are used for crop production and transport purposes (Cartman, 1994). Tractors have assumed importance in some areas, but much of the terrain of farming and the poverty

of the population restrict their use in the interior villages of the Thar desert. The present degree of mechanised farming in the hot arid region is selective and quite low. Moreover, increased cost of fuel, non-availability of spare parts when required in the interior villages, high maintenance and upkeep of tractor engines by the farmers are problems which compel the farmer to replace mechanical devices with camel or bullock power. Singh (1999) reported that animals continue to be a major source of motive power (tractive and rotary) in India for the smallholder farmers. The animal should be compatible with crop cultivation instead of competing with it for land and water resources. A camel keeping enterprise fits well with such requirements. Camel energy is not only cost effective but also profitable and remunerable. The total world camel population is estimated to be 19.3 million of which India has a camel population of 1.03 million (FAO, 2002). Since 85% of the gross cultivated area of the Bikaner district is non-irrigated, camel carts hold a significant potential for finance (Amresh Kumar, 1999). In the state of Rajasthan the major population of draught animals is bullocks followed by camels. In comparison to other livestock species the camel remained neglected until this century when attention was drawn to it because of it's unique adaptive characteristic for surviving in the harsh conditions of the desert eco-system. Camels can tolerate high temperature, solar radiation and water deprivation and subsists on poor quality thorny vegetation. The project aimed to investigate the main features and economics of use of camel power as well as bullock power in agriculture to see whether farmers effectively use these animals and also to find out economic viability of both types of draught power farming systems.

Methods of data collection and analysis

The required data were collected in the suitably developed and pre- tested performa by survey method. Observations were recorded on farming use of camels (a single camel with implements) and bullocks (a pair of bullocks with implements). The selection of respondents was carried out using a stratified random sampling technique. The study involved a total of four zones of khajuwala tehsils (Bikaner district) of Thar desert. Each of the four zones (north, south, east and west) consisted of twenty villages. A sample of 16–17 households was drawn from each village randomly for data collection. A total sample of 180 camel keepers and 164 bullock farmers were interviewed. Detailed economics of both power systems were analysed using linear programming (Loomba, 1992). To work out the estimates of maintenance cost of draught animals (feeding and health cover etc), implements and cost of crop cultivation, the opportunity cost of owned inputs and actual prices paid by the farmers for purchasing inputs were considered. To obtain the gross returns from different sources of income of farmers, the market prices and present day value were considered.

Observations

Agriculture and draught animals go side by side in boosting the farming business into a profitable enterprise. The average time required for ploughing of each 0.5 ha of land was almost the same in camel powered (1.12±0.32 day) and bullock powered (1.23±0.37 day) systems, but the average effective working life of a camel (18.5±0.89 years) was higher than that of a bullock (14.8±0.65 years). The average 'lifespan' of animal-drawn implements was almost equal. A similar trend was found by Jain *et al*

(2000). An equal number of family labour and hired labour were employed /ha/day in both systems. Most camel keepers (91%) involved themselves in the farming operation. The exceptions were in some larger farms (9%) that engaged some hired labour. A similar trend was found in the bullock power farming systems. The average cost of a male camel was Rs. 9782 and of a bullock was Rs. 5578. The average cost of animal-drawn implements was similar in both systems. Most of the camel keepers (91%) purchased their camel on a cash basis other (6%) by instalments or loan (3%). A similar trend was found for bullock farmers. Most camels used in farming operations (90%) were male. A wide range of ages of animals was used in agricultural operations. Most camels were in the age range 6–8 year age, followed by 8–10 years, 4–6 years, >10 years and <4 years age group with an overall average age of 6.4±0.98 years. Most bullocks were in the 4–6 years age group, followed by 6–8 years, 8–10 years, <4 years and the >10 years age group, with an overall average of 4.1±0.76 years. This is similar to reports by Bhakat and Sahani (2000). The average working days in a year (in agriculture operations and carting) were almost equal in both type of farming systems. The mean working time (hrs/day) for the Rabi and Kharif seasons was about same in both cases. Annual average net income (Rs/ha) from the kharif season crop was more in the camel power system than in the bullock power system, because camels are used to cultivate groundnuts (kharif season crop), which provided a comparatively higher return per rupees investment than other kharif season crops, where bullocks were mostly used.

Most animals were kept in an intensive system of management, with some camels and bullocks being managed semi-intensively or extensively. This is mainly due to a shortage of grazing land. The chi - square test showed a significant ($P<0.01$) influence of size of farm on the way the animals were kept (Table 7).

Among the kharif season crops, groundnut provided the highest return per rupees investment followed by guar, cotton and moth where as among the Rabi season crops, mustard provides higher return per rupees investment followed by gram and wheat (Table 8). For cultivation of groundnuts, camel power is mostly used because groundnuts require sandy soil. For the cultivation of cotton, bullock power is mainly used because cotton requires a sandy-loam soil. For cultivation of all other crops, camels and bullocks are both used as per their availability.

Table 7: Influence of size of farm on the way draught animals are kept and managed in the Thar desert region

	Camel (%)				Bullock (%)		
Category of Farm	**Intensive**	**Semi Intensive**	**Extensive**	**0verall**	**Intensive**	**Semi Intensive**	**0verall**
Small£ 6 ha	46	34	20	15	58	42	23
Medium 7–15 ha	57	23	20	62	63	37	55
Large³ 16 ha	60	22	18	23	79	21	22
Over all	56	24	20		65	35	
Chi square value		1.91 * *				4.43 * *	

* * Significant at 1% level.

Table 8: Economic gain from agricultural land where camel and bullock power is used in the Thar Desert region

Crop	Season (K-Kharif R-Rabi)	Average Production (Q/ha)	Av. cost cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Return/Rs investment (Rs)	By using Camel (C) Bullock (B)
Cotton	K	16.60	5,780	21,580	15,800	3.73	B-mostly C- rarely
Ground nut	K	31.40	9,340	45,530	36,190	4.87	C-mostly B- rarely
Moth	K	5.60	2,240	7,000	4,760	3.13	C / B
Guar	K	8.00	2,256	10,400	8,144	4.60	C / B
Wheat	R	23.60	5,460	15,340	9,880	2.81	C / B
Mustard	R	12.40	2,348	14,880	12,532	6.34	C / B
Gram	R	10.00	3,332	17,000	13,668	5.10	C / B

Table 9: Analysis of the economics of camel and bullock powered agricultural systems in the Thar desert region

	Camel powered system (N = 180)	Bullock powered system (N = 164)
Fixed cost (Rs)		
Interest on investment [@ 9 %]	1,010	1,192
Depreciation of implements[JV @ 10 %]	157	168
Depreciation of animal [SV @ 12 %]	438	663
Insurance on animal(s)	483	582
Total Fixed costs	***2,088***	***2,605***
Variable cost/year (Rs)		
Hired labour	11,310	12,246
Family labour	11,232	14,560
Maintenance of animal(s)	14,600	29,200
Repair and maintenance of animal-drawn implements	100	100
Misc/other expenditures	200	200
Total Variable costs	***37,442***	***56,306***
Economic estimate		
Total Expenditure (Rs)	39,530	58,911
Earning from different sources :		
Net income from agriculture per year(Rs / ha)	25,021	20,810
Sale of manure (@ Rs 75/Q)	821	1,600
Income from carting (Rs)	42,300	39,950
Profit(Rs)	28,612	3,449
Pay back period for investment on animal system (year)	0.39	3.84
Cost benefit ratio	1.72	1.05

Analysis of the economics of camel and bullock powered systems is presented in Table 9. The bullock system required higher interest on investment than the camel system (Rs 1,192/– and Rs 1,010/– respectively). The depreciation of all necessary implements used with camel and bullock power was almost same, when the scrap value

(J.V) of implements was considered @ 10% of average initial cost. The depreciation of a pair of bullock (Rs 663/–) was more than of a single camel (Rs 438/–) when the salvage value (S.V) was considered @ 12% . The expenditure for insurance on bullock power (Rs 582/–) was more than on camel power (Rs 483/–). Premium rate was considered @ 5% of average initial cost along with overall service tax @ 5%. The overall total fixed cost was higher in a bullock power system (Rs 2,605/–) than in a camel power system (Rs 2,088/–). The various components of variable cost were considered on a yearly basis. The expenditure for hired labour as well as family labour were almost same in both power systems. Maintenance cost of a pair of bullock (Rs 29,200/–) was higher than of a camel (Rs 14,600/–). The average contribution for expenditures towards repair and maintenance of animal-drawn implements and miscellaneous /other expenditure almost equal in both type of farming systems. The overall total variable cost was higher for bullock power (Rs 56,306/–) than for camel power (Rs 37,442/–).

The total expenditure was higher for in a bullock powered system (Rs 58,911/–) compared to a camel powered system (Rs 39,530/–) because a pair of bullock was involved in farming operations and a single camel was used for the same purpose. The average earning from selling of manure was greater in the bullock powered system (Rs 1,600/–) as more manure was available than in the camel system. The average income from camel carting was higher than for bullock carting. The use of camel power provided a higher profit than the use of bullock power in farming systems in a hot arid ecosystem. The pay back period (PBP) for investment on animal power system was much less in the case of camel power (0.4 year) than for bullock power (3.8 years). The cost benefit ratio was higher in a camel powered farming system (1.72) than in a bullock powered system (1.05).

Conclusions

The animal wealth of the farmers can be used efficiently and preserved as a fixed asset, which is a symbol of dignity, social prestige and pride to the farming community. A camel is an important asset to the rural population in the remote villages of the Thar desert. It also has the potential to provide more income and employment to the unemployed youth of a farmer's family. This study has shown the advantages of using camel power over bullock power in the farming systems in the Thar desert. This is due to a higher cost benefit ratio and shorter pay back period which makes the camel a more attractive power option than a pair of bullocks for the small and medium sized farms in the hot arid Thar region.

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(c) India

Comparative studies on the work performance of indigenous and crossbred bullocks during ploughing

P. V. Yawalikar, L.M. Karanjkar and R.A. Patil
Dept. of Animal Husbandry and Dairy Science, Marathwada Agricultural University

Introduction

Deoni (D) and Red Kandhari (RK) are two prized cattle breeds of the Marathwada region. Cows are low yielders, but males are famous as draught animals in agriculture particularly for ploughing. The Holstein Friesian x Deoni crossbred males (HF/D) are also used for all such work. Reports on the comparative studies on the draught capability of Deoni and Holdeo bullocks during ploughing operation are available, however, scientific information on the comparative draught ability of D, RK and HF/D crossbred bullocks during ploughing is not available. This study compared the three breeds during ploughing.

Methods

Two healthy pairs, each of RK, D and HF/D were selected for the study. All the animals were between the age of 3½ to 5 years. In selecting the animals, more emphasis was given to the body weight (RK: 433 and 455 kg, D: 550 and 551 kg and HF/D: 648 kg and 650 kg) rather than the age of the animals. Ploughing in the Kharif season was performed from 25 May-9th June 1999 and for the Summer season from 15-30 March 2000.

The draught force developed, speed of the operation, horse power generated and the area ploughed were measured. All the trials were conducted at the University Campus, Parbhani. Each trial was repeated for five consecutive days for three hours during the morning (8.00–11.00 am) and afternoon (1.30–4.30pm). A randomised block design with a three factorial model was used for the statistical analysis of the data collected (Panse and Sukhatme, 1967).

Results

Draught force generated in ploughing

Breed, season and time in the day had a significant ($P<0.05$) effect on the draught forces generated during ploughing (Table 10).

Other studies have observed higher draught forces when crossbred cattle are used for work compared to values obtained when indigenous bullocks are used.

The draught generated by bullocks was equivalent to 15% of live weight in Deoni and Red Kandhari cattle and equivalent to 13% in cross bred bullocks. The results of the present work agree with the results of Vaugh (1947) who noted that the bullocks working

continously could sustain a draught force equivalent to 17–20% of their body weight. Maurya and Devadattam (1982) also reported that the crossbred could sustain a draught force varying from 11–19 % of body weight when working. The power and work output of bullocks decreased with an increase in working time in a prolonged operation. Nagpaul *et al.* (1984) reported that the crossbred bullocks worked comparatively better than the '*deshi*' bullocks. Premi (1979) reported that Hallikar bullocks could sustain an average draught force of 13–16 % of the body weight during six hours of work.

Table 10: The mean draught force (kgdf) during ploughing measured using different breeds of cattle in different seasons and times of day

Breed	Summer season morning	Summer season afternoon	Karif season morning	Karif season afternoon	Overall[1] mean
Red Kandhari (RK)	68	67	69	69	69[a]
Deoni (D),	83	76	85	78	81[b]
Holstein/Friesian × Deoni (HF/D)	86	84	87	85	86[c]

[1]Different subscripts indicate significant differences at 5% level

Gattewar (1983) reported that crossbred could sustain a pull higher than that of Hariana bullocks; this difference may be due to more stamina and slightly higher body weight of crossbred bullocks.

Speed (km/hr) observed at ploughing

Breed, season and time in the day had a significant ($P<0.05$) effect on the speed of working during ploughing (Table 11).

Table 11: The mean speed of working (km/hr) during ploughing by different breeds of cattle in different seasons and times of day

Breed	Summer season morning	Summer season afternoon	Karif season morning	Karif season afternoon	Overall[1] mean
Red Kandhari (RK)	2.618	2.612	2.624	2.654	2.627[b]
Deoni (D),	2.676	2.616	2.704	2.694	2.673[a]
Holstein/Friesian × Deoni (HF/D)	2.640	2.590	2.742	2.572	2.636[b]

[1]Different subscripts indicate significant differences at 5% level

At increased draught the speed reduces and, therefore, at heavier draughts, the animals are not able to plough as much. The variation observed in speed of work was primarily due to differences in body size and the breed. Singh *et al.* (1970) reported the average speed of Sahiwal bullocks as 2.21 km/h during disc ploughing, and Premi (1979) observed that the Hallikar bullocks could work with an average speed of 3 km/h during six hours continuous exercise.

The speeds of the HF/D bullocks in the present study was comparable to the speed of the RK bullocks. Upadhyay and Madan (1985) concluded that the crossbred could be comparable to Hariana bullocks under hot summer condition, provided the crossbreds were only put to heavy loads for a short duration of work, i.e. for one or two hours of work.

In the present study speeds were lower in summer than in the karif season, presumably due to differences in environmental conditions, and in the afternoon than the morning, presumably as the animals tired. Gattewar (1983) also observed a decrease in speed from 3.14–2.53 km/h and 2.90–2.33 km/h in crossbred and Hariana bullocks, respectively when harrowing in the morning and afternoon.

Horse power (hp) developed at ploughing

Breed, season and time in the day had a significant (P<0.05) effect on the power output during ploughing (Table 12).

Table 12: The mean power output (hp) during ploughing by different breeds of cattle in different seasons and times of day

Breed	Summer season		Karif season		Overall[1]
	morning	afternoon	morning	afternoon	mean
Red Kandhari (RK)	0.690	0.640	0.670	0.662	0.667[a]
Deoni (D),	0.816	0.738	0.858	0.748	0.795[b]
Holstein/Friesian × Deoni (HF/D)	0.795	0.712	0.876	0.802	0.796[b]

[1]Different subscripts indicate significant differences at 5% level.

The horse power at ploughing increased significantly (P<0.005) in the Kharif season compared to that observed in the summer season and in the morning compared with the afternoon period. Power output was significantly lower in RK than in D or HF/D bullocks when ploughing. In comparison to other studies, Premi (1979) recorded that Hallikar bullocks could generate an average horse power of 0.91 in six hours continuous work.

Rautaray (1985) reported that in a pair of Malvi bullocks, the average power output decreased with the increase in working time for all the draught conditions in crossbred and local breeds. Bhagat (1986) reported an average horse power ranging from 0.789 to 0.733 in crossbred bullocks. Jadhao and Jagtap (2000) recorded the horse power requirement to pull an implement as 1.22, 0.60, 0.78 and 0.68 at ploughing, ploughing + harrowing, ploughing + cultivating and ploughing + drilling. The hp generated in the present study is in the range of 0.667 and 0.796.

Area covered by the bullocks at ploughing

Area covered by any field operation is the direct result of the effectiveness and production output of draught animals. Among all the field operations, ploughing generally requires the highest draught force during work, therefore the area of land ploughed by three types of bullocks was calculated (Table 13).

The unit area at ploughing was significantly (P<0.05) less in summer than in the Kharif season and in the afternoon compared with the morning period. There were significant differences (P<0.05) between the three breeds.

Deoni bullocks ploughed 6% more land during the same period and season as compared to the HF/D crosses, with RK achieving having the lowest area of land ploughed of all three breeds.

Table 13: The mean area ploughed (m^2/hr) by different breeds of cattle in different seasons and times of day

Breed	Summer season morning	Summer season afternoon	Karif season morning	Karif season afternoon	Overall[1] mean
Red Kandhari (RK)	590	577	596	585	587[a]
Deoni (D),	620	609	631	638	625[c]
Holstein/Friesian × Deoni (HF/D)	624	589	633	597	611[b]

[1]Different subscripts indicate significant differences at 5% level

Conclusions

The Deoni bullocks ploughed the most land in the time available, although draught forces generated were highest when the Holstein/Fresian x Deoni were working. The Deoni bullocks showed a greater speed of working than the other two breeds, whilst the Red Kandhari had the lowest speed of operation. All the parameters had higher values during the Kharif season (March) than Summer season (May-June). It was concluded that Deoni bullocks were superior either to HF/D crosses or RK in working ability.

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(d) India

Rubberised steel wheel carts – an innovative design for better use of animal energy in rural India

M.S. Adarsha., H.D. Harsha and T.N.K. Kurup.
CARTMAN, Koramangala, Bangalore, Karnataka, India.

Abstract
Rubberised Steel Wheel Cart (RSWC) was designed with the idea to combine the good features of the traditional wooden carts and operational efficiency of improved pneumatic tyre carts. These improved carts are made of durable steel components having the wheels embedded with rubber beading for cushioning action and steel axels with anti friction ball bearings to reduce friction for free movement. The pull beam is made of steel pipe and the body made of light steel sections. The cart can carry a payload of 2 tonnes. The rubber beading is readily available and can be replaced at the site. These features enable minimum draft requirement and thus makes the cart ideal, efficient and user and animal friendly. Four carts are operating in three villages of Karnataka, India.

Introduction and need for the project

Animal-drawn carts are widely used in many Asian countries. In India it is estimated that 74m bullocks and 8m buffaloes make available 40m Hp of energy worth Rs. 10,000 crores per year. Fifteen million draught animals haul 25 billion tones of freight on animal-drawn carts. Draught animal power (DAP) annually saves 6m tones of petroleum worth Rs. 12,000 crores, mostly in foreign exchange. The asset value of the DAP system is Rs. 25,000 crores. India has 2.06 crore bullock-carts (Anon, 2000). Inspite of the progress achieved in the development of transport system, over 80 % of the farm produce is being handled and transported by animal drawn carts.

Activities for modernisation of animal-drawn vehicles (ADVs), undertaken by CARTMAN and tyre manufacturers date back three decades. As a result of this work ADVs in towns and sugarcane industries are by and large of improved type fitted with steel axels, pull beams and pneumatic tyres, augmenting the operational efficiency, payload and reducing draught effort and animal discomfort. But these interventions have benefited only a fraction of cart users as more than 80% of the ADVs are in rural areas, where the users are averse to using these carts, because of their low ground clearance and unsuitability for muddy areas and loose soils.

There are more than 10 million ADVs in rural areas and they are of the traditional types. The cost to the owner and economy due to crude designs is many sided and high. First, a lot of wood and skilled artisans are required to fabricate these carts. Hard wood is becoming increasingly scarce and costly, and also laws prohibit felling of the trees. Secondly, use of poor quality bearings, increases wobbling of the wheels. Thirdly, heavy pull beams are responsible for the poor performance of carts and also there is huge loss of draught effort. Having these things in mind, this project executed by CARTMAN aimed at investigating rubberised steel wheel (RSW) carts as an alternate for traditional carts.

Material and methods

The preliminary and secondary studies were conducted in the year 2001–2002 and field trials of the RSW carts were done in the year 2002–2003.

The axle (50×1370 Hero brand, fitted with 30200 Hero Brand bearings) and wheel discs (362×19 Hero brand suitable for 700×19 tyres) were ready-made items available from manufacturers of ADV components for a 2-ton cart (Figure 5).

Wheels

The wheels were specially designed by CARTMAN. Initially the internal circumference of the circular rubber beading (cut circular from 1000×20 rubber used tyres from a heavy duty vehicle) was measured accurately and noted down (L). The rim was made of Mild Steel (MS) Channel of dimensions 75×25×6 mm (web × flange × thickness) and was cut to the correct length i.e. L+50 mm. The flanges of the M.S. channel on either side were reduced to a height of 12 mm by gas cutting and sharp edges smoothened. The channel was bent in to a circle by hitting with a hammer (Figure 5) or with the use of a heavy three roller bending machine, if available. For best results use a machine. The ends were arc welded after being bent to form a circle. The hub and disc were fabricated from M.S. plates of sizes 50×6 mm of 1170 length and 325 mm respectively. Twelve spokes were fabricated by cutting MS pipes to the lengths 5×5×360 mm.

The disc was welded to the hub and the spokes to the hub equally spaced. The rim, spoke, hub and disc were centrally placed and then welded each spoke to the rim. The rubber beading could then be inserted on to the wheel. The beading was cut with an inward taper so that it could be inserted to the correct depth inside the channel (Rim).

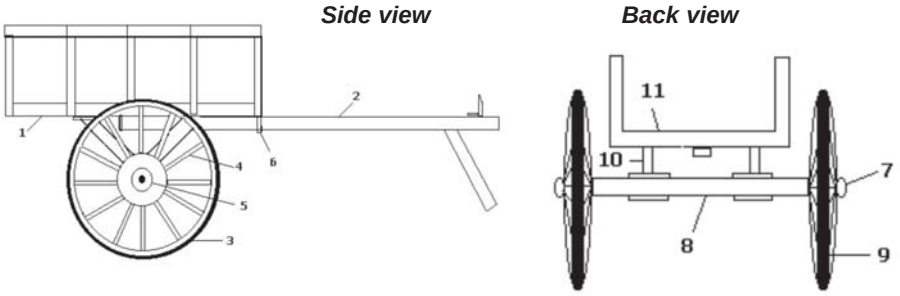

Figure 5: Double bullock rubber bonded steel wheel cart (capacity 2.5 t)

Sl. No.	Component	Dimension (l × b × h)	Quantity	Material
1	Platform Frame	1900 × 1100	1	Steel
2	Pull beam	1684 × 75	1	MS pipe
3	Wheel	1130 (dia)	2	MS channel
4	Spoke	390 × 50 dia	12	MS pipe
5	Ball Bearing	–	1	Steel
6	Bolts	100 × 16M	2	Steel
7	Hub	–	2	Steel
8	Axle	1370 × 50 × 50	1	Steel
9	Rubber Bonding	As required	2	Heavy duty lorry tyre
10	Support	500 × 75 × 40	2	MS channel
11	Platform	1900 × 1100	1	Wood

The insertion was done using levers. A 50mm difference between the circumference of the channel and the inside circumference of the rubber beading ensures proper fitting of the beading. Once inserted the beading remains snug inside the rim and there will not be any relative movement between the rim and the beading. The wheel was then ready to be mounted on the axle, which was done with self locking bolts provided by the axle manufacturer. The sub assembly was then ready for fitting to the steel fabricated body and the super structure.

Body and super structure

The major structural components of the body were made from 75 × 40 × 6 m channels and 50×50×6 m equal angles. The base 'V' shaped frames (2 Nos 1 m each side) were welded to steel flats, which were bolted to the steel axle. The 'V' frame supported the rectangular frame of the platform. The sections of the platform were cut to size and welded (Figure 5). The super structures (side walls) were fabricated from 38×38×4 mm MS angles and steel sheet of 1.6 mm thickness. After welding, the side frames were welded to the steel body.

Platform

This was made from 20 mm wooden boards bolted to the steel rectangular frame already fabricated. Having major sub assemblies ready (viz wheel assembly, body, super structure and Platform) the cart was assembled (Figure 5).

Pull beam

This was made from 75×3 mm M.S. pipe of suitable length depending on the animal size fitted by 'U' bolts to the platform structure. At the other end, a support pipe was welded at an angle so that the cart when not harnessed could be rested on the ground. For mounting of the yoke, an angle of 35×35×4 mm ×150 lengths was welded to the pull beam to pass the rope for fastening the yoke through. Since the pull beam is circular in shape two small angles of size 35×35×4 mm ×150 length was welded on either side of the pull beam at the hitching end so that the wooden yoke rested properly on the pull beam.

Two coats of primer and synthetic enamel were given to all steel parts to prevent corrosion. Thus the cart was ready for trials.

Results and discussion

The structural dimensions of traditional cart studied in the project area are given in Table 14. The main material used was wood along with scrap automotive axles that contribute to the overall weight of the cart (600kg approx). The important component of the RSW cart is metal, which has replaced wood, excluding the platform. The total weight of the RSW cart was 380 kgs. Wheel beading was of rubber in the RSW cart, while the traditional cart has an iron rim around the wooden wheel.

The following were the constraints of the traditional carts identified by the preliminary and secondary studies in the research areas:

- Lower capacity of carrying the freight and higher maintenance.
- More strain on the animals.
- Higher friction there by increased draught effort requirement.
- Uses wood as the main material, which is against environmental concerns.

- Durability of the pull beam and bearings is shorter.
- Period of use per month is less, in terms of number of hours used and distance travelled per day.
- Total weight of the cart is heavier making it difficult to handle.

Table 14: Structural differences between rubberized steel wheel cart and traditional cart

Components	Rubberized steel wheel cart				Traditional cart			
	Dimension (in mm)			Material	Dimension (in mm)			Material
	L	W	H		L	W	H	
Platform	1900	1100	–	Wood	2650	900	–	Wood
Side doors	1900	–	530	MS Sheet	2600	–	530	Wood
Pull beam (dia)	1984	75	–	MS Pipe	1984	130	120	Wood
Yoke	1890	–	–	Wood	1890	–	–	Wood
Axle	1370	50	50	Metal	1150	140	140	Wood
Bearing	–	–	–	Ball	–	–	–	Metal
Wheel (Dia)	–	1130	–	Steel	–	1400	–	Wood
Wheel bonding* (dia)	–	1050	–	tyre	–	1400	–	Iron ring
Total weight (Kg)			**380**				**600**	

L= Length W= Width H= Height dia= Diameter

Table 15: Draught studies of different types of double bullock carts

Cart types	Pay load (Kg)	Neck load (Kg)	Draft effort (Kg)	Terrain	Total weight of empty cart (Kg)
Traditional cart	Empty	24	25	Kuccha	600 approx
	500	50	44	Kuccha	
Tyre cart	Empty	21	18	Kuccha	700 approx
	500	27	24	Kuccha	
	1000	52	46	Kuccha	
R.W.S.C	Empty	14	13	Kuccha	380 approx
	500	21	18	Kuccha	
	1,000	30	25	Kuccha	

The data in the table are averaged from three replications over one year study.

Unlike the traditional cart, the RSW cart is light weight (380 kg), with a metal body, simple design with locally available materials, broader platform to carry bulk loads and is animal friendly due to its lower draught force required and potentially reduced neck load. The wheels with ball bearings reduce the friction during movement and the rubber beading allows the cart to move in any type of terrain without any road damage and noise. The carrying capacity is 2t where that of traditional cart is 0.5t–1.0t.

Apart from the structural adaptability studies in the areas, we have also conducted a comparative draught ability study of traditional, pneumatic tyred and improved RSW carts on the kuccha roads of the research villages (Table 15). The results clearly show that the draught effort required by the RSW carts is significantly lower than that of other two types of carts.

Conclusions

There is a wide potential to use RSW carts in the rural areas dominated by small and marginal farmers with smallholdings. For them the purchase of tractors is beyond their net income. The non-metalled rural roads are not suitable for traction either by wobbling wooden wheel or by pneumatic tyred carts, but for the RSW cart mounted on steel axles with anti-friction bearings they do not pose any problem. From the environment point of view, the RSW cart encompasses minimum wooden materials, hence felling of trees are avoided, also these carts are animal friendly with very less draught requirement and all the draught power is fully used assuring no wastage. There is of course higher income generation because of the fact that the animals can carry higher payloads and can work for longer hours. There is also less maintenance cost involved here.

Acknowledgement

We are heartily thankful to Indian Council of Agricultural Research (ICAR), New Delhi for providing financial assistance to carry out the research.

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SHORT NOTES AND NEWS

■ International Forum for Rural Transport and Development (IFRTD)

The IFRTD have been involved in the production of a CD-Rom Toolkit for 'Promoting Sustainability of Rural Transport Infrastructure. They are keen to develop the toolkit into a second phase. If you have been involved in the planning of a local level rural transport intervention in a developing country, whether or not you used the toolkit as a guide they would like to here from you. They would like to build upon the case studies presented in the toolkit. They will create an 'Experience Hib', initially on the IFRTD website www.ifrtd.org, and eventually using the lessons contained within it develop the toolkit into a second phase. For further details please contact IFRTD Secretariat, 113 Spitfire Studios, 63–71 Collier Street London, N1 9BE, UK, phone: +44 207713 6699 fax: +44 207713 8290, email:toolkit@ifrtd.org.

■ **The Pakistan Camel and Equine Society (PACES)** – Deptartment of Livestock Management, University of Agriculture, Faisalabad, Pakistan (Tel: +(041) 9200161/3206, +(041) 632995; Fax: +(041) 9200764; www.uaf.edu.pk/AnimalHusb/Lm.html; Email: uafhasan@fsd.comsats.net.pk)

The Department of Livestock Management, University of Agriculture, Faisalabad, Pakistan has established the 'Pakistan Camel and Equine Society' (PACES). The objectives of the society are:

- To promote research activities on different aspects of production, management and welfare of camel and equine.
- To promote collaboration between different research institutes/organisations/societies and groups working in the similar disciplines.

- To generate baseline data about camel/equine production at national level and disseminate information to researchers, students and academic/professional purposes.
- To prepare short courses on camel and equine production, management and welfare for better production.
- To arrange conferences/seminars/workshops to produce scientific culture at national and international levels.
- To arrange short training courses for the farmers for their capacity building for better camel and equine production.

Facilities

The Department maintains a Livestock Experiment Station and a well-reputed equine unit equipped with research facilities. The Department has established a special research group 'Range Livestock, Draught Power and Animal Welfare' to strengthen research on production potentials and managemental aspects of these animals using the infrastructure available in the Department. It is also involved in equiine sport, maintaining the current top tent pegging team in the Punjab

Office bearers of the Society

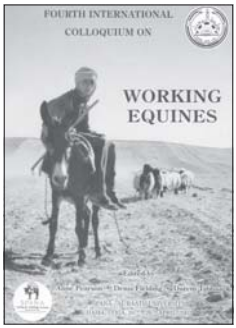
The President is Dr. Muhammad Younas younasah(@fsd.paknet.com.pk, The Vice president is Dr. Arshad Iqbal (PhD in Camel Production), drarshad_iqbal@hotmail.com The Secretary is Syed Hassan Raza, uafhasan@fsd.comsats.net.pk. The Treasurer is Dr. Muhammad Yaqoob Jhang_pk@Yahoo .com and Liaison Officer is Dr. Muhammad Riaz. For membership inquiries please contact younasah(@fsd.paknet.com.pk and for other general enquiries please contact: uafhasan@fsd.comsats.net.pk or the department address given above.

■ **FARMHANDS (U) Ltd**, Masaba Gardens, Mbale (Tel/ Fax: 045 35444)

The Farmers' Friend in Rural Development

This organisation has become a non profitmaking company in Uganda. They are producing and promoting animal draught power systems in Uganda, training people in engineering work, including implement manufacture and repair, and ran an open day having developed and tested tools. The draught animal activities included animal handling, harness design and application, equipment / animal relationship (acceptability of equipment to animals), animal feeding regime and health care, possible methods of implementation of training of operators.

The open day function was also complemented by displays by Kulika Trust with their organic farming techniques, Alan Chadborn's YWAM – Design Centre with their D.i.Y. implement designs, NARO – SAARI Agricultural Institute and El-Shaddai seed suppliers. Farmhands has also been operating a contract ploughing and planting operation. For further information on their activities in Animal Power contact Howard Gibson Director of Operations at the contacts above.



■ Books

Copies are still available of the 'Fourth International Colloquium on Working Equines', 2003 (Editors: Pearson, R.A., Fielding, D. and Tabbaa, D.)

Proceedings of an International Colloquium held at Al Baath University, Hama, Syria April 20–26 2002. SPANA, 14 John Street, London, WC1N 2EB. ISBN 0–907146–17–1.

These are free of charge from Darem Tabbaa, Faculty of Veterinary Medicine, Al Baath University, Hama, Syria, fax: 963 33510514, email: spana@net.sy

■ IFS is moving offices

It is now at: International Foundation for Science (IFS), Karlavägen 108, 5th floor, SE–115 26 Stockholm, Sweden. Please use this address immediately for all mailings. The IFS telephone numbers, fax number, email and web addresses will remain the same. If you are visiting IFS in Stockholm: The nearest Metro station is Karlaplan on the red line, direction Ropsten. The new premises are about 20 minutes walking distance from the old IFS address. A map of Central Stockholm, with both the new and old addresses marked, is available on the IFS Web (www.ifs.se).

■ www.ruralheritage.com/drew

Drew Conroy has a new video out called Basic Training of Oxen, which is available through Rural Heritage. Check out his website for a summary.

■ News from the African Conservation Foundation

There are two new links on ACF website:

1. Medicinal Plants – Special Interest

For information on traditional healing and practices as well as the sustainable use and conservation of medicinal plants. If you have access to any such information, please feel free to post it here, or to let them know about it.

2. Fellowships & Funding Opportunities

A forum for the sharing of information about fellowships, funding opportunities, travel grants etc. of interest to students and professionals involved in environmental conservation in Africa.

They hope you will find both of these of interest and of assistance. Don't forget, the forums are there for all to use, to share information and help spread the word about conservation on the Continent!

New Servers and Website Hosting

ACF are shortly going to be moving their own website and those of the conservation initiatives we host (at cost) to a more powerful server. The new server has many

additional facilities which will be useful to ourselves and all who are hosted by The African Conservation Foundation.

NB. for those of you that are hosted with us, you may experience a little down-time during the transfer. If you have any queries, please contact John Parkin (Technical Director) – john@africanconservation.org

■ Donkey wedding in Bangalore in July

Paul Starkey sent in news of a donkey wedding In July. The wedding was staged to bring rain. Residents of India's southern city of Bangalore married off two donkeys, in the hope that the ancient ritual would usher in good monsoon rains. The ritual is detailed in Hindu scriptures.Two donkeys – the bride Ganga and the groom Varuna – were 'married' at a temple on the city outskirts to loud cheers of about 100 guests, who attended the ceremony, a traditional Hindi one. Great attention was also paid to ritualistic details such as the perfect invitation card, the right wedding attire and the freshest flowers. A traditional band entertained the guests, who sprinkled the newlyweds with flowers. Only at one point did the groom get restless: when his attendant tied the holy threads around his hind and fore legs. The guests, each of whom contributed to the marriage expenses, were later treated to a traditional meal at the temple. Before leaving the ceremony, everybody was hopeful it would start raining. The news story came from the from BBC News: http://news.bbc.co.uk/go/pr/fr/–/2/hi/south_asia/2998872.stm .

NEW BOOKS

INASP Rural Development Directory 2003/4

Oxford: INASP, 2003, viii, 455pp • ISBN 1 902928 15 6

Printed version: £25.00 (inclusive of post and packing)
CD ROM: £10.00 (inclusive of post and packing)

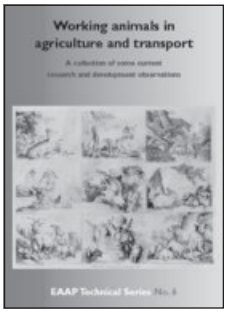
This aim of the Directory is to provide access to a wide range of information on rural development. It contains profiles of more than 430 international, regional and national networks and organisations around the globe, and is particularly concerned to promote South-South information dissemination and interchange.

Each entry provides contact details and a brief description of the organisation, highlighting its objectives, activities, subject areas of interest and geographical coverage. In addition there are details of information provided by the organisations, including newsletters, journals or online documents. The Directory is also made available on the INASP website, www.inasp.info/south/index.html / www.inasp.info/pubs/rd / where the contents will be updated on a regular basis.

Further information is available from:

International Network for the Availability of Scientific Publications (INASP)
27 Park End St., Oxford OX1 1HU, UK

Tel: +44 1865 249 909 • Fax: +44 1865 251 060
E-mail: pwr@inasp.info / inasp@inasp.info



Working Animals in Agriculture and Transport

A collection of some current research and development observations

Editors: R.A. Pearson, P. Lhoste, M. Saastamoinen & W. Martin-Rosset — EAAP Technical Series No. 6

208 pages • Paperback • ISBN 9076998256 – 40 Euros

This book covers many of the recent research observations on the management and use of working animals in tropical agricultural systems. Studies of oxen, donkeys and camels in sub-Saharan Africa, cows and donkeys in Ethiopia, buffaloes in Vietnam, camels in Libya and horses and donkeys in Southern Italy are some of the topics included. Technical issues in nutritional requirements, feeding, management, health, implement, work practices and harnessing are discussed and the contribution that working animals continue to make in many agricultural and transport activities are quantified.

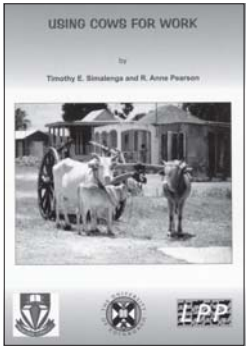
The book is a valuable source of reference materials on draught animal technology. It is a must for any scientist, student or extension worker in rural and urban areas where animal power is found. Table of contents can be downloaded from www.WageningenAcademic.com/ts06 . Order through the website or contact:

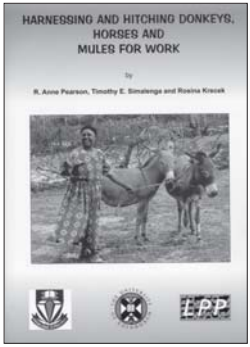
Wageningen Academic Publishers
PO Box 220, 6700 AE Wageningen, The Netherlands
E-mail: sales@WageningenAcademic.com
Tel: +31 317 47 65 14 • Fax: +31 317 45 34 17

The Centre for Tropical Veterinary Medicine, CTVM, University of Edinburgh *in conjunction with the* University of Venda in South Africa

has just published two new training booklets aimed at extension agents, trainers, and anyone working to improve use and management of draught animals. The booklets are on 'Harnessing and hitching donkeys, horses and mules for work' and 'Using cows for work'.

The booklets are free thanks to the support of the May and Stanley Smith Charitable Trust, who funded the development of the booklets and the UK Government's Department for International Development, DFID who have paid for the costs of printing and distribution.





Anyone wishing a copy should contact: Dr R.A. Pearson, Draught Animal News, Centre for Tropical Veterinary Medicine, Easter Bush Veterinary Centre, Roslin, Midlothian, EH25 9RG, Scotland, UK (fax +44 (0) 131 651 3903; email anne.pearson@ed.ac.uk).

LETTERS TO THE EDITOR

From Nigeria – A request for books on draught animal power

The International Veterinary Student's Association in Sokoto in Nigeria is trying to develop a library on various aspects of livestock care. "We would be grateful for any books in the near future so that our library can be kept up-to-date, and I believe this will keep pur studnets abreast of more recent trends on draught Animal Power."

Aminu Shittu (President), International Veterinary Student's Association (IVSA local chapter), Faculty of Veterinary Medicine, Usmanu Danfodio University, P.M.B. 2254, Sokoto, Nigeria (email: ivvsasokoto@yahoo.com)

From Rwanda – Web addresses for DAP needed

"We bring to your attention that we are a multi disciplinary team charged with the responsibility of developing a study on the Feasibility of introducing donkeys in Rwanda.. We would be grateful if anyone can guide us by suggesting to us probable websites on the net which can be of use to our study. We are particularly interested in Economics of donkeys management by small farmers. The Ministry of Defence is associated with the development of the coffee industry and we want to use donkeys for transport of coffee cherries in the hilly terrain.

M.K. Ranganath, Projects Manager, Ministry of Defence, P.O. Box 23 Kigali, Rwanda (email: ranganath@avu.org)

From USA – a request for information on energy expenditure and work

"I am working on muscle function during running in guinea fowl. As part of this work we have looked at the influence of loading on energy expenditure. I am trying to track all the available work on load carriage in mammals to serve as a comparison. I have many references to load carriage in humans but few for quadrupeds. I am looking for reviews or other crucial articles on quadrupeds in addition to the publications from the University of Edinburgh. I would be delighted to find any more leads to similar work."

Richard L. Marsh, Professor, Department of Biology, 414MU, 360 Huntington Ave, Northeastern University, Boston, Massachusetts 02115
(Tel: 617 373–3495, Fax: 617 373–3724 email: r.marsh@neu.edu)

From Zimbabwe – Information needed on a ground nut harvester

"I am a prospective MPhil student in agricultural engineering with the University of Zimbabwe. My interest is in the development of a soybean harvester that is animal drawn. Would you know if any work has been done on this in the past and where I can access it. Your input on the subject is also very much welcome. Besides the Mphil, I work for an agricultural equipment manufacturer as the Research and Development manager in Zimbabwe. Looking forward to hearing from anyone who can help."

M.L. Mautsa. Hastt Zimbabwe, 18 Galloway Road, Norton, Zimbabwe
(email: mmautsa@hastt.co.zw)

From South Africa – a request for information

"Who knows about this? A Sri Lankan friend recently told me that he remembers a farm in the northern part of his country (i.e. Tamil country) where donkeys were specifically kept for controlling an insect pest on the crops. What I would much like to know is (a) What insect? (b) What crop? and (c) How did the donkeys do it? Since presumably

eating the insects wouldn't agree with donkeys very much! Any information would be appreciated."

Peta Jones, P.O. Box 414, Louis Trichot, Limpopo Province, 0920, South Africa.
(Fax: +27 [0]15 5177040; email: asstute@lantic.net)

■ **From Uganda – a letter from Alan Chadborn of YWAM with news of his work**

"Here are some details about our carts. The photograph (plate 4) is one of our twin-wheel jobs, made with 2 bike rims and 80 spokes on a home-made hub which has wooden bearings. It can carry 300 kg, and with 260 kg can be handled by one man for 500m. We have coupled two such carts to make a long trailer for bringing eucalyptus roofing poles.

The other cart (Plate 5) is our wooden ox cart for carrying about 750 kg. We are testing different wheel options. Wooden bearings are on either side of each wheel.

I also enclose a picture of single ox harness which is a new idea here (Plate 6). Potentially useful for weeding as one yoke does all row widths. The ridger picture shows that a normal ploughing yoke is ok on the front pair of oxen while the back pair use a long one = two furrow widths. This is a long yoke so has to be strong and therefore heavy (Plate 7).

This would have been too heavy for donkeys so we used a 4"×2" with a light chain attached to either end of this spreader and to the plough chain in the middle. The triangle thus formed has no bending stress so 4×2 is strong enough.

But how does a farmer cope with ridging and weeding several different widths of row? Does he have a special yoke for each? A yoke with several alternative holes for oxbows would become weak. I shall be interested to know what people do?

Plate 4. YWAM donkey cart in Uganda (A Chadborn)

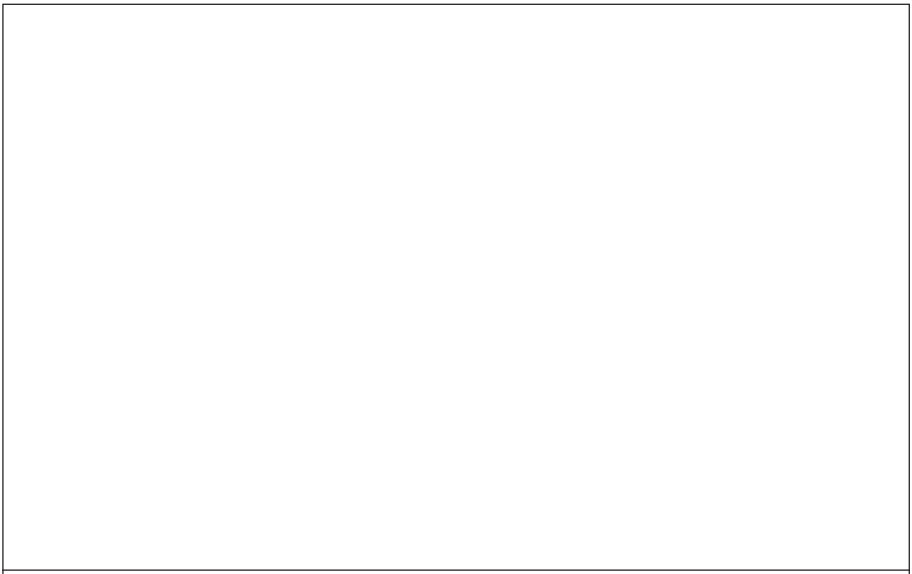


Plate 5. YWAM ox cart in Uganda (A. Chadborn).

Plate 6. YWAM single ox harness (A Chadborn).

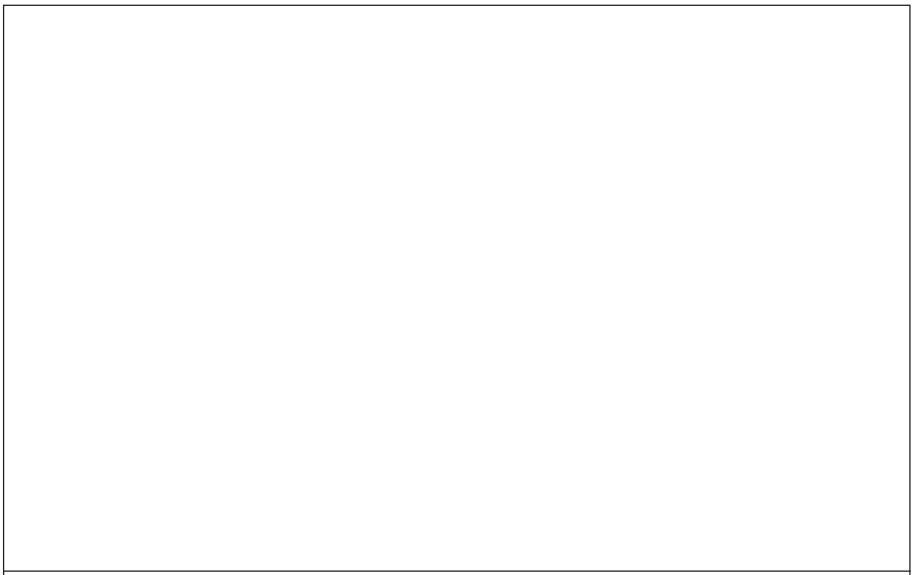


Plate 7. Ridging with oxen in Uganda (A. Chadborn).

Incidentally, we are using the shape of ridging plough that came from Bolivia courtesy of Brian Sims, alerted to us by his article in a previous DAN issue.

We are also making ripper-planters and 35 cm wide knife rollers for conservation agriculture.

With best wishes to all your readers—Alan Chadborn, Design Centre, YWA

For now please use P.O.Box 792, Soroti (work@ywam.or.ug – not P.O.Box 50, Katakwi, Uganda, Tel: +256 (0)985 992)

■ **From Kenya – Barney Muckle in Nairobi writes in response to Hrimati dasi's letter** (see DAN 38, page 27)

"Dear Hrimati dasi,

I have just read your interesting letter in the current issue of Draught Animal News and am sending some information which I hope you will find useful.

Not far from my home, in a district called Kirinyaga, there are hundreds if not thousands of single ox carts which are in regular use for transporting vegetables from the field to the market for onward movement to the capital Nairobi.

For this situation the technology is fully developed performance and cost wise and all carts are made locally.

Cart body and wheel/axle unit: This is similar in construction to a cart for two oxen but has two shafts, as with a single donkey cart, in place of the single shaft. The width of the shafts will depend on the size of the animal which should be measured and a little added so that no part of the animal is in normal contact with the shafts.

The length of the shafts should avoid the rear parts of the animal contacting the cart body especially when stretched out exerting a pull.

Yoke: You use the normal yoke with neckband or skeys for two animals but cut into two. In fact it is made to fasten permanently across the ends of the shafts and held by bolts so it will be longer then a half of the one for two animals!

To yoke the animal the shafts are raised, the cart moved forwards and the shafts lowered over the animal with the yoke over its neck then the neckband is fitted.

Materials used: I cannot offer advice on this due to the differences in conditions but if carts are already being made in your area then the same materials are adequate for a single ox cart.

One advantage I have observed is that a single animal can easily learn to trot so cover distances quickly whereas a pair of animals do not synchronise their steps.

I hope this information will be of use but can assure you that it is similar, except for the yoke, to a single donkey cart with larger dimensions. I also enjoy reading DAN and without it and e-mail you would remain with your problem. I will try to take a photo on my next visit to the area. — Best Wishes

T.B. Muckle, Triple W. Engineering Ltd, P.O. Box 176, Naro Moru via Nyeri, Kenya.
Email: muckleb@africaonline.co.ke.

■ **From India – News from Hrimati dasi** (see letter DAN 38, page 27)

I just received the new DAN June 2003 and noticed that you have posted my letter about the single-ox-cart. Well, I am happy to announce, that I had received a nice simple design from Professor Ramaswami, made the cart and using it now for our local transport. The cart is very useful. We haul in the daily grass for our cows for example. The yoke I designed myself. It has a wide surface, so Balaram is not insured on the neck

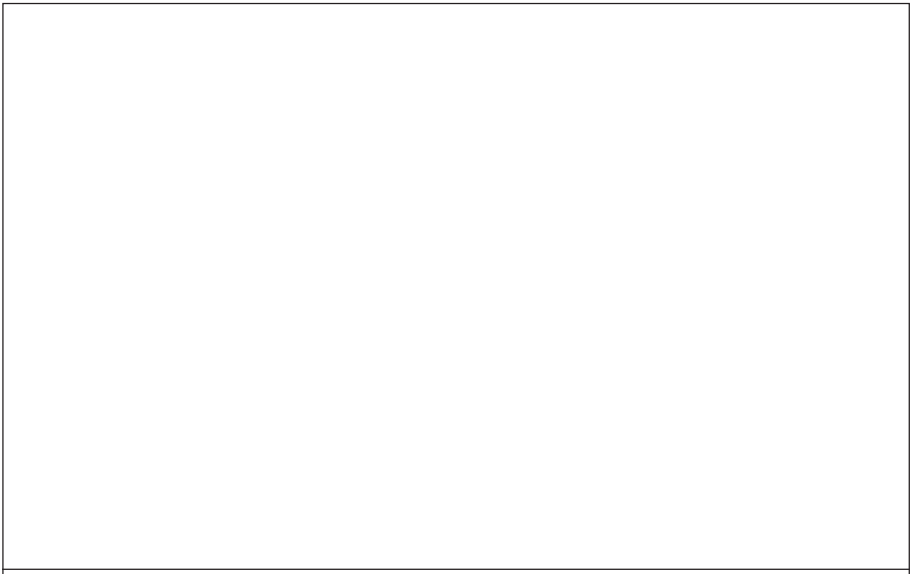


Plate 8. Hrimati dasi's cart in India (H.dasi)

and has no problem pulling the cart (Plate 8). Thank you very much again. My new mailing address is:

Hrimati dasi, c/o ISKCON Mayapur ISKCON Gita Bhavan, 110A Matilal Neheru Rd, Kolkata 700029, WB, India

MEETING REPORTS

British Rare Breeds on Parade!

This report has been submitted by The Fell Pony Conservancy of North America

On the third weekend in June, the Kentucky Horse Park (KHP) hosted the American Livestock Breed's Conservancy's (ALBC) *British Rare Breeds On Parade!* – an unprecedented display of rare British equines. The Event was easily the most ambitious equine exhibit sponsored by ALBC, a non-profit organization for the conservation of rare breed livestock. The Event was constructed to complement the Horse Park's 'All the Queen's Horses,' a summer long exhibit of British artifacts at the International Museum of the Horse.

Ten breeds, considered rare in North America, were represented; Cleveland Bay, Hackney Horse, Clydesdale, Shire, Suffolk, Dartmoor, Exmoor, Dales, Fell, and Highland. The exhibit was conceived and organized by the Fell Pony Conservancy of North America on behalf of ALBC.

The Event began on Friday with the opening of the Exhibit Hall in the Big Barn, a huge wooden structure with a history all its own. Later in the afternoon, exhibitors participated in a unique instructional horse show judged upon British standards with the two judges, Sue Millard and Clive Richardson, flown in from England by the Conservancy. Both judges used microphones to comment openly during their judging.

The premise of the show was to explain why certain traits are useful to each heritage breed and how we attempt to measure these traits in the ring. The exhibitors were very receptive and complimentary of this format. Saturday and Sunday were filled with individual live breed demonstrations, the parade of the breeds through the lovely grounds of the Park, and the continued educational and live displays of the breeds in the Big Barn.

Millard and Richardson also lectured in the Hall of Champions Pavilion using live horses to illustrate certain points, expanding on the evolution and conservation of these native breed traits and explaining why the show ring is only *one* tool in determining the quality of breeding stock. Other talks included renowned geneticist Dr. Gus Cothran of the University of Kentucky who lectured on the issues surrounding the genetic conservation of rare breeds. Chuck Bassett, executive director of ALBC, addressed the role of ALBC, plus warned how the focus on money can corrupt breed conservation and commented on the importance of proper preparation in carrying out your breed work. The judges and clinicians made themselves very accessible for exhibitors and visitors alike throughout the weekend. (Full transcripts of these talks & a highlight video will be available in the near future; purchase details will be posted on the website listed below.)

The major goals of the Event were realized in that everyone promoted their breed while learning more about conservation.

More information and photographs of this Event can be found at: http://www.Fellpony.org (use 'Completed Projects' links) or fax: 508–519–6533. For more information on ALBC please see http://www.albc–usa.org .

The First Annual New England Invitational Ox Drover's Workshop

This was held from 3rd to 5 October 2003, Drew Conroy sent the following report on the event.

For the first time, Dr. Drew Conroy of the University of New Hampshire and Tim Huppe, proprietor of Berry Brook Ox Supply, of Farmington, New Hampshire in the United States teamed up to offer a workshop focusing on the use and training of oxen in the New England tradition. For centuries oxen have been used in the Northeastern United States. The skills and traditions of ox teamsters have been passed down through the generations, and Conroy and Huppe together shared their 55 years of experience. This unique cultural tradition was shared with an enthusiastic group of participants from 8 different states, who came from small farms, agricultural museums, living history farms, and there was even a writer for the New York Times.

The workshop started at the New Hampshire Farm Museum, where participants learned about the animals and equipment that have remained unchanged for centuries. They learned why this region of the United States has maintained this cultural tradition, while other areas long ago made the move to horses and later tractors. With four teams of oxen, participants were also instructed in the safe handling and training of the animals.

On the second day, the participants were given a series of exercises to help them further understand the animals, and New England training techniques. The animals were hitched to carts, farm equipment and sleds (Plate 9), and small projects were assigned. The second half of the day was spent in the forest learning how to safely handle teams of all ages and levels of training while drawing logs out of the forest.

The final day of the workshop was spent at the Fryeburg Fair, in Fryeburg, Maine, USA, where hundreds of teams of oxen were on display and in competition. Discussion and dialogue was encouraged with experienced ox handlers, so the participants could learn how some of the regions best ox drivers handle and work with their animals in the United State's largest ox competition.

10th Anniversary SANAT Workshop

'Strategies for promoting animal traction as a power source for small-scale farmers'

A South African Network for Animal Traction (SANAT) workshop was held at the University of Fort Hare, Province of the Eastern Cape, South Africa from 3–7 November 2003

The workshop was attended by 60 participants from 11 countries: South Africa, Zimbabwe, Zambia, Kenya, Tanzania, Madagascar, Namibia, Uganda, Lesotho, Scotland and England. The participants included: 14 farmers, both small-scale and

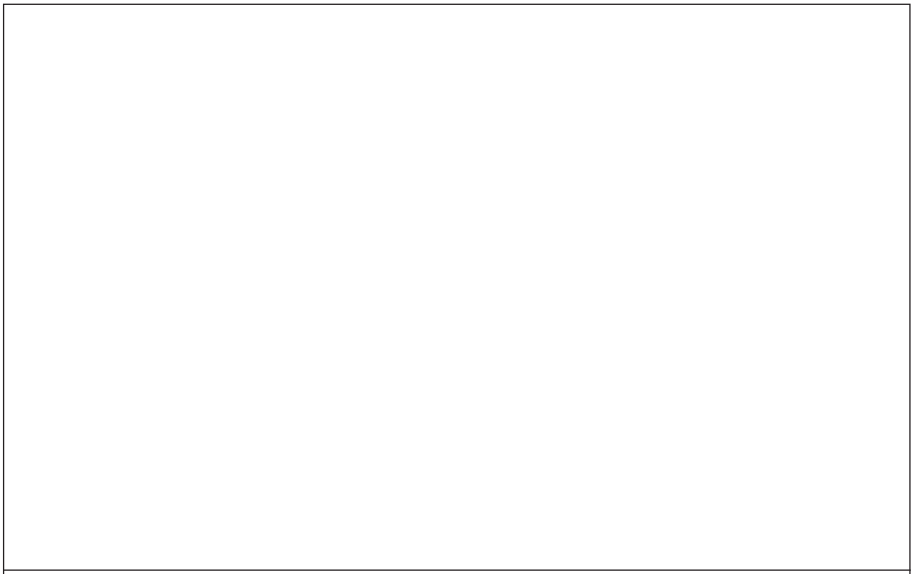


Plate 9. Action at the new England ox drovers workshop in USA (A Conroy).

commercial, government officials, researchers, promoters, NGO trainers and community development agents.

The workshop was officially opened by Mr John Allwood, Director of Development in the Eastern Cape Department of Agriculture and Rural Development. The theme of the workshop was 'New networking strategies for SANAT/ATNESA, which will place animal traction at the fore front of sustainable development in the 21st century'.

The main objective of the workshop was to bring together farmers, national, regional as well as international specialists involved in training, research, policy making, development and extension relating to animal traction. Specifically the workshop was aimed at:

- Celebrating SANAT's 10th anniversary and to review its activities since its inauguration.
- Conducting a SWOT analysis of animal traction networks in Africa.
- Sharing experiences with farmers and various promoters of animal traction.
- Identifying new roles which animal traction technologies and networks can play in the development of agriculture in Africa.
- Proposing strategic action plans and goals for the next decade.

The participants shared experiences and achievements in promotion and support of animal traction in their various operation areas. The workshop also shared present and future needs and requirements in improving draft animal power utilization and management. A strategic program was proposed which will enable SANAT and ATNESA to fulfill their roles as dynamic, effective and representative networking organizations which can guide the progress of animal traction.

The workshop identified a number of issues to be addressed by ATNESA and SANAT over the next decade. These touched on policy, socio-economic, technical and environment issues which, inter alia, included the following:

- Sensitizing policy makers on the potential contribution of animal traction to rural development and poverty alleviation in general
- Strengthening ATNESA/SANAT linkages with other networks on cross-cutting issues such as HIV/Aids and conservation agriculture
- Enhancing operationalization of the networks through private sector involvement, incorporating new initiatives as well as fund raising and publicity
- Mainstreaming AT as a cross-cutting issue in rural development with emphasis on gender and inclusion in education curricula
- Empowering farmers and animal traction practitioners through participatory research, technology transfer and training in proper animal welfare and utilization
- Promoting entrepreneurship and marketing through provision of appropriate rural transport and support services

The need for a policy on AT was identified as an essential component in empowering rural communities. It was also necessary to foster research and training and extension support at a national level. The importance of linkages and networking with institutions and various organizations undertaking relevant research and development cannot be over emphasized. This was identified as a vital element in ensuring that potential applications are channeled to target groups.

There is no doubt that there is agreement amongst professionals in considering animal traction not only as a 21st century technology but also as a viable and sustainable power source for smallholder farmer empowerment and poverty alleviation.

FORTHCOMING EVENTS

24th Pakistan Congress of Zoology (International)

30 March–1 April 2004 • Allama Iqbal Open University, Islamabad, Pakistan
organised by the Zoological Society of Pakistan and Allama Iqbal Open University.

The scientific programme will consist of plenary lectures and oral presentations. The theme of the congress will cover all the major areas of Zoology and related disciplines. There will be three sessions each day.

For further information and registration form, please contact the secretariat:

Prof Dr Nazir Ahmed Sangi, Dean, Faculty of Sciences
Allama Iqbal Open University, Islamabad
Tel: 92 51 9257285 (direct), 9257029 Ext. 4809
Fax: 92 51 9258297; email: congress_zoology@yahoo.com.

Dr Muhammad Irfan Khan, Dept of Environmental Science
Allama iqbal University
Tel: 92 51 9257029 Ext 4725; mobile: 03205110884

HARNESSING AND IMPLEMENTS

Profiling the
Harness Development Agency

Dedicated to Harnessing the Energy of Working Equines

Terry Davis, HDA
(Email: harnessaid@yahoo.co.uk • Telefax = (0044) 01694781206)

The Harness Development Agency (HDA) is a recently formed organisation whose focus is to create a better understanding in the use and manufacture of Harness systems used by draught animals worldwide.

Equines, for centuries have played an active role in the progress of mankind. Currently, in the developing world they're still greatly depended upon as a vital, sustainable low cost energy source and this needs to be supported, indeed further encouraged. In many of the poorer regions worldwide, in the daily grind for existence, working equines and their owners endure harsh conditions that are unintentional and difficult to avoid. Through lack of knowledge and unrelenting poverty owners of equines are unable to benefit fully from the capabilities this 'tool' has to offer nor to give them the care and attention they deserve.

Owner/users, through necessity and without adequate guidance are usually left to their own devices in creating suitable harness. Materials such as rubber car tyres, inner tubes, nylon rope, polypropylene sacking and wire are used extensively with little or no understanding of the full dynamics of animal draught. The out come is at best a valiant effort at recycling in an attempt to make something out of nothing and at worst animals seriously restricted and not reaching their full potential.

Harness development is only one aspect of a host of difficulties faced by draught animals and their owners but none the less a very important one. Many of the injuries sustained by working equines are caused by makeshift, ill-fitting harness. On occasions, simply drawing attention to bad practices or making minor alterations to harness can achieve a reduction in injuries. Other issues such as veterinary, foot-care and nutrition are equally important along with cart and wagon design. Dealing with any of these aspects in isolation is difficult and will have a limited effect.

The HDA. recognises the importance of a collaborative approach in achieving a 'whole draught animal' concept and is willing to co-operate with other interested parties towards this objective. Our intentions are to introduce educational and skills based programmes aimed at giving assistance to all harness and harness related problems. With our experience and expertise obtained from over 30yrs. in harness manufacture in the UK and involvement in animal welfare projects in Central America and Africa, we have a broad understanding of the difficulties faced by equines and their users in developing countries. With this in mind we are resolute in finding practical, ongoing solutions to the problems encountered. Based on this knowledge, our highly skilled personnel are able to advise, instruct and educate to a level that will provide a means by which people, through their own efforts, can find ways of improving some of the longstanding difficulties caused through inappropriate harness systems.

The approach taken by HDA. in its skills training introduction is a non-dogmatic, non-imposing one. Our preference is to work closely with a small group of carefully chosen indigenous people who show willingness and interest in the subject. The focus of training will be to work from the bottom up by providing a practical, hands on, progressive programme in harness development. Specific requirements regarding cultural and traditional aspects that arise are taken into account and programmes can be designed to suit these circumstances.

The key feature as seen by HDA. is that the results of our efforts will be sustainable. Skilled people within communities are the bedrock for sustainability and form a basis on which to build. They greatly assist in 'wealth creation' and generate conditions for future employment, greater autonomy and self-reliance. We believe that this can be achieved. Individuals, with the requisite training and comprehensive understanding of the subject will be able to provide 'professional services' in support of valuable local resources, in this instance, draught animals.

Draught animals, in order to function at their best require harness that's efficient, comfortable and cost effective. It should allow for freedom of movement with minimum risk of injury. Adequately trained harness makers can play a vital role in the manufacture and supply of such harness and provide a full maintenance service by repairing/ replacing items as necessary. Harness making in many developing countries is nonexistent as a skilled trade/craft. This needs to be redressed and given the attention it deserves. Animals that are fit, healthy and efficiently harnessed are more productive; their output can be increased by an approx 20%–25%. This could prove to be rewarding to the community as a whole.

Equines are able and willing workers who have much to offer. HDA is dedicated to harnessing this energy by offering support, encouragement and practical assistance to improving methods of draught for the benefit of both man and animal. Our training programme is unique. We hope that it will present real opportunities to improve lifestyles where it's most needed and help ensure a sustainable future for local rural communities, especially those who are underprivileged.

If you think that any of the above could be of interest to you or your organisation we would be pleased to hear from you.

Improved Camel Drawn Implements for Crop Production in Rajasthan

G.S. Tiwari, C.P. Doshi, Rajeev Garg and Hemant Shrimali
Department of Farm Machinery and Power Engineering,
College of Technology and Engineering, MPUA&T, Udaipur (Rajasthan), India

Introduction

Camels are extensively employed for operating agricultural implements in Rajasthan. It is estimated that there are 0.73 million camels in the state. Traditional farm implements for the camels consist of a wooden desi plough, duphali and tripahali. These implements have lower field capacity and poor quality of work at the same time the animal power is not used at optimum levels. Recently the farmers of the area has started using improved agricultural implements designed and developed with consideration of

the requirements of the farmers of the area and available animal power. The implements are a five tyne cultivator, single acting disc harrow, offset disc harrow, bund former and blade harrow. They are described below.

The Five tyned cultivator

This is used for seedbed preparation and sowing. It consists of a frame on which five tynes are mounted in two rows (two in front and three in the rear). A beam is attached to the frame, a handle is provided for operator to guide it (Plate 10). Cultivator tools (sweeps) are bolted on to the tynes which can be replaced when worn out. The overall width is 800 mm, length is 372 mm, height is 1,061 mm and weight is 23–25 kg. Land areas of 0.15–0.17 ha can be covered in one hour. It needs 0.70 to 0.75 horse power at operating speed of 2.3–2.5 km/ hour.

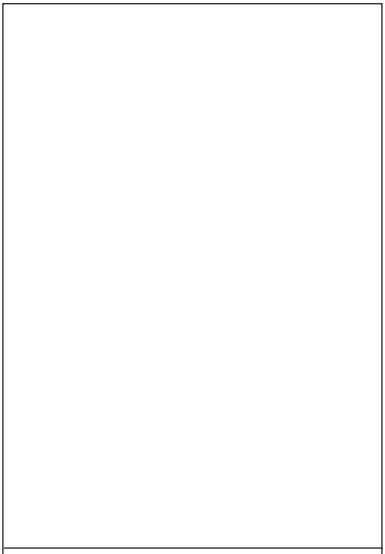


Plate 10. Five tyne cultivator in India (G.S. Tiwari).

Single acting disc harrow

This is a secondary tillage implement used after ploughing. It consists of three concave discs (diameter 400 mm) mounted on a common shaft (gang bolt).The disc are separated through cast iron spools (spacers). The gang operates as a single unit. Two gangs are attached to a frame through bearings such that the angle between gangs is adjustable. The gangs are arranged in such a manner that the soil is thrown from centre to side, leaving a dead furrow at the centre. A seat is provided for the operator (Plate 11). Overall width is 950 mm, length is 1,275 mm, height is 700 mm and weight is 58 kg. Land areas of 0.14–0.16 hectare can be covered in one hour. It needs 0.70–0.75 horse power to operate at forward speed of 2.9–3.0 km/hour.

Offset disc harrow

This is similar in construction to the single acting disc harrow. Four concave discs (diameter 400

Plate 11. Single acting disc harrow in operation in India (G.S. Tiwari).

mm) are mounted on each gang. These gangs are placed one behind the other and the angle between them is adjustable (Plate 12). The gangs are oriented such that soil is thrown in a reverse direction from the two gangs thus avoiding a dead furrow at the centre. The overall width is 600 mm, length is 1,455 mm, height is 470 mm and weight is 70 kg. Land areas of 0.14–0.16 hectare can be covered in one hour. It needs 0.75 horse power to operate at forward speed of 2.6–2.7 km/hour.

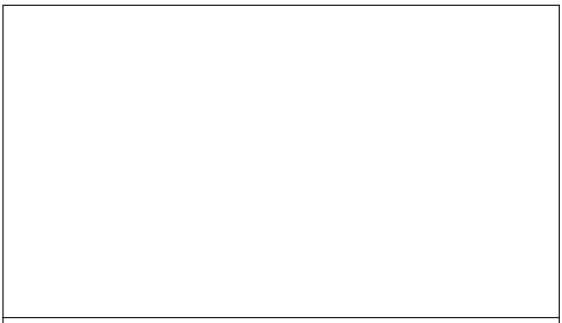


Plate 12. Offset disc harrow in operation in India (G.S. Tiwari).

Blade harrow

It consists of a mild steel (MS) bar on which the cutting tool in the form of a curved blade is attached. The inclined blade moves into the top surface of the soil without inverting it. It is locally known as a 'bakher'. A handle is provided for the operator to guide the implement (Plate 13). The overall width is 400 mm, length is 300 mm, height is 1,070 mm and weight is 12 kg. Land areas of 0.11–0.13 hectare can be covered in one hour. It needs 0.40–0.42 horse power at an operating speed of 3–3.5 km/ hour.

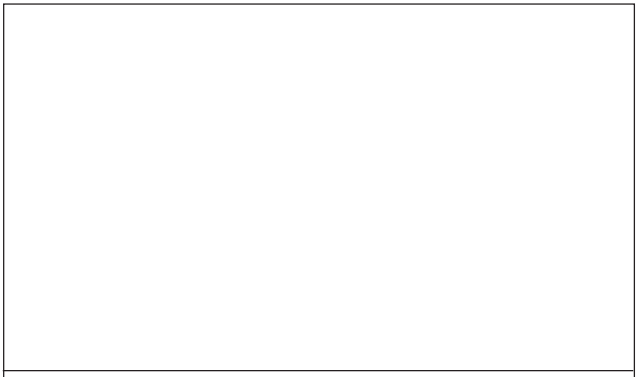


Plate 13. Blade harrow in operation in India (G.S. Tiwari).

Bund former

The bund former consists of a MS flat frame on which two boards are so fitted that it collects the soil towards the centre to form the bunds. The boards are mounted such that the width of bund can be adjusted. The implement is hitched to the animal through a wooden beam or hollow pipe. Two people are needed to operate it, one to guide the animal and other to firmly hold the implement by both hands as the volume of soil handled increases (Plate 14). It is used for making bunds or ridges in the prepared

seedbed. In rainfed areas it is used for forming bunds to prevent runoff and retain water. The overall width is 470 mm, length is 740 mm, height is 910 mm and weight is 12 kg. Coverage of area varies according to the spacing of bunds. Land area of 0.11–0.13 hectare can be covered in one hour. It needs 0.20–0.26 horse power at an operating speed of 3.3–3.6 km/ hour.

Plate 14. Bund former in operation in India (G.S. Tiwari).

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For further details please contact:

Triple W Engineering Ltd
P.O. Box 176 Naro Moru 10105,
Kenya
Tel: +254 62 62255
E-mail: muckletb@africaonline.co.ke

CONTRIBUTORS TO DAN 39

Drew Conroy
Oxwood Farm
22 Little River Road
Berwick, Maine 03901, USA
E-mail: oxwoodfarm@aol.com

K.T. Djang-Fordjour *et al*
Faculty of Agriculture
University for Development Studies
Box 1350, Tamale, Ghana.

A. Wallace
Pool House Veterinary Hospital
Dam Street, Lichfield, Staffordshire,
WS13 6AA, UK

Mai Van Sanh
National Institute of Animal Husbandry
(NIAH), Thuy Phuong, Tu Liem,
Hanoi, Vietnam

Champak Bhakat,*et al*
National Research Centre On Camel,
Jorbeer, P.B.7, Bikaner–334001, India
E-mail: bhakat@scientist.com

G.S. Tiwari, *et al.*
Department of Farm Machinery and
Power Engineering
College of Technology and
Engineering, MPUA&T, Udaipur
(Rajasthan), 313001, India
Fax 0294 2471056
E-mail: tiwarigsin@yahoo.com

M.S. Adarsha *et al*
C/o T.N.K. Kurup
CARTMAN, # 870, 17 E Main,Block VI,
Koramangala, Bangalore – 560 095.
Karnataka, India.
E-mail: cartman@vsnl.com
+ 91 – 80 – 553 0121

P. V. Yawalikar et al.
c/o L.M. Karanjkar
Dept. of Animal Husbandry and Dairy
Science,
Marathwada Agricultural University
PARBHANI – 431 402
E-mail:

Artemio Cruz León, César Adrián
Ramírez Miranda y José M. Omaña
Silvestre
Desarrollo Rural Regional. Universidad
Autónoma Chapingo, México.

Terry Davis
Bridle Cottage, Leamoor Common,
Wistanstow, Craven Arms
Shropshire, SY78DN, UK
E-mail: harnessaid@yahoo.co.uk