DRAUGHT ANIMAL NEWS

No. 47

December 2009

Produced by:
Centre for Tropical Veterinary Medicine, University of Edinburgh

Personally sponsored by:
Pit Schlecter

DRAUGHT ANIMAL NEWS

No 47

December 2009

Royal (Dick) School of Veterinary Studies
University of Edinburgh, Scotland
ISSN 1354-6953

- This issue has been very kindly sponsored by Pit Schlechter from Luxembourg one of the founders and chairman of the European Draught Horse Federation (FECTU). We are very grateful to him for his support of this issue. For more information about FECTU see www.fectu.org.

- Despite the continued interest in DAN, funding is a problem. For this reason, this will be the last issue until money can be found to support further issues, either as internet issues only, thus saving costs of printing and postage, or as hard copy if more funds are available.

- The editor Anne Pearson would like to thank all who have contributed to the issues since the first issue in 1983. Many people from all walks of life and many different countries have provided news of research or development projects and of meetings, events, new books and recent publications. Many people have found answers to their quests for information through the letters pages. Over the years Frances Anderson has done an amazing job in formatting and arranging the layout of each issue and Archie 'Picasso' Hunter has been responsible for the drawings on the front covers of the later issues. Many people have provided photographs for articles including Paul Starkey who has willingly supplied photographs often at short notice to illustrate the newsletter. Stuart Lansley has put all the issues on line on the internet - Google *Draught Animals News* for back copies (the photographs are separate to help with downloading).

- The front cover of this issue contains a selection of drawings taken from back issues of *Draught Animal News.*

- Contact details for the newsletter remain the same Dr R.A. Pearson, Draught Animal News, Division of Veterinary Clinical Studies, University of Edinburgh, Easter Bush Veterinary Centre, Roslin, Midlothian, EH25 9RG, Scotland, UK, fax +44 (0)131 651 3903, email: anne.pearson@ed.ac.uk. There are some back issues available on request.

CONTENTS

RESEARCH & DEVELOPMENT PROJECTS

1. EUROPE

(a) United Kingdom

Unusual applications of animal power underground: ponies in coal mines

R Trevor Wilson
Bartridge Partners, Bartridge House, Umberleigh Devon EX37 9AS, UK.

Abstract
Equines were used in mines from the middle of the seventeenth to the end of the twentieth centuries. First used on the surface they later worked underground, taking over much of the heavier work previously performed by children and women. They were eventually succeeded by mechanical and electrical power. Ponies worked in mines all over the world but were most used in Great Britain. Limited regulation of working hours and welfare were introduced in 1887 with more wide reaching laws being introduced under the Coal Mines Act 1911 following pressure by charitable groups. Maximum UK numbers were 70,000 ponies in 1913 with the last four ponies being brought to the surface in 1994. Various breeds and types were used from small Shetlands of about 10 hands (95 cm) high to full 16 hand (163 cm) horses. In spite of a widespread general belief to the contrary ponies were generally very well cared for and provided an adequate diet.

Introduction
In the late eighteenth and early nineteenth centuries extraction of underground coal to fuel the British Industrial Revolution intensified. In a situation paralleled by the oil and gas industries in the early twenty first century the resource became increasingly difficult to exploit and the process became more expensive. It was a case, almost literally, of all hands to the wheel. As mine shafts got deeper and the working face more distant from the shaft bottom, children as young as six years – girls as well as boys and among whom were many of my great-great-great-grand-forebears – slaved underground in appalling conditions to get coal from, as it were, A to B[1]. It was in the context of the demand for more and more coal that was becoming increasingly difficult to harvest that equines were introduced as an early form of more power and a step towards mechanization.

This paper looks briefly at equines in popular culture. It then examines use in mines other than in Great Britain. Subsequently it describes in more detail the role of

[1]The 1833 Factories Act had already made it illegal for children under 9 years to work at all, those aged 9 to 13 were not to work more than 9 hours per day and to have 2 hours of schooling and those aged 13 were not to work more than 12 hours per day. The 1844 Act modified these conditions such that children aged 8 to 13 (the minimum 9 years of the previous act had obviously proved untenable but children under 10 were not to work underground) were to work less than 6½ hours and have 3 hours of compulsory schooling every day and women must not work more than 12 hours a day.

equineses, legislation governing use, numbers and distribution, breeds and types and management in coal mines in England, Scotland and Wales from the mid seventeenth to the end of the twentieth centuries.

Popular culture

The popular image of the pit pony is of a poor small animal that is badly treated by its handlers, inadequately fed, suffering from induced physical defects and of inherently bad health. In this context there is a plethora of dedicated or incidental web sites devoted to pit ponies (Digby 2006 and also see references section). Several books of a sentimental nature have been published (Squires 1974, Barkhouse 1989), poems have been written (Heuchan 2006) and there have been at least two films and a television series devoted to equines in and around mines and their perceived relations with humans.

World use

Outside the United Kingdom equines were used in many countries. They were perhaps more widely used in Canada than elsewhere and were important in mining around Drumheller in Alberta in west-central Canada (Barkhouse 1985) and in Cape Breton in Nova Scotia in the east. The Cape Breton Regional Municipality has a pit pony with a black diamond (= coal) collar as one of the 'Bearers' of the Shield in its Coat of Arms. Equines were also widely used in Australia most notably and most recently at Collinsville in the far north of Queensland until 1986 (Plate 1). Ponies were used at the Ulan coal mines in the Western Coalfields of New South Wales until about 1980.

Plate 1. Working pony at Collinsville, Australia.(Nat. Library of Australia; nla.pic-vn3580897-v)
(Note that this pony does not have the protective head/eye gear compulsory in the UK)

When coal was first extracted in the United States of America ponies were imported from northern Scotland to work in the mines of Pennsylvania, Ohio, West Virginia, and Kentucky. The last pony mine in America was the New Gladstone Coal Mine in Appaloosa County, Iowa, which shut down its operations in 1971. The Pottock breed of pony from the Basque country of southern France/northen Spain was used in coal mines in northern France and in Italy.

Use in the UK

History

Horses and ponies in the service of coal originally worked on the surface providing general haulage and transport of the precious fuel for local use. During the 17th century (1600s) animals provided power above ground (known as the 'bank' in many mining areas) for gins. These gins provided the power via shafts and pulleys for the underground pumping and winding machinery.

The first records of pony use underground appear in the mid-18th century (1700s) when they were used to drag a single corf (basket) on a sledge. The introduction of wooden waggonways underground meant that a single horse could draw several corves at once. By the 1790s, when cast iron rails were introduced, one horse could pull as many as ten rail tubs each holding 300 kg of coal. In thin seam pits where roadways were too low even for the smallest ponies women and children continued to be used to drag the coal to the bottom of the shaft. The early Factories Acts undoubtedly accelerated the use of horses and ponies for underground haulage.

Legislation and welfare

The first legislation to protect ponies underground was part of the Coal Mines Regulation Act of 1887 (which also raised the minimum age for boys working below ground from 10 to 12 years). Under its limited provisions the mines inspector could investigate how the ponies were treated and whether roofs were high enough to prevent damage to their backs.

Several charitable organizations were also active in seeking to ensure that pit ponies were well treated and provided with the best possible living conditions for their peculiar circumstances. These included national societies such as the Royal Society for the Prevention of Cruelty to Animals (RSPCA) and the National Equine Defence League (which later came to incorporate the Pit Pony League). The Pit Ponies Protection Society was still in nominal existence in 2007 when it had more than £500,000 in investments in its account with the RSPCA, of which it had become a subsidiary. These funds are dedicated to the protection of working horses and they made a substantial contribution to providing new facilities at Gonsal Farm (the RSPCA farm for equines) and to the upkeep of equines there in 2007 (RSPCA 2008).

Regional or local bodies included the Scottish Society to Promote Kindness to Pit Ponies and the splendidly named Yorkshire Society for the Encouragement of Humane Treatment and Kindness to Pit Ponies. This second undoubtedly august body had the Countess Fitzwilliam as its President, His Majesty's Inspector of Mines for Yorkshire and Leicestershire as Vice President and no less than 11 titled ladies (from Lady to Countess), three Dukes, an Earl and a Lord among a plethora of other worthies as

Patrons (Figure 1). In 1907 the Scottish Society for the Prevention of Cruelty to Animals carried out an inspection of collieries and distributed prizes to the drivers of pit ponies (as part of a wider inspection it found that 25 % of horses drawing Edinburgh tramcars were unfit to work) (Hunter 2004).

Figure 1. Letter from a Yorkshire charitable society concerned with pit pony welfare, 1904

Further legislation under The Coal Mines (Horses) Regulations, 1949 and The Coal and Other Mines (Horses) Regulations, 1956 defined conditions even more carefully and provided for the welfare of horses and ponies in greater detail.

A Royal Commission on Mines sat from 1906 to 1911. This eventually resulted in the passing of the Coal Mines Act, 1911. The treatment of all animals in the United Kingdom had already been regulated by the Protection of Animals Act, 1911. The Royal Commission had, however, taken evidence on the living and working conditions of equines in mines due in part from pressure by charities concerned by animal welfare. The 1911 Act thus provided pit ponies with additional protection in its very comprehensive Third Schedule. This 'Pit Ponies' Charter' (that is, the Third Schedule) provided legislation to regulate the condition of stables, the keeping of daily records and the appointment of a competent horseman (note that this is not the driver) for every 15 ponies. It also made the use of protective headgear and eye guards compulsory. In some pits that had problems with gas ponies were fitted with rubber shoes instead of the usual iron ones. Pit ponies could legally only begin work at the age of four and could then continue for as long as they were able (many worked well past their twentieth year). Before going underground ponies had to be trained to pull weight and to get them used to the harness, headgear and limbers. The once popular belief that pit ponies go blind underground is totally untrue and the use of blind ponies was specifically prohibited.

Inspectors were appointed to ensure that ponies received the care and attention to which they were legally entitled. As early as 1919 the Secretary of State for the Home Department was asked in parliament whether the eight inspectors of pit ponies that were employed were sufficient to ensure systematic and frequent examination of the 65,000 ponies employed in 1880 mines. On 290 occasions between 1901 and 2000 questions relevant to pit ponies were asked in parliament. Most of these related to compliance with the regulations, welfare and numbers. In general the Ministry charged with pony welfare (which for much of the twentieth century was that of Fuel and Power or its equivalent) 'carries that responsibility very seriously and it is in no way second either to my honourable friend or other honourable gentlemen who belong to the various associations in its desire to show kindness to animals and to make sure that pit ponies are not unduly worked or hurt in any way'. The Honourable Member for Newport – in the heart of the Welsh coalfields – was not always satisfied with the answers he received to the no fewer than 19 points he raised in parliament in the 22-year period 1930-1952. These ranged from the simply bizarre to the very serious. In one of his first questions he asked whether the Secretary for Mines had any information concerning the provision of a head-lamp for pit ponies with a view to minimising accidents and injury. One of his later interventions was to present a petition on behalf of pit ponies, signed by 50,175 persons, praying that work now being done by them should be done by mechanical haulage.

Several well-known politicians became involved with the parliamentary discussions on pit ponies. These included Winston Churchill as Minister for Home Affairs, Emmanuel (Manny) Shinwell and Aneurin ('Nye') Bevan who had himself been a coal miner. Shinwell, when Minister for Mines, was asked by the Member for Pontefract (in the Yorkshire coalfield) whether he was in a position to give the full results of the

special investigation made into the working hours of horses in mines: what number of horses were employed for six shifts of seven hours per week and the number working nine or eleven or more shifts per week; and whether the Regulation providing one horsekeeper for every 15 horses in a mine was generally observed? Mr Shinwell replied that investigations had confirmed the general conclusion that pit ponies were not overworked and that special reports had been obtained in respect of some 46,000 horses. Of these approximately 43% were employed for six shifts a week, 26% for more than six but less than nine, 20% for nine, 6% for more than nine but less than 11 and 5% for 11 or more. Shinwell went on to add that the real test of overwork was the condition of the ponies and, save in a few isolated cases (where effective action was taken by the inspectors), this was found to he satisfactory.

Numbers and distribution

There are no data on the numbers of equines working in mines before 1913. In that year, according to colliery books, there were approximately 73,000 working in mines covered by the Coal Mines Act (this last is important as some small mines were not regulated and there were no data on numbers of ponies being used in them). Over the succeeding years there were constant reductions in numbers as mechanical or electrical power was introduced to move coal from face to shaft. It should be noted, nonetheless, that the peak numbers in 1913 coincided with the greatest historical output of coal. By the end of the First World War numbers were down to about 65,000. Some 20 years later at the beginning of the Second World War in 1939 numbers had been reduced to about 32,000 which was further reduced to 23,000 by the end of that war in 1945. Numbers then fell rapidly to about 2,000 in 1969. From 1970 the policy of the National Coal Board was to withdraw all ponies from under ground with the exception of a small number in collieries where the expected life would not justify capital expenditure on new haulage equipment. Numbers were a nominal 55 ponies in 1984. Ellington Pit in Northumberland had 24 ponies in 1992 that were used for salvage work. The last four ponies owned by British Coal (the successor in name to the National Coal Board that had been formed in 1947 when all pits were nationalized to become ‘public’ rather than private property) were brought to the surface at Ellington in 1994 (Figure 2). This was not, however, quite the end as a few ponies remained in use in private drift mines in South Wales. The really last two working pit ponies in Britain – Welsh Cobs – were due to be retired from the private drift mine of Pantygassed in South Wales in 1999 (Garner, 1999).

In 1923, ten years after the first numerical data became available, mechanical forms of haulage had displaced nearly 10,000 ponies. Equines were employed underground at 1,449 mines in 1927. There were in that year, however, some 1,300 mines with no horses below ground. These last included many small mines where the absence of horses did not necessarily imply the presence of mechanical haulage. Nearly all mines employing horses at that time also had some mechanical system (the number of mines at which no horses were used but which had an electrical haulage system was then 324).

The percentage of mines that used ponies varied by region. In 1941, for example, the regional range was from 7.5 % to 56.7 %. By that time, of course, there had already

been a considerable reduction in the number of ponies down pits and most of the coal moved from face to shaft was already carried by conveyors (Table 1).

Figure 2. Numbers of equines working in mines under the Coal Mines Act, 1913-1994

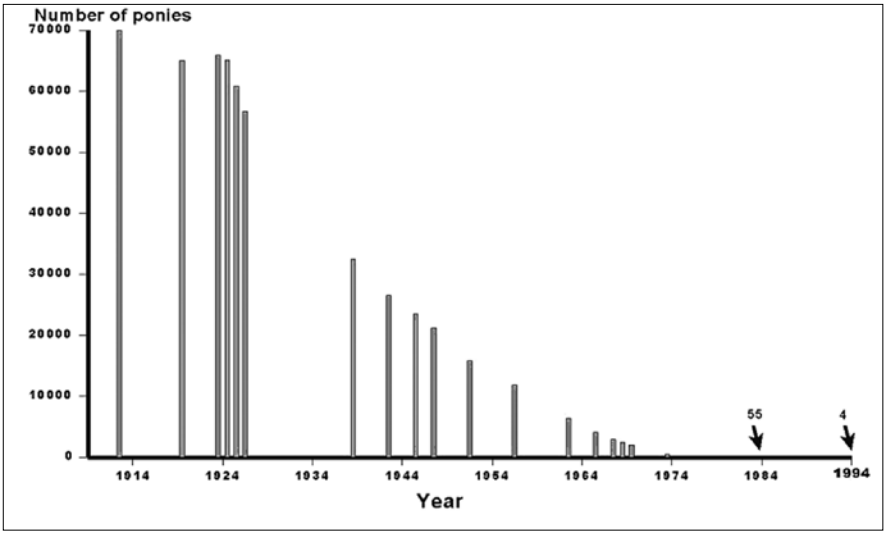


Table 1. Number and per cent of mines using ponies and per cent coal moved by conveyors in 1941

Area	Working mines	Mines using ponies		Percent of output carried by conveyors
		Number	Percentage	
South Yorkshire	113	59	52.2	74.81
West Yorkshire	109	40	36.7	49.34
North Derbyshire	90	51	56.7	87.54
North Staffordshire	53	4	7.5	92.26
Warwickshire	20	5	25.0	71.01

As the era of pit ponies was coming to a close the northeast of England employed the greatest number of animals. This was followed by the East Midlands and Yorkshire with far fewer animals being worked in the other Divisions (Table 2).

Breeds and types

The archetypal image of the pit pony is the shaggy sturdy Shetland of about 10 hands high (hh) (102 cm) at the withers). This concept is only partially true as location and type of task governed the breed and size of the ponies used. Ponies up to 11 hh (112 cm) were used near the coal face. Animals of 13 hh (132 cm) were employed in the

Table 2. Ponies employed underground in National Coal Board Divisions on 30 June 1965

NCB Division	Ponies underground
Scottish	6
Northumberland and Durham	2,409
Yorkshire	575
North Western	9
East Midlands	657
West Midlands	48
South Western	363
Kent	0
Total	4,067

main roads with higher roofs. Close to the shafts where many tubs had to be kept moving and the roofs of the haulage ways were higher again very large ponies (or horses) of 16.3 hh (170 cm) were more likely the norm.

Breeds varied considerably in different areas. Shetland, Welsh and Dales ponies were common in the United Kingdom. When tin mining was an important industry in the southwest of England in the nineteenth century Dartmoor ponies were used as pack animals to carry the tin from the mines to surrounding towns. Belgian horses and Shetland ponies – ranging in size from 'farmyard standard' to that of a large dog – were used in Canada (Barkhouse 1985). Ponies of various breeds were occasionally imported to the UK from the USA (in a reversal of what had gone before), Russia and Iceland. During times of high production and particularly after a slump when pony stocks were low very high prices might be paid for good animals.

Geldings were the preferred animal underground. Stallions were also used but the use of mares underground was very unusual. The selection of each pony was carefully considered before it was accepted for work. The preferred age at first use was 4–5 years but some up to 14 years were also bought. Ponies needed to be sure-footed, stocky, heavy limbed and strong to cope with the heavy and relentless work and a low set head helped in working under low roofs and steep roadways. Some colliery owners attempted selective breeding to encourage the development of the sturdiness and strength required for hardworking animals.

Temperament was very important. A good pit pony had to be even-tempered and not high-strung. More lively animals were a danger to the drivers and could cause injuries and possibly fatal accidents. Nervous, timid or shy horses took too much time and expense to break in. Before a pony started working underground it went through several weeks of training. This period also gave the trainers time to observe the ponies and remove unsuitable ones from the system.

Working time and work performance

The hours a pony could work were laid down by law (see also earlier section on Legislation and welfare). A 48-hour week was the maximum except in special

circumstances. A pony must not work for more than two shifts in 24 hours or more then three shifts in 48 hours. A shift was 7½ hours or less. A pony carrying supplies or on repair work often worked a shift of only three or four hours.

Ponies are adaptable creatures. They worked equally well along the busy main roads or on isolated side cuttings and were at home on straight or winding roads. A fault in the strata would not affect a pony's performance but could mean that mechanized haulage was, at least temporarily, impossible. Underground they pulled empty tubs or carried materials such as pit props into the workings then brought back tubs full of coal to the shaft.

Equines could pull a heavier weight than men. This offset their higher cost. In 1810, for example, it cost 5s ½d (25p) per day to keep a horse whilst a driver's wage was around 1s 2d (6p). Welsh Cobs on underground duties hauled cast iron and steel drams of coal weighing two tonnes over an uneven railway. In Canada the larger Belgian horses pulled as much as 6-8 tonnes of coal in the mines around Drumheller in Alberta (Barkhouse 1985).

Management, health and feeding

The driver was the most important person in a pony's ambit and he generally treated his workmate with affection and respect. These lads fed and watered their animals during the working shift. It was their duty to report both to the official they worked under and to the horse keeper any accident that happened to or any matter that affected a pony's well-being. These last then reported to the manager or under-manager. In addition to making daily reports on the state of their ponies and their working times the horse keepers cleaned and groomed them and kept harnesses and collars in good condition.

At some pits, ponies were taken underground in the cage like the men but at many they were suspended beneath the cage in a sling or net. Once down the ponies were usually stabled there permanently because it was difficult to get them back to the surface. In deep mines they became used to warm and stable temperatures whereas on the surface their health could suffer from changes in temperature. Some pits brought ponies to the surface only during the annual holiday or during long strikes or lockouts but others tried to keep ponies underground even at these times.

If ponies were brought to the surface in large numbers their arrival at the pithead often became a community occasion. Miners and their wives and children visited the ponies on this rare opportunity to allow the family, particularly the womenfolk, into the men's working world. During long strikes in particular the field containing the ponies became the objective of family walks so that fathers and sons could show off 'their' ponies to wives, sisters and girl friends.

Prior to bringing animals to the surface some collieries had a farrier remove all the shoes or just those of the hind feet whilst underground. Despite the removal of shoes, however, a deal of damage could be done in the first days of a 'holiday'. Serious accidents were not uncommon. The first response to the freedom of a field after close confinement – as for most domestic stock – was usually a bout of bucking, a few kicks and then a gallop around. If ponies were above ground long for long periods they often underwent a kind of personality change. In addition to getting fatter on green grass and

due to the unaccustomed idleness they got wilder through lack of handling. With the passage of time many tended to an unwillingness to answer to their names and even to ignore their visitors.

If there were problems in getting ponies up and releasing them there were more difficulties in taking them below again. Even when safely below ground again and re-shod the troubles were not over. Many pony drivers thought it took at least a week before ponies were fit for work again. Most colliery vets, however, considered that it took longer for ponies to get back to full fitness and that three to four weeks were required.

The welfare societies that campaigned for 'holidays' for ponies often received little support from the miners who saw the disruption of routine as both damaging and unkind. This applied even during long strikes but the Unions allowed the horse keepers to go below ground to ensure the ponies' welfare. Responding to a question in parliament during a major strike in 1921 the responsible minister replied that about 4,000 ponies were being kept underground at about 100 mines. Instructions had, however, been given that they were to be brought to the surface if they were in danger of drowning (NYT, 1921).

The stables were very important and much was done to keep the ponies as comfortable as possible. This in turn also lengthened their useful working lives. By law ponies had to be able to raise their heads in the stables. In their underground stables the ponies were out of the way of the main roads but in the intake airway so that they could breathe the same fresh air from the surface as the men. The stables were later lit mainly by electricity (which few miners had in their homes), had concrete floors that had a good slope for drainage, brick walls and the natural roof of the mine was usually supported by steel girders.

Ponies were usually examined and tested for glanders (caused by the bacteria Burkholderia mallei although the disease was supposedly eradicated in the UK in 1928) before they went underground[2]. They were also examined at least once a year by a veterinary surgeon and at least twice a year by the inspectors employed by the responsible ministry. Sick ponies were usually isolated in a loose box underground where they were treated by the vet or horse keeper. If the illness was likely to be long term they may have been taken to the surface.

Water was freely available at the stable and most pits had facilities for washing animals at the end of a shift. The staple diet was 'choppy' which was a mixture of hay, oats, pulses and maize. In addition to normal feeding outside working time, most miners had a 'choppy box' or provided a nose bag to give their ponies a snack when they themselves had their 'snap' or 'bait'. Where the piece work system (that is, miners were contracted to get a certain amount of coal per shift) was in operation, however, there was pressure on both miners and ponies to work through without a break. A good daily allowance for each pony was: hay 12 pounds; straw – not essential – 1 ½ pounds; oats, 8 pounds; maize 3 pounds; bran 3 pounds. Beans sometimes replaced part of the oat ration.

[2]The disease is called 'glanders' when the principal lesions are in the nostrils, submaxillary glands and lungs and 'farcy' when located on the surface of the limbs or body.

As an example of the treatment of pit ponies, about 150 were employed at Blackwell 'A' Winning Colliery at Alfreton in Derbyshire in 1933 for gathering and pit bottom work. They were well cared for and the stables were clean and well ventilated. A mill equipped with the latest machinery catered for the needs of ponies at five pits by carefully preparing their food. This consisted of a mixture of hay, cooked maize (= flaked maize?), oats, maize and beans which was filled into 7½ stone bags for transport to the collieries. In spite of this general kind of treatment there were embargoes by some people on the use of coal from pits where ponies were employed. The Colliery Guardian deplored this in its article 'An Infamous Appeal'. It appears the Pit Pony Protection Society had published a request by 'Distinguished Men and Women' (who, according to the Guardian, were predominantly novelists, musicians, actresses and clergymen [that is to say they did not know much about real life!]) to boycott on humane grounds all coal from pits where ponies were employed (Baker 1995).

At the end of their working lives pit ponies were humanely destroyed or retired from underground duties. The numbers involved at National Coal Board mines in the period 1950 to 1965 varied from almost 2,000 to about 500 (Table 3) with the downward trend reflecting the general reduction in the numbers of pit ponies in use.

Table 3. Ponies destroyed or retired at NCB mines in the period 1950-1965

Year	Ponies destroyed or retired		Year	Ponies destroyed or retired
1950	1,859		1958	1,102
1951	1,744		1959	969
1952	1,457		1960	1,192
1953	1,442		1961	865
1954	1,411		1962	716
1955	1,346		1963	655
1956	1,178		1964	618
1957	1,177		1965	539

Acknowledgements

I thank the National Library of Australia and the National Mining Museum for England for permission to use photographs. Much of the information in this paper has been extracted from mining websites and from Hansard which is the edited verbatim report of proceedings in both Houses of the UK Parliament.

Dedication

This paper is for my grandfather George Alfred Heighway (31 August 1886-5 January 1963), a miner underground for more than fifty years. His first job was that of 'hurrier' – boys who pulled trolleys from coal face to shaft. All granddad's generation, and especially those distant cousins of mine who were pony drivers, were grateful to the ponies that assumed their burden.

References and websites

Baker, F.H. (1995). A description of Blackwell 'A' Winning Colliery, Alfreton, Derbyshire in 1933. *Bulletin of the Peak District Mines Historical Society* **12**: 39-57.

Barkhouse, J. (1989). *Pit Pony*. Gage.
Bright, J. (1986). *Pit Ponies*. Batsford: London. ISBN 0-7134-5226-9.
Digby, L. (2006). Pit ponies - a coal miner's best friend. http://www.travelmininghistory.com/ponies.htm.
Garner, C. (1999). Last pit ponies are made redundant. *The Independent Newspaper*: London (Monday, 15 February 1999).
Hansard. www.parliament.uk/publications/hansard.cfm.
Heuchan, C. (2007). The Last Pit Pony. Australian Bush Poets Association. http://www.abpa.org.au/Bush_Poetry/Modern_Poetry/the_last_pit_pony.html
Hunter, P. (2004). *Veterinary Medicine: A Guide to Historical Sources*. Ashgate Publishing, Ltd.: Farnham, UK. ISBN 0754640531, 9780754640530.
Infomine. http://www.infomine.com/minesite/minesite.asp?site=ulan
International Museum of the Horse. http://www.imh.org/museum/history.php?chapter=101.
Leicestershire County Council Museums. http://museums.leics.gov.uk/collections-on-line/GetObjectAction.do?objectKey=176156.
National Coal Mining Museum for England (NCM). www.ncm.org.uk
NYT (1921). Big Strike Powers for Lloyd George. *New York Times* (5 April 1921).
Poney-Pottok. http://christian.pubert.free.fr/frametrad/gb/mil.htm.
RSPCA (2008). *Trustees Report and Accounts 2007*. Royal Society for the Prevention of Cruelty to Animals: Horsham, UK.
Scottish Mining Museum. www.scottishminingmuseum.com/museum/download.asp?id=13 -
Squires, E. (1974). *Pit Pony Heroes*. David & Charles: Newton Abbott, UK.

2. AFRICA

(a) South Africa

Adaptation in donkeys

Peta A. Jones
Donkey Power Facilitation and Consultancy, PO BOX 414, Tshitandani/Makhado 0920, South Africa

Paper prepared for symposium 'An Integrated Approach to Community Empowerment Through Livestock', organized by the Developing Animal Agriculture Interest Group, South African Society for Animal Science, Karakul Research Station, Upington, Northern Cape, 3-6 July 2006

Abstract
The increase in demand for donkeys in our region is resulting in donkeys being sought (but usually not obtained) in their hundreds and being transported for long distances, often across international borders. The experience challenges not only the humans involved, but the donkeys themselves, not all of which survive. Nutritionally adapting to new vegetation communities is one problem, but perhaps more serious is the mental adaptation of an intelligent animal dependent on herd structures, but nonetheless required to work. A number of recommendations are made to ensure better adaptation and minimize loss in the future.

Introduction
No animal empowers rural people, and thus their communities, more than the donkey does. Although the donkey does not (usually) provide meat or have any ritual

significance, it can be argued that the work it does – and the variety of tasks involved – have a much greater value than mere food or tradition. Yes, it is rich people who own cattle (and even sheep), but in today's world plenty of people make a living using donkeys, and some of them even grow rich.

Think about today's world: fuel is becoming ever more expensive, and when fossil fuels exceed the price of biofuels, much of the food we need to eat will be needed for fuel-hungry vehicles. Rivers are drying up and water tables dropping, so access to water is becoming ever more difficult. The Upington statue shows a donkey raising water from underground; that water also needs to be transported, as do a lot of other things that communities need. If communities are using donkeys, they are using one of the most fuel-efficient as well as cost-efficient means of transport known to humankind (Naudé-Moseley and Jones, 2002), and six thousand years of use have shown how sustainable it is. Donkey owners themselves confirm time and again that they already know all this (*eg*. Mwenya and Chisembele, 2004).

> Donkeys are on the increase! Donkey populations are spreading in Africa. Women and men are finding donkeys ever more important for transport and farming. However, donkeys are neglected by governments, educational establishments, researchers and extension services. Despite their poor image in many societies, donkeys are being employed successfully thanks to farmer inventiveness and indigenous knowledge. (Fielding and Starkey 2004).

So it is no surprise that the demand for donkeys is growing. In my own area the price has already risen to R600 per animal – but never fear, it is still cost-efficient. Government officials from neighbouring countries such as Mozambique, Zambia and Malawi, usually with NGOs involved, are on the search for large numbers of donkeys to improve their agriculture, thinking even of having them flown into the areas where they are needed!

These enquiries come my way, and always I have to pass them on – sometimes to the Northern Cape, where I hear that people are still selling donkeys and that they are cheap. Unfortunately, I never hear more about these transactions, or about how the donkeys manage once they arrive at their destinations. So far I have knowledge of only three instances of donkey transfers from one country to another, in each case involving changes of environment. Each will be discussed in more detail below (see also Table 1), but they were:

1. Zimbabwe (Gwanda) to Zambia – 150 donkeys required, but only 89 were sent by lorry. 1995.
2. Zimbabwe (Zambezi Valley) to South Africa (Soutpansberg) – eight of my own donkeys walked most of the way. 2001.
3. Swaziland to Mozambique (Inharrime) – 24 donkeys sent by lorry. 2003.

It is from these that I have been learning at first hand of some of the adaptation problems of donkeys when they encounter new environments, although the literature is suggestive, too. It is to be emphasized that, although each of these instances involves the crossing of international borders, it is actually the environmental change – compounded by the distances covered – that is the crucial thing.

There are good grounds for arguing that, of all the domestic animals of Africa, donkeys are best adapted to African environments, and there is thus no justification for trying to 'improve' them through breeding (Jones, 2003, 2006). This, however, refers to the genotype or types; the phenotype/s may be quite another matter. Individual donkeys certainly do have different responses to different environments, not all of them good ones. This distinction between genotype and phenotype is thus an important one to know for those seeking to buy donkeys at a distance from home.

The genotype: Africa's own animal

The ability of donkeys to live, even thrive, on a poor diet and very little water is as well known as their longevity (Aganga and Maphorisa, 1994; Kelly, 1991; Sewell, 1990). Food high in cellulose and low in protein is what they are adapted to consume, as they are adapted to high temperatures and low humidity (Smith and Pearson, 2005). They even seem surprisingly well adapted to heavy burdens of internal parasites (Yoseph *et al.,* 2005), and are legendary as regards their resistance to most livestock diseases, including diseases which affect horses. As conservers as well as converters of energy, they do better even than humans, and certainly better than cattle or horses (Smith *et al*., 1994). Like horses, they are not of course ruminants, but their digestive as well as their working requirements are so different to those of such other animals of roughly equivalent size, that humans who regard donkeys as simply a poor variant are making a fundamental mistake. Donkeys deliver better work for more years while having a much lesser impact on the environment than either cattle or horses, so that in Africa particularly they are by far the better choice.

Of course this is no coincidence. The modern donkey owes most if not all of its genes to two African ancestors (Aranguren-Mendez *et al*., 2004; Camac, 1989; Patton and Snyder, 2002). We know from tomb reliefs that it was working in Egypt some four thousand years before the birth of Christ. The donkey has had ample time to adapt to the harsh environments and to the arduousness of the work. If it did not cross the equator until quite recent times – seemingly doing so on boats brought by the Portuguese – this is largely because the farmers who originally crossed the equator were not using donkeys when they came. As long as women could cope with cultivation and transport on their own, donkeys were obviously not seen as necessary. That situation, on this side of the equator, has long since changed and the donkey is now an established part of southern African agriculture just as it is further north and in other parts of the tropical world.

The phenotypes: wanderers preferring home

There are further general things to be said about donkeys, but they are not true of all of them. For any animal reproduced sexually, the gene mix for an individual ensures that even siblings can be very different one from another, so it should be no surprise that an animal as intelligent as a donkey shows wide variations in the things it likes to eat and the things it likes to do.

One of the ways in which donkeys have become useful is in their ability to carry loads, usually on their backs, over long distances especially over barren and mountainous terrain. In this way donkeys became the chief means of transport over the

Asian Silk Road between China and Europe for many centuries (Camac, 1989). At the same time they were apparently being used for the transport of precious metals across the Sahara (Willett, 1977). Worldwide, donkeys have proved useful in smuggling goods across borders (*eg*. BBC, 2003), but also in bringing aid (Abd, 2006; BBC, 2001).

Donkeys' capacity for such travel comes about through some of their genotypical characteristics, notably their ability to range long distances in search of food as well as low intakes of food which is also of low quality (Smith and Pearson, 2005), and their ability to carry heavy loads without apparent difficulty (Ayo-Odongo *et al*., 2000; Dijkman, 1991; Jepson, 1994; Wambui *et al.,* 2004). This is not to say that all individuals will do this equally well, which is why special breeds of donkey have been developed for some tasks (Hutchins *et al*., 1999; Squance, 1997) to give the advantage to some of the phenotypes.

A donkey's memory for routes is frequently reported by observers, and is of course a factor in the smuggling strategies whereby donkeys cross borders without human accompaniment (*eg*. BBC, 2003). This is obviously a homing strategy in donkeys, and most donkey owners could report how easily donkeys are able to find their way home especially where care and comfort are provided. What exactly constitutes home to donkey is more difficult to specify. My own donkeys, after travelling some 900 km, marched straight into a stable constructed along the lines of the one they had left six months before, and thereafter seemed to regard it as home without demur, despite the distance and distinctly different environment. Another familiar element, however, was me, and it may have been an example of donkey recognition and assessment of humans, also known to be fairly acute. And, of course, they had each other.

So donkeys can apparently settle to new places easily, especially if they reach there slowly and have their friends about them. This, however, is mental adaptation. Whether physical adaptation is quite as easy is open to question. There is some evidence, but not research, to suggest otherwise.

The evidence of experience

There is very little documentation of donkey movements between environments, but Table 1 below represents some of what may be accessed. Each one, however, requires some discussion as the bare facts cannot necessarily be taken at face value.

No. 1 - Zimbabwe to Zambia

These two episodes of importing donkeys into Zambia from Zimbabwe are, from the literature, a little difficult to separate, especially as Menya and Chisemble (2004) report a fair amount of informal and private importation across the Zambezi in addition to their own formal involvement. It was not an easy exercise for them, nor for the local extension officers involved, as I myself remember well hearing it described. More laconically, they report: 'Sometimes it took approximately one and half hours to load ten donkeys and the same amount of time to unload them' (Menya and Chisembele 2004). When donkeys want to resist, they do it thoroughly.

And, although very careful health measures were taken, including periods of quarantine on both sides of the border, not all survived the journey or its aftermath, as reflected on the table. A number of reasons are proposed:

Table 1. Some experiences

	Reference		
	1 Zimbabwe to Zambia	**2 Zimbabwe to South Africa**	**3 Swaziland to Mozambique**
No. donkeys sent (year)	65 (1990-1994) 89 (1995)	8 (2001)	24 (2003)
Origin	Zimbabwe - arid plateau (mostly)	Zimbabwe - tropical river valley	Swaziland - mountain slopes
Destination	Zambia - tropical river valleys	South Africa - mountain slope	Mozambique - coastal area
Approx. distance	600-1,600 km	800 km	400 km
Mode of transport	Lorry	Foot (mostly)	Lorry
No. surviving after arrival	52 82 [?]	8 - until attacked by snake 6 months later; then 6	13 - and some still ailing a monthy later
Sources of information	Chisembele & Imakando 2004; Mwenya & Chisembele 2004	Self	Jones 2004a

- Lack of health care services at destinations
- Poor management on the part of recipients
- Donkeys shared on a rotational basis, so no consistency of management
- Donkeys 'catch diseases' (unspecified) and are not treated due to ignorance
- Encounter with unfamiliar 'disease organisms'(unspecified) to which the animals are not adapted
- General differences in the environment
- Stress – two days without food or water in the lorry
- Lorry with open sides enabling the animals to see out
- False reporting by owners so as to avoid repaying loans

And a few others could be imagined, including the psychological stress of being separated from friends – not examined in the reports – and the abortions which occurred as a result of the journey; subsequent adaptation of the dams was also not reported.

Also, it has to be said that the matter of 'disease' in donkeys can be problematical. There is so little research on the diseases to which donkeys actually are subject, that the list is very short. There is dourine, of course, a form of trypanosomiasis sexually transmitted or perhaps by a kind of fly other than the tsetse, said to be very prevalent in Botswana at the moment. In my own book (Jones, 1997) I refer mainly to the notifiable ones such as rabies and anthrax, the rest being ailments, being the only ones I could find in the literature at the time and having encountered none of them. Subsequent sources such as Svendsen (1997) give more and some detail, but for this part of the world there seems to be no information. All that we know is that donkeys seem to share

very few diseases with ruminants, and recover quickly when they are ill. If they die, this goes unreported and certainly undiagnosed.

No. 2 – Zimbabwe to South Africa

Health checks in this case were more cursory, since the donkeys were privately owned and known to be in good health and were not going to change ownership. 'Quarantine' on the Zimbabwe side of the Limpopo border occurred more or less involuntarily, as the donkeys arrived there on the very day of a foot and mouth outbreak which tied up the veterinary services and caused a delay of three months. (Donkeys themselves, of course, do not suffer from FMD.) During those months the travelling donkeys associated with local ones, and two of them fell pregnant, so it was hardly quarantine.

In accordance with veterinary requirements, the donkeys were inoculated against equine influenza, and tested for dourine. They were also supposed to be tested for glanders, but it transpired that even Onderstepoort could not do this, since glanders had not been encountered in the region for something like 30 years. Curiously enough, one of the donkeys arrived on the Limpopo border with sore legs in that the skin was raw and hair fallen out. His escorts along the way had taken him to a vet who diagnosed glanders and recommended that he be shot. Luckily this was not done, and my own diagnosis was some kind of topical irritation from plants or small insects. I recommended applications of vaseline, but this was not done and he recovered anyway. At least that time ...

Because of the delays, in the end these donkeys had to travel the last 100 km by truck. It was an open truck, and yes, it was difficult to persuade them to get aboard. The process was quick, however, because an electric cattle prod was used, but the whole process looked very unsafe for the donkeys as they stumbled and fell over one another and the gaps between ramp and lorry. However, through their own efforts they all ended upright in a row facing out in the same direction. Transit through the mountain tunnels was the worst few minutes, during which all eight re-arranged themselves with a great deal of metallic noise and came out facing in the other direction. They needed little persuading in offloading; the first one fell, luckily without injury, and the others all jumped, and then they plodded up the mountain without further fuss until they met the horses ...

They encountered fog for the first time almost immediately, but initially there seemed to be no adaptation problems. It was six months later, at the beginning of winter that they all, over the space of 24 hours, exhibited symptoms of a snake attack. Veterinary diagnosis and treatment was luckily available, but it took time to realize the full effects and to deduce that a spitting cobra was involved. One donkey died fairly immediately, and three ended up blind. Within two further months, both pregnant donkeys aborted near term. One of the blinded donkeys, the first one treated and – apart from the one that died – seemingly the worst affected, was only able to swallow after three days and chew after ten. The other two seemed to be eating normally, and one seemed gradually to recover her sight and the other on the way to doing so. However that one had a long-standing problem of a displaced lower jaw, the result of a fight when he was a foal, and two months later he collapsed from debilitation because presumably he wasn't finding enough to eat. Supported in a sling at night and given

heaps of straw and buckets of supplements, he still couldn't make it and died about five months after the snake attack. The one initially worst affected also collapsed, although a little later, and was treated in the same way, but in the end he recovered although he had lost a lot of his hair, which took a while to grow back, and he is still blind. This particular donkey, however, suffered periodic patchy hair loss – though never so severe – even while on the Zambezi, the cause of which was assumed to be dietary although never really established.

In the same six months before the next rains came, even the recovered donkeys suffered loss of condition, and for the first time in their lives grew winter coats.

That was in 2002. Since then I have been very watchful for adaptation problems, and it seems that they are still manifesting. All except the blind donkey have been attacked at least once more by spitting cobra, but so far medical intervention has been in time. In the early part of the rainy seasons several of the donkeys can look so bloated by the end of the day one could think they were pregnant, although they deflate during the night when they do not eat, but this last season it was not quite so bad. Also, they did not lose quite so much weight in the dry season: they are browsing more. Where I have been able to identify the browse, it is often of a kind that they never encountered on the Zambezi, such as Brachylaemia discolor, a particular favourite. They have also discovered some domestic plants such as avocado – leaves and fruit – and grape leaves. Different donkeys, as ever, prefer different things. They all like carrot roots, but three of them, all jacks, will not eat carrot greens. Even more remarkable is the observation that they munch vegetation known to have medicinal qualities, such as Eucalyptus – so far, only the bark, although they have been observed munching pine needles – Aloe dried leaves, used by local people for snuff whereas the gel inside the fresh leaves is an all-purpose medicine, and kakibos (*Tagete minuta*) which, at least applied externally, repels ticks. None of these were available in the area in which they were raised.

However, there are some things they are eating that clearly disagree with them. Periodically a donkey passes an afternoon lying down and groaning pathetically – very alarming the first time it happens, and so far it has only happened to the jacks, and more often to the two greedy ones. The jennies are perhaps more discerning eaters. There are known poisonous plants in the pasture, such as bracken and *Crassula acinaciformis*, not to mention *Lantana camara*, with war waged against all of them, but there is no sure sign that they are being browsed by donkeys or any other animal. *Crassula* may in fact not be poisonous, but there may be other species lurking that I have still to learn about.

With much effort, I was able to arrange that the two jennies – the only two surviving – that lost their pregnancies should become pregnant again at the end of 2003. One was successful, the other resulted in a stillbirth, and I have no idea why. Perhaps something in the jenny's diet? Local people are certainly concerned about the high incident of foal deaths, and this is one of the things for which research is being proposed.

Where parasites are concerned, when recovering from the snake attack the donkeys were often hosts to blue ticks, diligently removed every day and thrown to the chickens whose job it is to control them. Such ticks have not been seen since. They received one worm dose in the autumn after their arrival, and none since since

only wild grazers and browsers share their environment, and the manure is removed daily from their stable to create organically-treated compost. The donkey that arrived on the Limpopo with sore legs, however, started the same problem on the mountain, and has had it ever since. He was also the only one that ever had ticks on the Zambezi – donkeys generally manage to control them naturally with rolling and grooming. The leg problem, however, seems to be caused by a smaller parasite, a 'pepper tick' or something of the sort. A local harness-maker has complained of the same problem in his donkeys, and we have both been taxing our minds as to how to control it. Now, after particularly good rains, I am dismayed to see all my other donkeys suffering from the same thing, although with varying degrees of severity, the original one still being the worst.

Thus for four years a process of adaptation has been under way, but I am not certain it is yet complete. Given individual differences, and the fact that, over ten years, three snake deaths had also occurred on the Zambezi, the problems seem to consist in:

- The presence of venomous snakes
- Unfamiliar vegetation
- Lack of resistance to unfamiliar parasites

No. 3 – Swaziland to Mozambique

This, too, was an exercise in which I was personally involved, although not as much as I would have liked to have been and perhaps should have been. The experiences and recommendations reflected in Chisembele and Imakando (2004) and Mwenya and Chisembele (2004) were not widely accessible at the time, but they were in my possession in the form of the initial electronic version of the conference proceedings of which they were part.

Although the correspondence dated back a couple of years, the first I knew that the donkeys had actually been acquired and imported into Mozambique was when I was invited to come and train people how to use them and look after them. I had made earnest recommendations, but I think they were largely ignored – if, indeed, they ever reached the right people. Because of the international nature of the transactions, veterinary services were obviously involved, but there is little on the books of veterinary services of any country that specifically refers to donkeys, and it is my guess that regulations applicable to horses or even cattle were applied.

At any rate, the donkeys were transported by lorry, and I was told they were 'looked after' on the way. This story has also been told elsewhere (Jones 2004a). By the time I was taken to see the imported donkeys at their destination, by vets, about a month after their arrival, over a half had already died, and others seemed in poor enough condition that I was not confident of their survival. One thing, though, that I observed, something at odds with one of the conclusions drawn by Mwenya and Chisembele (2004), is that the older donkeys seemed less stressed than the younger ones. Generally, my own assessment of the problems amounted to the following:

- Strong friendship bonds between donkeys had been broken in the purchasing exercise
- Young donkeys had been prematurely removed from their mothers and/or friends
- The vegetation was too alien

- No supplementary nutrition had been provided
- Possibly open trucks had been used
- Possibly there were venomous snakes

In short, the mental stress had aparently been just as acute as the physical stress, mainly in the form of nutrition. This resulted in an unacceptable level of loss, especially given the huge resources that had been invested in the exercise, not to mention the size of the need for donkeys in Mozambique.

Trying to minimize loss

While always bearing in mind that donkeys, being travellers by nature, are thus predisposed to adaptation, and also that individuals will differ markedly in their responses to change, it is obviously not a good idea to impose too many challenges on animals in which money and time is to be invested. Even with donkeys purchasable at low prices, the organization and travel involved in relocating them increases their value, as does also the demand for them, so losses should be minimized.

The experiences described here have taught some valuable lessons, many of which are enumerated in Mwenya and Chisembele (2004) as well as Jones (2004b), but might be summarized as in Table 2.

The various 'care aspects' need some explanation, especially as they are so interrelated that separating them may seem an exercise in artificiality.

Mental

No distinction is being made here between mental and emotional – psychological, if that term is preferred. It is becoming clear, as research accumulates, that all animals have their psychological needs, and donkeys are no exception. However, since adaptation is being considered, it is simpler to regard it as 'mental'.

Some people may think that no attention need to be paid to the mental aspects of care, but experience with donkeys reveals them to be highly intelligent animals. The fact that they are less nervy than horses reflects on their ability to assess the situations that affect them and to make decisions about what to do. In emergencies or in pain, they become immobile. In the face of danger, like zebras, they take flight, but only so far as it necessary to form a group, and then they turn around and face the danger, assessing it. Always they have a very good knowledge of their environment, and seem never to forget routes. For work, they need very little training, little more than being shown what to do. They interpret verbal instructions, usually accurately.

Such intelligence of course makes them very good working animals, and the fact that they are expected to work must be taken into account. They are herd animals, and work as a team. A single working donkey simply regards its handler as part of the team, and therefore as part of the herd, so the relationship between animal and handler is crucial to any work that must be done.

Their general mental abilities also make them adaptable to change – but there are limits. With environment and routes being important to them, very rapid changes in these are going to be disorienting and disturbing. Watching the vegetation and the road speed by from the sides of an open truck is a challenge to which donkeys are NOT adapted.

Table 2. Relocating donkeys to new owners and new environments

Stage	Care aspect	Recommendations
Purchase	Mental	Purchase in pairs, maintaining existing friendships
	Mental	Foals under 1 year to be with mother or close friend
	Physical and mental	Age preferably between 3 and 5 years
	Physical	To be in general good health and condition
	Mental	Record and use names
Transport	Physical and nutritional	Walk as group
	Mental	If motorized, closed sides
	Mental and physical	If motorized, preferably at night and certainly when cool
	Physical and nutritional	Offload for movement and grazing after 6 hours maximum
	Nutritional	Ensure plenty of water every 24 hours and feed every 6 hours
Reception	Physical	Involve local community leadership
	Nutritional	Provide supplementary feed and vitamins for 3 months
	Nutritional	Check environment for poisonous plants, and eliminate for 12 months
	Physical	Check closely for pests and parasites, be ready with treatment
	Physical	Close veterinary supervision for first 3 months
	Physical	Regular checks on hoof condition
	Physical and mental	Ensure that new owners are well trained in donkey care and management
	Mental	Allocate to owners in pairs, maintaining existing friendships, so not necessarily breeding pairs
	Mental	No changes in ownership and management for at least 5 years

Then, even more difficult to separate from the mental aspects of care, are the emotional ones, so here they are regarded as the same. The disruption of relationships puts severe stress on animals with the strong herd instinct and facility for bonding that is characteristic of donkeys. If at the same time they are removed from everything familiar, the effects can be very long-lasting, and will certainly impact on their behaviour, including their ability to adapt physically.

Physical

This refers generally to health, whether or not nutrition is involved, although it usually is. Internal and external parasites will also impact on health, and new species of parasite

will probably impact more severely than those in the animal's native environment. In the case of donkeys, it may take them time to find suitable places for rolling and scratching, their usual method of dealing with itchy parasites, with then have longer to establish themselves. The state of the donkeys' coats – i.e. hair – would be one way to monitor this.

Their hoofs, too, may not be adapted to the ground they find themselves on. Donkey hoofs are seemingly designed for hard, rocky places (ADBS, 1979), but need some adaptation to the soft and muddy; in any case, in those circumstances they would need more attention. It should not be forgotten that a donkey's legs and feet are essential parts of its working equipment.

Poisonous creatures as well as plants come under this heading, too. Harmful ones in the new environment may be similar in appearance, smell or sound to what was harmless or even beneficial in the environment from which the animal came, and although donkeys are capable of learning much, it would take them time to learn the new dangers, and meanwhile they could make mistakes, perhaps fatal ones.

Other kinds of safety should also be considered. In some communities donkeys can prove unpopular, often because of the competition they are perceived to constitute for cattle (*eg*. Jacobs, 2001), but sometimes because of interpersonal antipathies which can result in the donkeys rather the owners being attacked. And occasionally, too, it is the owners who can be attacked on account of their donkeys (*eg*. Natal Witness, 2004).

Nutrition

Even supposing the donkeys manage to avoid poisonous plants, or learn about them quickly enough, in a totally different plant community they may find themselves severely limited in choice as to what to eat. Most grasses will be safe, and probably even the most cautious individuals will try them, but not all grasses will be nutritious,

Plate 2.
Donkey browsing on twigs of Acacia ataxantha in S Africa (P. Jones)

and likewise the other types of vegetation. It is a fallacy to suppose that that animals can distinguish between good and bad simply by taste. Sometimes, as with Crassula, the crushed leaves can at least smell (I haven't tasted them myself), like a harmless plant eaten by the donkeys in their original area. Perhaps animals can distinguish what is bad more often than can humans, but if it were always true, they wouldn't have digestive problems at all, and they certainly do get those. Besides, when very little that it is sure about is available, the animal is liable to get hungry, and hunger can lead to risk.

This is one reason (among others) why donkeys moving from one environment to another should walk. From hour to hour, day to day, the changes in vegetation will be more gradual. There will be opportunity to experiment with new plants on a fairly small scale while still having available an adequate range of more familiar plants. Donkeys generally manage to graze and browse while they walk (Plate 2) without losing too much time, although they should regularly be given proper 'eating time', so that the exercise need not be stressful in any way.

Recommendations

Table 2 thus incorporates all these aspects of care with the aim of making recommendations to ensure the minimum loss of animals both during and after transit, however transported – although motorized transport is obviously the one most fraught with danger. The strategies for purchasing the animals are also important in minimizing loss, and the experiences of Emmanuel Mwenya and others (Mwenya and Chisembele, 2004) are illustrative of further problems that can effect financial loss even when every other precaution is taken. The buying exercise dramatically increased the price, especially when community leadership got involved, while at the same time mainly old and sick donkeys were presented for sale, as is the case when the buying is done for lion parks or the like. It is also true, as has already been argued (Jones, 2004b:198), that people are simply unwilling to sell good working animals, however many they may already have.

Conclusions

These recommendations are not lightly made. The demand for and thus the value of donkeys is rising, so many more donkey relocations can be expected in the future – and yet veterinary and other knowledge of donkeys and their needs is largely lacking. The knowledge that we do have, as reflected here, needs to be conscientiously applied so that losses are minimized.

Donkeys are adaptable, which is just as well given that they live long lives during which they are expected to work hard, but if adaptation is made too difficult for them their work will suffer just as much as they do, and the financial aspects cannot be ignored.

Looking at the possible areas of supply and demand for donkeys of which I have personal knowledge in this region, it can be seen that almost all of them involve long transit distances and quite dramatic differences in environment and thus of vegetation.

Table 3. Areas to and from which donkeys are likely to move

Possible area of supply, with brief description of general environment	Possible area of demand, with brief description of general environment
Botswana: flat, arid, warm	Eastern Zambia: moist, warm
Kwazulu-Natal: moist and warm	Lesotho: mountainous, dry, cold winters
Northern Cape: flat, arid, warm	Malawi: moist, warm
Southern Zimbabwe: flat, arid, warm	Mozambique: moist, warm, coastal
Swaziland: mountainous, moist, cold winters	Northern Limpopo: mountainous, moist, cold winters
	Northern Zimbabwe: dry, warm
	South-western Zambia: dry, warm

Most of them involve the crossing of international borders, so in addition to all the other precautions, the proper permits must also be obtained. In the case of Botswana, where dourine seems to be endemic, this might be difficult. It is to be hoped that the conditions for the granting of such permits, and whatever other movement permits are involved, will take account of other special needs of donkeys. Apart from anything else, they cannot be regarded in the same way as meat animals. Their destiny is work.

References

Abd, R. (2006). Photograph of Pvt Donley leading a supply donkey in Afghanistan. *The Sunday Independent (South Africa)*, June 25:2.

ADBS (Australian Donkey and Breed Society – NSW Branch), 1979. Donkey feet. Mr Longears (Spring): 32-36

Aganga, A.A., Maphorisa, K. (1994). Characteristics and uses of donkeys in Botswana. 146-149 in P. Starkey, E. Mwenya and J. Stares (eds), *Improving Animal Traction Technology*. Proceedings of the first workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA), held 18-232 January 1992, Lusaka, Zambia. Wageningen: Technical Centre for Agricultural and Rural Co-operation (CTA). ISBN 92-9081-127-7

Aranguren-Mendez, J., Beja-Pereira, A., Avellanet, R., Dzama, K., Jordana, J. (2004). Mitochondrial DNA variation and genetic relationships in Spanish donkey breeds (*Equus asinus*). *Journal of Animal Breeding and Genetics* **121**(5): 319

Ayo-Odongo, J., Mutyaba, C., Kalunda, P. (2000). Improving on-farm transport using animal draft power in 2 hilly districts of Western Uganda. 210-212 in Kaumbutho, P.G., R.A. Pearson and T.E. Simalenga (eds), *Empowering Farmers with Animal Traction* (Workshop proceedings, Mpumulanga, South Africa, September 1999). Harare: Animal Traction Network for Eastern and Southern Africa. ISBN 0-907149-10-4

BBC (British Broadcasting Corporation) (2001). News report of 23 October, 'Afghan aid delivered by donkey' http://newssearch.bbc.co.uk/cgi-bin/search/results.pl?start=10andscope=newsifsandtab=newsandgo.y=13andq=donkeysandgo.x=23

BBC (British Broadcasting Corporation) (2003). News report of 13 November, 'Tragic end for smuggling donkeys' http://newssearch.bbc.co.uk/cgi-bin/search/results.pl?start=10andscope=newsifsandtab=newsandgo.y=13andq=donkeysandgo.x=23

Camac, R.O. (1989). Introduction and origins of the donkey. 1-8 in E.D. Svendsen 1989. *The Professional Handbook of the Donkey* (2nd edn). Sidmouth, UK: The Donkey Sanctuary.

Chisembele, C. Imakando, M. (2004). Donkey lending and credit schemes in rural Zambia. 137-139 in D. Fielding and P. Starkey (eds), *Donkeys, People and Development*. A resource

book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. ISBN 92-9081-219-2

Dijkman, J.T. (1991). A note on the influence of negative gradients on the energy expenditure of donkeys walking, carrying and pulling loads. 221 in D. Fielding and R.A. Pearson (eds), *Donkeys, Mules and Horses in Tropical Agricultural Development* (Colloquium Proceedings). Edinburgh: University. ISBN 0-907146066

Fielding, D. Starkey, P. (eds) (2004). *Donkeys, People and Development*. A resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. ISBN 92-9081-219-2.

Hutchins, B., Hutchins, P., Patton, L. (1999). *The Definitive Donkey* (2nd edn). Texas: Hee-Haw Book Service. ISBN 0-9659312-0-X

Jacobs, N.J. (2001). The great Bophuthatswana donkey massacre: discourse on the ass and the politics of class and grass. *Amer. Historical Rev*. **106**(2): 485-507

Jepson, P. (1994). Military pack transportation. 159-160 in Bakkoury, M and R.A. Prentis (eds), *Working Equines* (colloquium proceedings). Rabat: Actes Editions. ISBN 9981-801-11-9

Jones, P.A. (1997). *Donkeys for Development*. Louis Trichardt, South Africa: ATNESA/ARC/ Donkey Power. ISBN 0-620-22177-1

Jones, P.A. (2003). Must castration be selection? The case of donkeys. 149-152 in D. Vilakati, C. Morupisi, L. Setshwaelo, C. Wollny, A. von Lossau and A. Drews (eds) *Community-based Management of Animal Genetic Resources* (Workshop Proceedings). Rome: Food and Agriculture Organization of the United Nations

Jones, P.A. (2004a). Donkey power in Mozambique. *Draught Animal News* **41**:29-31.

Jones, P.A. (2004b). Response to demand: meeting farmers' needs for donkeys in southern Africa. 196-202 in D. Fielding and P. Starkey (eds), *Donkeys, People and Development*. A resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. ISBN 92-9081-219-2

Jones, P.A. (2006). Donkey work for Africa. *SA Stud Breeder/Stoetteler* **11**(January): 24-27

Kelly, R. (1991). Rocky Mountain canaries. *The Brayer* **24**(4):119

Mwenya, E., Chisembele, C. (2004). Donkeys in Zambia: experiences with their importation and quarantine. 143-147 in D. Fielding and P. Starkey (eds), *Donkeys, People and Development*. A resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. ISBN 92-9081-219-2

Natal Witness (2004). Alleged murderers 'feared curse'. Reported 27 January.

Naudé-Moseley, B., Jones, P.A. (2002). Beasts of burden can save you money. *Farmer's Weekly*, 92043/Grow 129 (8 November): 4.

Patton, L., Snyder, J. (2002). Equine evolution. *The Brayer* **35**(3): 90-91.

Sewell, S.E. (1990). *The Donkey: Care and Feeding* (Agdex 467/20-1). Edmonton: Alberta Agriculture.

Smith, D.G., Nahius, A. Archibald, R.F. (1994). A comparison of the energy requirements for work in donkeys, ponies and cattle. 17-22 in Bakkoury, M and R.A. Prentis (eds), 1994. *Working Equines* (colloquium proceedings). Rabat: Actes Editions. ISBN 9981-801-11-9

Smith, D.G., Pearson, R.A. (2005). A review of factors affecting the survival of donkeys in semi-arid regions of sub-Saharan Africa. *Tropical Animal Health and Production* **37**(Suppl.1: Special issue on Nutrition and Health of donkeys in the Tropics): 1-19.

Squance, M. (1997). Breeds in Europe, 138-154 in E.D. Svendsen (ed), *The Professional Handbook of the Donkey* (3rd edn). London: Whittet Books. ISBN 1-873580-37-1

Svendsen, E.D. (ed) (1997). *The Professional Handbook of the Donkey* (3rd edn). London: Whittet Books. ISBN 1-873580-37-1

Wambui, C.C., Abdulrazak, S.A., Ondiek, J.O., Ogore, P.B. (2004). Role and management of donkeys at farm level in Nakuru district, Kenya. *Draught Animal News* **41**:24-29.
Willett, F. (1977). Medieval Ife. Univ. Edinburgh 13th Herskovitz Lecture
Yoseph, S., Smith, D.G., Mengistu, A., Teklu, F., Firew, T., Betere, Y. (2005). Seasonal variation in the parasite burden and body condition of working donkeys in East Shewa and West Shewa regions of Ethiopia. *Tropical Animal Health and Production* **37**(Suppl.1: Special issue on Nutrition and Health of donkeys in the Tropics): 35-45.

(b) Senegal

Etat actuelle de la marechalerie au Senegal

M. Ouassat[1], S. Bakou[2], N.E. Gualabert[2] and J.B.M. Adjelakarra[2]
[1]Institut Agronomique et Vétérinaire Hassan II, Rabat, Maroc; [2]Ecole Inter-Etats des Sciences Vétérinaires du Sénégal.

Situation du Sénégal

Le Sénégal est situé à l'extrême ouest du continent africain. Avec une superficie de 196,712 Km², il est limité au Nord par la République Islamique de Mauritanie, à l'Est par la République du Mali, au Sud par la République de Guinée Bissau et la République de Guinée Conakry, à l'Ouest par l'Océan Atlantique. La Gambie située entre les régions de Kaolack et de Ziguinchor, forme une enclave sur le cours inférieur du fleuve Sénégal.

Le climat au Sénégal est de type Soudano - sahélien. Il est caractérisé par l'alternance d'une saison sèche allant de novembre à mai et d'une saison pluvieuse allant de juin à octobre. La pluviométrie moyenne annuelle suit un gradient croissant du Nord au Sud du pays. Elle passe de 300 mm au Nord semi - désertique à 1,200 mm au Sud, avec des variations d'une année à l'autre.

Place du cheval au Sénégal

Au Sénégal l'élevage du cheval est caractérisé par la cohabitation des systèmes traditionnel et moderne. Ces systèmes sont à faible niveau d'intrants. La quasi totalité des chevaux (environ 99.5%) est élevée dans les systèmes agricoles ruraux des zones nord et centre du pays. Dans ces zones, le nombre d'équins est fortement corrélé à la surface agricole emblavée par le producteur. Les races exploitées sont surtout locales (le cheval du Fleuve, le Foutanké, le cheval Mbayar et le cheval Mpar). Le système moderne est surtout pratiqué en zone urbaine et périurbaine où se localisent les écuries. Ces dernières exploitent pour la plupart du temps des chevaux de race importée ou améliorée (pur-sang arabe, le pur-sang anglais et le pur-sang anglo-arabe).

L'utilisation des chevaux pour la traction, les travaux agricoles et le transport, fait que leur mode d'alimentation fait appel aux sous-produits agricoles comme les fanes d'arachide et à une complémentation alimentaire en mil ou sorgho. Tout comme d'autres filières, la filière équine fait face à de nombreuses contraintes d'ordre essentiellement alimentaires (sous-alimentation des chevaux qui sont surexploités) ; sanitaires (peste équine, tétanos, trypanosomose et de lymphangite épizootique. Malgré ces contraintes, le nombre global de chevaux du Sénégal fut estimé à 513,700 têtes 2005. L'effectif équin a connu une croissance de 3% en 2005.

Au plan social, le cheval occupe une place importante dans les sociétés traditionnelles africaines. En effet, chez les Wolofs et les Peulhs du Sénégal, le cheval fait partie de la dote exigée au mari. Les chevaux danseurs du Cayor constituent un régal pour les publics. L'attirance indéniable du grand public aux multiples réunions hippiques, aux fêtes données par les sociétés rurales et urbaines montre bien le réel intérêt accordé à ces manifestations.

Plate 3. Charrette utilisée pour la livraison des boissons (M. Ouassat)

Plate 4. Calèche utilisée pour le transport des touristes (M. Ouassat)

Le cheval est présent dans plusieurs secteurs d'activités économiques. Il intervient dans la traction hippomobile urbaine et rurale, l'industrie des courses hippiques, l'équitation sportive ou d'agrément et, dans une moindre mesure, dans la chorégraphie équine et la boucherie hippophagique. Après l'Ethiopie, le Sénégal est classé parmi les cinq premiers pays africains du point de vue des effectifs chevalins. Ainsi le cheval de trait et la traction hippomobile jouent un rôle fondamental dans les relations et les échanges ruraux, la commercialisation des produits agricoles, l'approvisionnement en intrants et produits de consommation et le transport des personnes.

Typologie et profil des maréchaux-ferrants

Les différentes catégories de maréchaux-ferrants rencontrées au Sénégal sont: les traditionnels, les professionnels privés et les militaires (corps de la gendarmerie).

- **Maréchaux-ferrants traditionnels:** Les maréchaux-ferrants traditionnels représentent 81% des maréchaux identifiés dont 45% sont des forgerons qui se sont spécialisés en maréchalerie et 36% des maréchaux-ferrants traditionnels simples, qui n'ont pour métier que la maréchalerie. Ce sont des personnes qui se sont initiées dans le parage et le ferrage des chevaux. Ils travaillent en atelier ou sont ambulants. Les 47% de cette catégorie sont illettrés, 44% ont un niveau élémentaire et le mode d'apprentissage est lignagère, se faisant le plus souvent de père en fils. La moyenne d'âge de cette catégorie de maréchaux ferrants est de 45 ans.
- **Maréchaux-ferrants professionnels privés:** Les maréchaux-ferrants professionnels privés sont constitués de quelques expatriés européens et des locaux qui ont suivi une formation adéquate dans les écoles de maréchalerie françaises. Ces derniers travaillent pour des centres équestres et quelques particuliers qui engagent leurs chevaux dans les concours d'équitation et courses hippiques. Ils se déplacent le plus souvent chez les propriétaires des chevaux. C'est la catégorie la plus faiblement représentée avec un pourcentage de 5%. Leur moyenne d'âge est de 41 ans, ils sont tous lettrés.
- **Maréchaux ferrants militaires:** Ce sont des maréchaux-ferrants gendarmes qui appartiennent à l'escadron monté de la gendarmerie sénégalaise. Ils sont au nombre de 10 soit 13% de l'effectif recensé. Leur moyenne d'âge est de 31 ans. Ils ont suivi une formation professionnelle et font régulièrement des stages de mise à niveau au Maroc ou en France. Ils peuvent parfois ferrer les chevaux de certains particuliers mais sont salariés de l'Etat sénégalais.

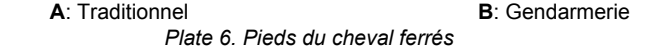
Fournisseurs en matériels de maréchalerie

1. Haras et quincailleries françaises: Les haras français vendent non seulement les chevaux, mais aussi du matériel équestre. Les quincailleries sont celles qui vendent et livrent les matériaux et instruments de maréchalerie. Quelques maréchaux-ferrants et propriétaires de chevaux de races ou de course s'y approvisionnent en ce qui concerne le matériel équestre.

2. Centres équestres et quincaillerie de la place: Certains centres équestres basés au Sénégal fournissent non seulement le matériel équestre mais aussi les fers à cheval et les clous à ferrer qu'ils importent eux-mêmes d'Europe. Quelques quincailleries de

A: Clous industriels **B**: Clous artisanaux

Plate 5. Clous à ferrer



A: Traditionnel **B**: Gendarmerie

Plate 6. Pieds du cheval ferrés

la place tenues surtout par les Libanais, fournissent des fers à cheval et clous à ferrer aux maréchaux-ferrants qui en achètent.

3. Ferrailleurs et vendeurs de charbon: Les ferrailleurs sont des personnes qui récupèrent du matériel amortis dans les poubelles, les vieux fers dans de vieilles carcasses de véhicules et des édifices abandonnés ou inachevés. Ils sont les principaux fournisseurs des maréchaux-ferrants traditionnels à qui ils vendent le matériel et les matériaux de récupération tels que : les profilés et les fers à béton. Les vendeurs de charbon sont de personnes qui vendent du bois dans les différents quartiers ou

marchés de villes qui ont fait l'objet de notre investigation. Seuls les maréchaux-ferrants traditionnels achètent ce charbon pour la fabrication des fers à cheval et des clous.

Activité des maréchaux-ferrants

L'activité principale des maréchaux-ferrants se limite à la fabrication des fers à cheval et clous et au parage des sabots et à la pose des fers à cheval. La majorité des maréchaux-ferrants traditionnels qui ont fait l'objet de notre étude, travaillent du lundi au samedi pendant 8 heures en moyenne par journée. La plupart commencent le travail à 9 heures pour arrêter à 17 heures. Les maréchaux-ferrants de l'Escadron Monté de la Gendarmerie sénégalaise travaillent les lundi, mardi, mercredi et vendredi. Le jeudi étant réservé pour les activités sportives et culturelles. Ces derniers travaillent environ 4 heures de temps par jour. Pour ce qui est des professionnels privés, les heures de travail sont fonction des sollicitations. Ils n'ont pas un lieu de travail fixe et font le tour de certains écuries et centres équestres, leur temps de travail par jour est estimé 4 heures. Le temps de ferrage est lié à plusieurs paramètres à savoir la docilité du cheval à ferrer, le niveau de qualification du maréchal et le respect des différentes étapes du ferrage.

Les maréchaux-ferrants traditionnels ne respectent pas souvent toutes les étapes que comporte le ferrage. Ces derniers déferrent, parent, posent le fer et le brochent. (Tableau 1). Le temps moyen mis par ces derniers pour ferrer un pied de cheval est de 15 minutes. A la Gendarmerie où toutes les différentes étapes du ferrage sont scrupuleusement respectées, le temps mis pour ferrer un pied est de 45 minutes en moyenne.

Tableau 1. Temps de travail et nombre de chevaux ferrés par jour

Maréchaux-ferrants	Temps moyen de travail par jour (heures)	Temps moyen de ferrage d'un pied de cheval (minutes)	Nombre de chevaux ferrés par jour
Traditionnels	8	15	3 - 22
Professionnels	4	30	1 - 4
Gendarmes	4	45	4 - 6

Charges et recettes des maréchaux-ferrants

Charges: L'Escadron Monté de la Gendarmerie sénégalaise appartient à l'Etat sénégalais. Il reçoit une subvention annuelle pour le renouvellement du matériel et des instruments de ferrure et l'achat des fers à cheval et des clous. Ainsi l'Escadron dépense chaque année 6 107,96€ (4,000 715 FCFA) pour la maréchalerie. Le renouvellement du matériel et des instruments se fait une fois par an, alors que les fers à cheval et les clous à ferrer sont achetés quand les stocks de réserve sont épuisés.

Chez les maréchaux-ferrants traditionnels, le matériel de la forge et les instruments de ferrures ne sont presque pas souvent amortis. Ils les héritent ou les fabriquent eux-mêmes. Aucun maréchal-ferrant n'a été capable de nous dire à quel moment il renouvelle ou change son matériel. Parmi les maréchaux-ferrants qui ont fait l'objet

de notre étude, 3% louent leur atelier et 96% ne payent ni taxe ni impôt. Aucun n'a un compte d'épargne.

Les charges fixes correspondent aux dépenses que les maréchaux-ferrants doivent effectuer quel que soit le nombre de chevaux ferrés. Elles concernent la location de l'atelier qui s'élève à 8,000 FCFA en moyenne et la taxe municipale qui s'élève à 2,000 FCFA. Alors que les charges variables dépendent du nombre de chevaux ferrés. Elles se résument à l'achat du charbon de bois pour le foyer, achat de fer à béton pour la fabrication des fers et clous ou l'achat des fers et clous industriels.

Un kg fer de diamètre 8mm ou 12mm leur permet de fabriquer en moyenne 4 à 5 fers à cheval selon la pointure. Un mètre de fer à béton de 8mm diamètre permet la fabrication de 25 clous à ferrer et pendant qu'il faut 4 clous à ferrer pour brocher un fer à cheval artisanal, il en faut 8 clous à ferrer pour un fer à cheval industriel. Le sac de charbon de bois coûte 2,500 FCFA et permet de fabriquer en moyenne 50 fers à cheval.

Tableau 2. Estimation des coûts de matériaux de maréchalerie.

Désignation	Coût en FCFA
Un sac de charbon de bois	2,500
Un mètre de fer à béton de	225
Un fer à cheval industriel	2,500
Une boîte de clous industriels	7,500

1 FCFA = 0.00179 €

Recettes journalières

Tableau 3. Recettes journalières des maréchaux-ferrants

Recettes Journalières (FCFA)	Effectif	Pourcentages (%)	Nombre moyen de chevaux ferrés par les traditionnels
2,500 - 5,000	46	61.3	4
5,000 - 10,000	15	20.0	8
10,000 - 15,000	8	10.7	13
15,000 - 32,000	6	8.0	19
Total	**75**	**100.0**	

1 FCFA = 0.00179 €

Chez les maréchaux-ferrants traditionnels les recettes dépendent relativement du nombre des pieds ou des chevaux ferrés. Le ferrage d'un pied de cheval coûte 250 FCFA. Chez les maréchaux-ferrants professionnels la pose d'un fer industriel coûte 8,000 FCFA. Les recettes journalières moyennes vont de 2,500 FCFA à 32,000 FCFA par jour pour toutes les catégories de maréchaux-ferrants. Seuls les professionnels ont une recette supérieure ou égale à 32,000 FCFA. Les maréchaux-ferrants de l'Escadron

Monté n'ont pas souhaité communiquer leur salaire. Toutefois, une estimation a été faite en fonction des grades. Ainsi, le salaire moyen d'un sous-officier va de 80,000 FCFA (pour les hommes de rang) à 250,000 FCFA pour les sous-officiers en fin de carrière. Il est aussi à noter que, ce salaire ne dépend pas du travail de maréchalerie qu'ils font, mais plutôt des grades. Le salaire moyen des maréchaux-ferrants gendarmes rapporté à la journée se situe entre 2,665 FCFA et 8,335 FCFA. Mais il s'agit du gain net des maréchaux-ferrants gendarmes, marteaux, des couteaux qui servent de mailloche, des pinces, des tenailles et des tord-nez. Les outils de travail de maréchaux-ferrants traditionnels sont des adaptations artisanales et dans l'ensemble peu performants.

Matériaux et techniques utilisés

Pour ce qui est des matériaux, 73,5% des maréchaux-ferrants enquêtés fabriquent leurs fers à cheval et clous à ferrer à partir du matériel de récupération alors que 26,5% n'en fabriquent point, mais les importent plutôt. Concernant la technique de ferrage, 24,5% des maréchaux-ferrants rencontrés ne font pas recours à un aide alors que 75,5% utilisent des aides.

Maréchaux - ferrants gendarmes

Auparavant, le service de maréchalerie importait des lopins et de l'aluminium pour la fabrication des fers à cheval. Actuellement les maréchaux-ferrants ne fabriquent plus des fers et les clous. Néanmoins la forge dispose des lopins de la houille et du charbon qui ne sont pas utilisés. Les fers à cheval et clous sont importés de la France. Le fer antérieur porte un pinçon en pince alors que le postérieur porte un pinçon sur chacune des mamelles de ses branches interne et externe. Chaque branche a quatre étampures.

A: Fer antérieur **B**: Fer postérieur

Plate 7. Fers à cheval industriels la Gendarmerie sénégalaise

Tableau 4. Niveau d'équipement

Equipement, matériels et instruments	Maréchaux-ferrants gendarmes	Maréchaux-ferrants traditionnels
Atelier	+++	±
Forge	+++	±
Forge ambulante	- - -	- - -
Foyer	+++	±
Soufflet	+++	±
Enclume	+++	+++
Etau	+++	- - -
Meule électrique	+++	- - -
Meule mécanique	+++	++
Hangar à ferrer	+++	- - -
Marteaux	+++	+++
Râpe	+++	+++
Râpe-lime	+++	++
Brochoir	+++	±
Repoussoir	+++	++
Mailloche en fer ou acier	+++	±
Mailloche en plastique	+++	++
Compas d'angles	+++	- - -
Pinces à river crocodile	+++	- - -
Dégorgeoirs	+++	- - -
Compas d'angles	+++	- - -
Etampes	+++	±
Tenailles de forge	+++	±
Rénettes	+++	- - -
Tricoises	+++	±
Lopin	±	- - -
Fer à béton	- - -	+++
Fers à cheval industriels	+++	++
Fers artisanaux	- - -	+++
Clous industriels	+++	++
Clous artisanaux	- - -	++
Matériel de contention	+++	±

+++ : Existe et est en bon état ; ++ : Existe mais pas chez tous ; - - - : n'existe pas ;± : Existe mais en mauvais état ou est une adaptation dans l'ensemble peu performants.

Le ferrage des chevaux se fait dans le hangar à ferrer. La technique utilisée est le ferrage à la française et à froid. Toutes les étapes sont scrupuleusement respectées.

A savoir: l'abord du cheval,l'examen des pieds et des aplombs, le déferrage, le parage, le choix du fer, le modelage du fer, la pose du fer, le brochage, la râpe, le

dégorgeage, le nivelage et l'examen des pieds et des aplombs après le ferrage. Toutes les opérations réalisées sur un cheval sont enregistrées dans un cahier de ferrure qui porte les noms de tous les chevaux de la Gendarmerie ayant été ferrés, le nombre de fois que le cheval passe au service de la maréchalerie. Ce qui facilite le suivi des chevaux. Contrairement aux ferrures des chevaux faites chez les maréchaux-ferrants traditionnels.

Maréchaux-ferrants traditionnels

Parmi les maréchaux traditionnels enquêtés, 98% fabriquent uniquement le fer à cheval alors que 90% fabriquent à la fois les fers et les clous qu'ils utilisent. Ces fers et clous sont de fabrication artisanale.

Plate 8. Fer à béton utilisé par certains maréchaux-ferrants traditionnels

A: Chauffage du fer à béton **B**: Réalisation des étampures

Plate 9. Processus de fabrication du fer à cheval artisanal

Le fer à cheval est fabriqué à partir du matériel de récupération tel que les profilés ou les fers à béton d'un diamètre de 8mm ou 12mm. Ces fers sont acquis auprès des

commerçants (77%) ou par ramassage (23%). L'achat se fait en général au comptant et souvent en fonction de la longueur et des dimensions. Le prix moyen pour le fer à béton est 225FCFA le kilogramme.

Le morceau de fer à béton d'une longueur de 22 à 26 cm est mis dans du feu à charbon. Puis il est façonné quand il est rouge pour être adapté à froid au pied du cheval. Ce fer à cheval a 4 étampures et le fer à cheval antérieur porte un pinçon en pince.

A: Fer postérieur **B**: Fer antérieur

Plate 10. Fers à cheval artisanaux

Les clous sont fabriqués à partir du fer à béton de diamètre 8mm. Certains maréchaux-ferrants de Dakar, Rufisque et Saint-Louis, les maréchaux-ferrants de Kaolack, Fatick, Louga et Tambacounda fabriquent seulement les fers à cheval, ils utilisent des clous industriels qu'ils achètent dans des quincailleries de la place. Le fer à cheval antérieur fabriqué par tous les maréchaux-ferrants traditionnels porte un pinçon qui se situe en pince alors que celui postérieur ne porte aucun pinçon. Les chevaux sont ferrés à l'air libre. La méthode utilisée est le ferrage à la française. Généralement c'est le propriétaire du cheval qui sert d'aide. Toutes les étapes du ferrage ne sont pas respectées. L'examen des aplombs n'est pas fait. Le parage est rapide, sommaire et mal fait. La maréchalerie est dirigé par un Chef d'atelier adjudant sous la responsabilité d'un vétérinaire lieutenant.

Niveau d'équipement

Notre étude montre que 65,3% des maréchaux-ferrants enquêtés sont mal équipés, 6,1% ont un matériel de travail relativement bon et 28,6% sont très bien équipés (*tableau 4*).

Maréchaux-ferrants gendarmes

La Gendarmerie dispose d'un atelier de maréchalerie moderne fixe. Il comprend une forge et un hangar à ferrer. La forge est un local bien spacieux, bien aéré, à l'abri des courants d'air. Le plafond de la forge est muni d'un dispositif d'évacuation des fumées.

Le sol est bétonné. Cette forge dispose de deux foyers et deux soufflets électriques, deux enclumes soutenues par des socles en bois, trois étaux, des étagères pour y conserver les fers à cheval, une meule électrique, quatre tables et des chaises. Le hangar à ferrer est un vaste local couvert, aéré, fermé sur un côté qui communique avec la forge. Le sol bétonné est anti-glissant et Les barres de sécurité portent d'anneaux scellés pour immobiliser les chevaux.

La maréchalerie de la gendarmerie est très bien équipée. Elle dispose: des marteaux, des mailloches, des rogne-pied, des tricoises à ferrer et à déferrer, des râpes-limes, des dégorgeoirs, des tranches à rainer, des étampes, des pinçons, des pinces à fer et à feu, des compas, des tisonniers, une pelle, du matériel de contention (tord-nez, courroux) et des tabliers pour maréchaux-ferrants.

Maréchaux-ferrants professionnels privés

Les maréchaux-ferrants privés sont relativement bien équipés. Tous utilisent des fers à cheval et des clous importés. Ils n'ont pas d'atelier de maréchalerie. Ils ferrent les chevaux chez leurs propriétaires.

Plate 11. Atelier d'un maréchal-ferrant traditionnel

Maréchaux-ferrants traditionnels

Les maréchaux-ferrants traditionnels travaillent dans des cabanes ou bicoques, construites avec du matériel de récupération, des plastiques et du carton; qui leur servent d'atelier de maréchalerie. Ces cabanes n'ont rien à voir avec un atelier de maréchalerie standard (*Plate 11*). Le ferrage se fait à l'air libre il n'y a pas de hangar encore moins de travail. A l'intérieur, on y trouve une enclume et un soufflet de fabrication artisanale. Les instruments de maréchalerie sont constitués: des

Notre étude révèle que 61,3% des maréchaux-ferrants ont une recette journalière qui se situe entre 2,500 FCFA et 5,000 FCFA, 20% entre 5,000 FCFA et 10,000 FCFA, 10,7% entre 10,000,FCFA et 15,000 FCFA et 8% entre 15,000 FCFA et 32,000 FCFA.

Essai de compte de résultat d'un maréchal-ferrant traditionnel

Le compte de résultat retrace l'ensemble des charges et recettes du maréchal-ferrant. Les différentes charges et recettes moyennes d'un maréchal-ferrant traditionnel moyen sont regroupées (*tableau 5*). Nous avons choisi de présenter le compte de résultat d'un maréchal-ferrant qui a 4000FCFA de recette journalière. Sachant qu'il ferre en moyenne 4 chevaux par jour, il doit utiliser 4m de fer à béton pour la fabrication du fer à cheval et 3m de fer à béton pour la fabrication des clous à ferrer et il utilise un sixième (1/6) de sac de charbon de bois par jour. Et comme il travaille 6 jours par semaine, le total de besoin en matériaux par jour sera multiplié par 6. Le compte de résultat est établi pour un mois donc 4 semaines.

Tableau 5. Compte de résultat mensuel d'un maréchal-ferrant traditionnel

Rubriques		**Total en FCFA/mois**
Charges fixe		
Taxe municipale	2000F	2,000
Location atelier	8000F	8,000
Amortissement des instruments de ferrage (5 ans)	1000F	1,000
Total des charges fixes		*11,000*
Charges variables		
Charbon	2500F x 4	10,000
Fer à béton pour fer à cheval	225F x 4m x 6 x	21,600
Fer à béton pour clous à ferrer	225F x 3m x 6 x 4	16,200
Transport	500F x 6 x 4	12,000
Total des charges variables		*59,800*
Total de toutes les charges		**70,800**
Recettes par mois	4000 x 6 x 4	**96,000**
Marge brute		**36,200**
Marge nette		**25,200**

1 FCFA = 0,00179 €

La marge brute est la différence entre les recettes totales (96,000 FCFA) et le total des charges variables (70 800,FCFA). La marge brute dégagée par le maréchal-ferrant traditionnel par mois est en moyenne de 36,200 FCFA.

La marge nette est la différence entre les recettes générées (96,000 FCFA) et le total des charges variables et fixes (70,800 FCFA). La marge nette dégagée par un maréchal-ferrant traditionnel qui gagne en moyenne 4,000 FCFA par jour est de 25,200 FCFA. C'est le bénéfice engendré par son activité. Pour les maréchaux-ferrants qui

n'ont pas de charges fixes, le bénéfice correspond à la marge brute qui est de 36,200 FCFA.

Avec le bénéfice engendré par leur activité, 91% des maréchaux-ferrants ont reconnu avoir bien gagné leur vie à travers le métier de maréchal-ferrant. Seulement c'est un métier complexe qui demande beaucoup d'efforts physiques et des moyens matériels. Plus de 95% maréchaux-ferrants bénéficient de la main d'oeuvre familiale bénévole, ce qui est un coût d'opportunité pour leur activité.

Conclusions et recommandations

Au Sénégal, le cheval est présent dans plusieurs secteurs d'activités tels que la traction hippomobile urbaine et rurale, l'industrie des courses hippiques et l'équitation sportive ou d'agrément. Tous ces différents usages faits du cheval ne sont rendus possibles que grâce à ses pieds. Pour ce faire, les soins aux pieds sont primordiaux car empreints de conséquences sur l'état général du cheval mais aussi sur les utilisations escomptées.

Poue étudier ce secteur nous avons questionné 287 propriétaires de chevaux et 75 maréchaux-ferrants. Les enquêtes se sont déroulées de décembre 2006 à août 2007. De cette analyse des données, il ressort que, des 287 propriétaires des chevaux enquêtés, 54% sont des cochers, 13.9% des éleveurs, 23% des commerçants, 0.4% l'Escadron Monté de la Gendarmerie sénégalaise et 8.7% les autres types de propriétaires, à savoir, les centres équestres, les fonctionnaires et marabouts. Ces différents propriétaires utilisent leurs chevaux pour le transport hippomobile, les courses et concours hippiques. Plus de 90% des chevaux travaillent pendant 5 à 8 heures de temps par jour, et sont nourris à la fane d'arachide et au concentré pour quelques uns. Près de 90% des propriétaires de chevaux qui font la traction hippomobile urbaine, ferrent leurs chevaux chez les maréchaux-ferrants et 98% disent les ferrer pour protéger le sabot contre l'usure. Parmi ces propriétaires, 67% sont satisfaits des ferrures effectuées alors que 22% sont relativement insatisfaits. Dans les villes de Kaolack, Fatick et Tambacounda, on note une forte présence des ânes dans le transport hippomobile urbain. Ces ânes ne sont pas ferrés et seulement 40% des chevaux sont ferrés.

Sur les 75 maréchaux-ferrants qui ont été enquêtés, 81.3% sont des traditionnels dont 36% de maréchaux simples et 45.3% de maréchaux forgerons. Leur moyenne d'âge est de 45 ans avec 46.9% d'illettrés et le mode d'apprentissage est surtout lignagère se faisant de père en fils. En dehors des maréchaux-ferrants traditionnels, il existe aussi des maréchaux-ferrants gendarmes représentant 13.4% de l'effectif, leur moyenne d'âge est de 31 ans et ils sont formés en France ou au Maroc. Les maréchaux-ferrants professionnels privés qui ont un pourcentage de 5.3%, leur moyenne d'âge est de 41 ans. Ils sont tous lettrés et ont subi une formation ou un stage en maréchalerie en Europe.

Sur le plan équipement des maréchaux-ferrants, notre étude a montré que 65.3% des maréchaux-ferrants enquêtés sont mal équipés, 6,1% ont un matériel de travail relativement bon et 28.6% sont très bien équipés. Les maréchaux-ferrants gendarmes sont mieux équipés que les maréchaux-ferrants traditionnels.

En ce qui concerne les matériaux et techniques utilisés, 73.5% des maréchaux-ferrants enquêtés fabriquent leurs fers à cheval et clous à ferrer à partir du matériel de récupération alors que 26,5% les importent. La majorité des maréchaux-ferrants

traditionnels fabriquent les fers à cheval et les clous à ferrer artisanaux à partir du matériel de récupération tel que les profilés ou les fers à béton d'un diamètre de 8mm ou 12mm.

L'analyse socio-économique du métier de maréchal-ferrant au Sénégal nous confirme que, seuls les maréchaux-ferrants gendarmes disposent d'un cadre juridique et institutionnel bien défini. Les maréchaux-ferrants professionnels privés et traditionnels n'ont pas de reconnaissance officielle vis à vis des collectivités et des autorités. L'activité principale des maréchaux-ferrants se résume à la fabrication des fers à cheval et clous, au parage des sabots et à la pose des fers à cheval. Le ferrage orthopédique est rarement effectué. La majorité des maréchaux-ferrants traditionnels, travaillent du lundi au samedi ceci pendant 8 heures en moyenne par journée.

Concernant le temps de ferrage et le nombre de chevaux ferrés, chez les maréchaux-ferrants traditionnels, le temps moyen mis pour ferrer un pied de cheval est de 15mn pour 3 à 22 chevaux ferrés par jour. Chez les maréchaux-ferrants gendarmes, le temps mis pour ferrer un pied de cheval est de 45 minutes en moyenne pour 4 à 6 chevaux par jour.

L'estimation des charges et recettes des maréchaux-ferrants montre que, les principales charges concernent le renouvellement des matériels et instruments de maréchalerie, l'achat des profilés et fers à béton, l'achat du charbon de bois, les fers à cheval et clous à ferrer. Les maréchaux-ferrants traditionnels renouvellent rarement leurs matériels et instruments de maréchalerie.

La comparaison des marges brutes engendrées, par les activités d'un maréchal-ferrant ayant une recette journalière de 4,000 FCFA et d'un conducteur d'attelage hippomobile ayant un chiffre d'affaire quotidien de 4,200 FCFA nous a permis de conclure que le métier de maréchal-ferrant est plus rentable que celui de cocher.

Au terme de cette étude où il était question de l'état actuel de la maréchalerie au Sénégal, force est de constater que, l'exploitation du cheval sous diverses formes, a remis le maréchal-ferrant aux devants de la scène équestre. Seulement, le manque de formation professionnelle, d'encadrement, d'organisation et d'appui technique et financier aux maréchaux-ferrants, fait que la maréchalerie sénégalaise a un caractère artisanal et utilise des techniques et des moyens archaïques. Toutefois, si les différents acteurs de la maréchalerie au Sénégal, les autorités et les instituts de formation prennent en compte les recommandations que nous leur avons faites, la maréchalerie permettra au cheval de continuer à jouer son rôle socio-économique au Sénégal.

3. ASIA

(a) India

Standardization and performance evaluation of a pneumatic wheeled ox-cart for Central India

R.C. Singh, U.C. Dubey and C.D. Singh
Central Institute of Agricultural Engineering Bhopal, India – 462038

Abstract
A pneumatic wheeled ox-cart was developed based on most common dimensions and payload capacity of conventional wooden wheel carts used in urban and rural areas of central India. Standardization of different components of cart chassis was done for a two-tonne payload capacity under different terrain conditions by using the commercially available standard components. The chassis has provision for mounting the different size of platforms required to transport the agro and non-agro materials and passengers. A water or oil tanker could also be mounted as required. During the performance testing on a tarmacadam road, earthen road and in field conditions, the draught and power requirement of a pair of the Malvi breed of oxen ranged from 867–920 N and 0.54–0.55 kW as payloads varied from 1.0–2.0 tonne, respectively.

Introduction
An array of animal-drawn vehicles of different shapes, sizes, structures and source of motive power fill a vital slot in rural and urban transportation, satisfying demand for movements of small consignments over short distances. Oxen, male buffaloes and donkeys are most commonly used in many countries for haulage purposes at low cost (*eg.* Starkey, 1995). India, like many other Asian and African countries, still has about 13.3 million animal carts, which is 40% of world population. The total investment is estimated at Rs 105 billion ($2.33 billion) and it provides employment to about 20 million people. These carts log about 25 billion ton-km/year agricultural and non-agricultural materials (Livestock Census, 1987, 1992; Ramaswamy, 1987). The animal transport system alone saves about 6 million tones of petroleum fuel (Singh and Singh, 2003). Ox carts handle about 70–80 % of the total agricultural materials in India. But there has been limited organized research and development work to improve the design of carts. The ox carts are still fabricated by the village artisans using local materials. These conventional wooden wheel carts carry about 0.5–0.8 tonne load and last for 5–6 years. Wood is the most commonly used material in fabrication of different components, which causes undue stress to the animals and limits the load carrying capacity. Under the project work an attempt has been made to standardize and develop an ox cart pneumatic wheel chassis for two-ton payload capacity to facilitate centralized manufacturing using the commercially available materials.

Materials and methods
Development of a pneumatic wheel chassis
Conventional wooden wheeled ox carts used in the rural and urban areas of central India were surveyed and their details specifications were recorded viz, payload capacity,

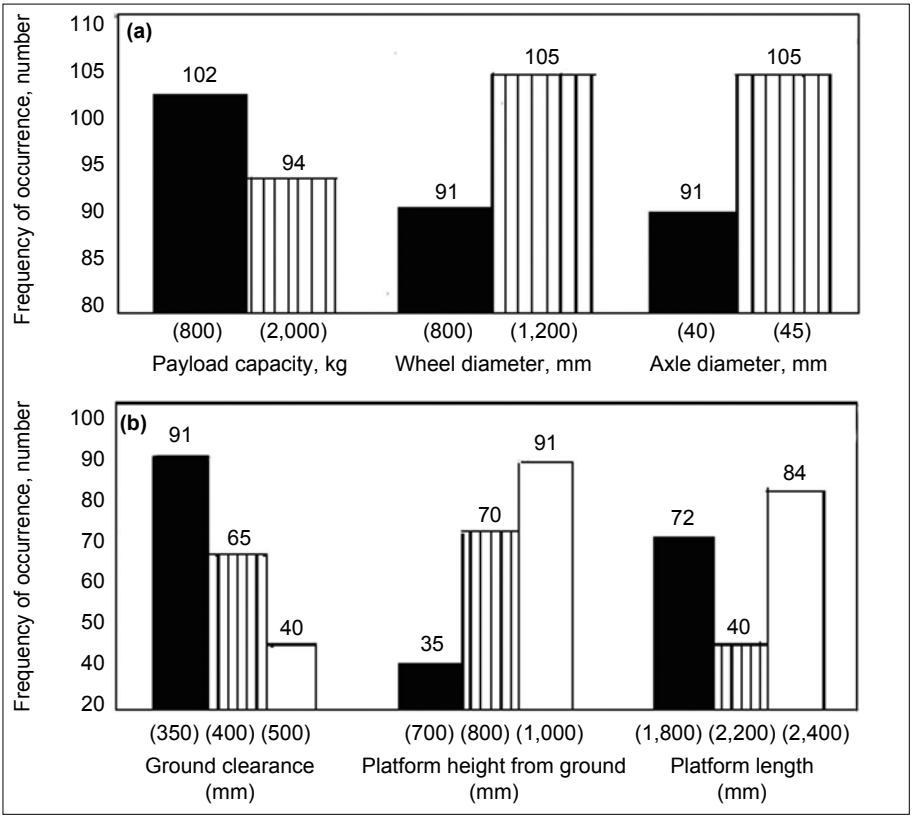


Figure 1. Frequency distribution of payload, wheel and axle size (a) and ground clearance, platform height from ground, platform length (b) of ox-carts used in central India

wheel and axle diameter, bearing size, ground clearance, wheel track, and platform size. Based on the frequency distribution of most common dimensions of different components of the carts, the sizes of the axle, bearing, wheel diameter, cart frame and platform were selected and their dimensions and materials were standardized for the development of a cart chassis to carry the payload of two-tonne on a tarmacadam road, earthen road and in field terrains (Figure 1). The diameter of the axle was designed and standardized for shock load experienced during operation on irregular surfaces. Size of the axle was computed assuming uniformly distributed load along its longitudinal axis as given in Equation 1 (Deshpande and Ohja, 1985):

$$D = \left[\frac{32(Ms)^2}{3.14f}\right]^{1/3} \quad (1)$$

$M_s = 1.5\ M_b$ and
$M_b = wl^2/8$
where:
D – Diameter of axle, mm; f - maximum permissible stress, kg/mm^2; w – weight supported by the axle per unit of its length, kg; and l – length of the selected axle supporting the cart body, mm.

The axle is made of steel (ultimate strength = 5,000 kg/cm^2 and average carbon content of 0.11%). The maximum permissible stress has been taken 2,500 kg/cm^2 and factor of safety 1.5, as it is a stationary axle liable to bear shock loads. Substituting the length of axle 1.35 m and distance between two wheels, 800 mm in Equation (1), resulted diameter of axle as 440 mm. Hence the commercially available animal-drawn vehicle (ADV) axle of size 450 mm × 450 mm was selected, which is safe for 2-tonne payload capacity.

Bearing
Taper roller bearing of 85 mm out side diameter and 19 mm rim width (No. 30209) was used as a standard. Dynamic capacity of bearing is expressed as:

$$c = \left(\frac{L_b}{L_{10}} \right)^{1/2} P \qquad (2)$$

where:
c - dynamic capacity of bearing, kgf ; Lb – life of bearing, 10×10^6 h ; L10 – life of bearing in 90% survival of bearing, 9×10^5 h ; and P force – 2640 kgf.

The ratio of axial (fa) and radial thrust load (fr) is less than 2.17 in case of ox carts, therefore, the values of x and y are 1 and 0 in dynamic load condition. The value of service factor (s) for bearing has been taken 1.32 for shock loads of higher magnitude and axial load as 2,000 kg for design. P = ((x fr + y fa) s); and k is 10/3 for roller bearing. Substituting the values in Equation (2) yielded 2724 kg dynamic capacity of bearing. The taper roller bearing (No. 30209) of 6,270 kg dynamic capacity, used in developed cart-chassis is safe for two-tonne payload capacity.

Pneumatic wheel
The towing force to pull the cart by a pair of oxen depends upon the wheel size, (wheel diameter and rim width) and friction at hub and axle under any particular loading condition. It was calculated on the basis of Equation 3 (Singh and Singh, 2003):

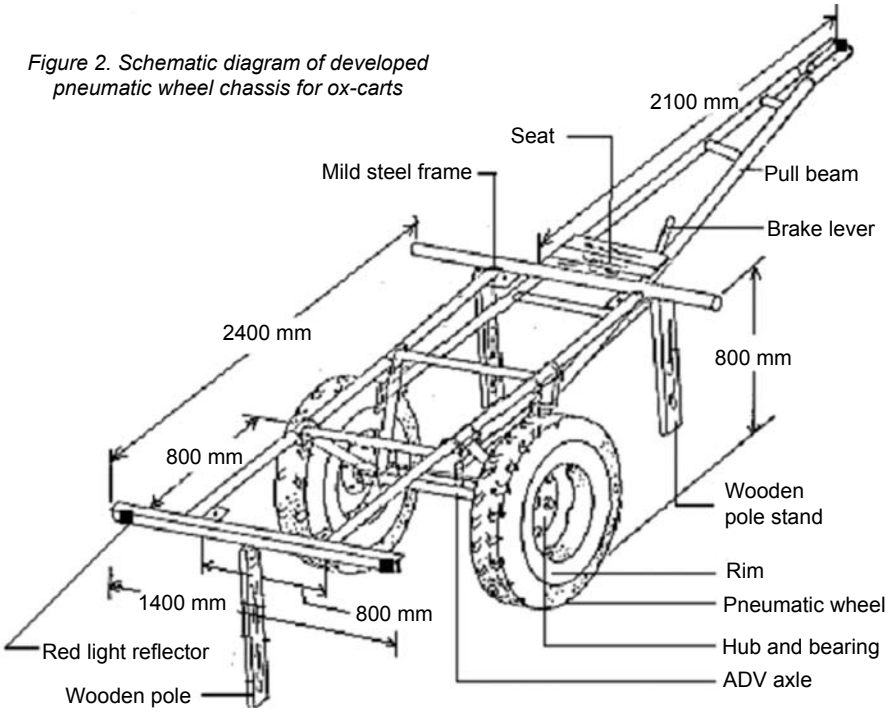
$$F = \frac{kW^{3/2}}{db^{1/2}} + \frac{b}{d} C \qquad (3)$$

where:
F - towing force; W - weight of the wheel; d - diameter of the wheel; b - width of the wheel; C and k are constants.

It may be noted from Equation (3) that F is directly proportional to $W^{3/2}$. Therefore, the animal drawn vehicle (ADV) pneumatic tyre size (6 × 16), were used as these are light in weight in comparison to wooden and iron wheels.

Cart frame and platform

Figure 2. Schematic diagram of developed pneumatic wheel chassis for ox-carts



Cart frame made of mild steel pipe (inside diameter of 40 mm, and thickness of 4 mm) was mounted on axle as shown in Figure 2. Pull beams made of same size of mild steel pipe was fixed on the side pipes of the frame with nuts and bolts. The position of the pull beam could be changed depending upon the size of animal to keep the cart frame parallel during the transport of materials. The axle was placed in the center of the frame for better stability during haulage. The length of platform was fixed as 2,400 mm, approximately three times of the diameter of wheel to avoid excessive weight transfer on the neck of the animals (Singh and Singh, 2003). The overall width of the cart frame and platform was 800 mm and 1,400 mm respectively to accommodate the bruised straw and compost materials up to 2,000 kg. The volume of platform could be expressed as:

$$V = \left(wH + H^2 \tan\alpha\right)l \quad (4)$$

where:

v – volume of platform, mm3; w – width of platform, 1400 mm; ф – angle of repose of material to be transported (for dry compost it is 200); H – height of the platform, mm; and ∫ – length the platform, 2400 mm.

Substituting these values in Equation. (4), the height of platform commuted was 380 mm from the ground.

Brake, red light reflector and hanging poles

A simple mechanical brake (brake shoe) having braking drums of diameter of 750 mm and thickness 2.5 mm mounted on the hubs of the ADV axle was used to create the friction by a hand lever mechanism. Two red light reflectors of equilateral triangle of 350 mm were provided on the back of the chassis and one reflector in front of the beam of the cart to avoid the road accident of slow moving vehicle. Three wooden poles of 50 mm diameter, one in back and two in the front of the cart chassis were hung to avoid the over-turning of the cart on an upward slope and to keep the cart stationary on the ground, respectively.

Demonstration and performance of improved pneumatic wheel cart at farmer's field

Seven operational demonstrations on improved pneumatic wheel cart were conducted to the 51 farmers of village Barkheda-Baramad, Udaipura and Fatehpur Kariyari. The farmer used the improved cart for transportation of crop/crop straw and passengers for 10–14 km distance per trip as shown in Table 1. The comparative performance of improved pneumatic wheel cart and conventional wooden wheel carts used by the farmers of villages for the transportation of material/ crop/passengers is shown in Table 2. The ambient temperature was 19.5–24°C and humidity was 45-67%. The solar intensity and wind velocity was 9,656-12,904 lux and 2.1-2.4 km/h respectively at the time of testing at farmer's field. The maximum distance travel by both the carts was about 20 km/trip. The load transported by the improve cart varied from 1.2–1.5 ton. However it varied from 0.6–0.8 ton for the conventional wooden wheel carts. This was due limited payload capacity of wooden wheel cart on earthen road and in field condition. The average increase in capacity and earning were 86% and 80% for the improved pneumatic wheel cart as compared to local wooden wheel cart (Table 2).

Table 1. Details of demonstrations of improved pneumatic wheel carts to the farmers of different villages

Village	No. demonstration	No. participants	Avg distance traveled with load as crop/crop straw / passengers
Barkheda -B	3	20	15
Udaipura	2	17	14
Fatehpur- Kariyari	3	14	12
Total	7	51	Mean = 11.8, SD = 1.5

Table 2. Comparative performance of improved pneumatic wheel cart and conventional wooden wheel cart

Particulars	Traditional wooden wheel cart	Improved pneumatic wheel cart
Transport capacity, ton	1.0	2.0
Nos of passenger transported	3-6	6-8
Material loaded, ton	0.6-0.8	1.2-1.5
Distance travel, km	15-20	15-20
Time taken, h	8	8
Avg load carried (transported), ton-km/h	1.8	3.3
Nos of users	12	6
Cost of cart, Rs	6,000	15,000
Avg earning Rs.	125	225
% Increase in earning	–	80

Feedback from the farmers and adoption of improved pneumatic carts

The farmers of the villages have used the improved pneumatic wheel carts for transportation of materials/crop/passengers during the demonstration. They repotted that the improved cart performed well in transportation of materials/passengers on earthen road and in field condition and double materials such as harvested crop/grain/passengers could be transported by using the improved cart as compared to conventional cart. They suggested that the cost of improved cart Rs 15,000 would be subsidized to Rs 8,000–10,000. The feed back information about the improved pneumatic wheel cart are given in Table 3.

Performance evaluation

The developed pneumatic wheel cart was evaluated under three terrain conditions, i.e. tarmacadam road, earthen road and freshly harvested (soybean) field at the Central Institute of Agricultural Engineering, Bhopal (India). The tare weight of the cart was 220 kg. A pair of the Malvi breed of oxen (combined body weight of 1,050 kg) were used to pull the cart. Draught force, speed of operation and rpm of wheel of cart were recorded using load cell sensor (0–5,000 N), radar sensor and proximity sensor, connected to the 21-× micro logger (Plate 12).

A conventional wooden wheeled ox-cart was evaluated with the oxen used for testing the developed cart under similar terrain conditions. The conventional cart was made of wood sections except for the axle of mild steel of 45 mm diameter. The tare weight and payload capacity of the cart were 180 and 800 kg respectively.

Field trials were also conducted at a farmer's field on an earthen road and in field conditions, where the cart was com[pared with a conventional cart too.

Table 3. Feed back information from the farmers and adoption of the pneumatic wheel cart.

S. No.	Particulars	Remarks
1	Ease of operation	Good
2	Straight	Good
3	Turning	Good
4	Stability	Good
5	Load on bullocks	Normal
6	Comfort to bullocks	Very good
7	Cost	Rs 15,000
8	Price suggested by users	Rs 8,000-10,000
9	Adoption	The farmers have suggested that the improved cart would be provided on subsidy @ Rs 10,000/unit. Some farmers have purchase the pneumatic wheel cart from the Private Manufacturer (Rishi Agro – Industries, Indore) @ Rs 12,000/unit

Plate 12. Infield recording of speed and pull of oxen by using 21-X micro logger with radar and load cell sensors.

Results and discussion

The draught force, speed and power requirement under different terrain conditions for different payloads are shown in Table 4. On the tarmacadam road, the draught increased from 223–1,061 N and speed decreased from 0.83–0.55 m/s as payload increased from tare weight of cart to payload of 2,000 kg. The oxen gave maximum power output of 0.55 kW and scored the fatigue below the limit, *ie*. 20 at payload of 2,500 kg. On the earthen road the draught increased from 269–1054 N and speed decreased from 0.83–0.56 m/s, as the payload increased from tare weight of cart to 2,000 kg. The maximum power developed was 0.58 kW. On the soybean crop harvested field, the oxen gave a power output of 0.58 kW at operational speed of 0.57 m/s and payload of 1,000 kg. The power output of bullocks decreased to 0.42 kW as the payload increased to 1,500 kg. This was due to the higher increase in rolling resistance in the field as compared to the tarmacadam road and earthen road conditions.

Table 4. Performance of pneumatic wheeled cart on different terrain surfaces during three hours testing in sustained loading condition

Pay load (kg)	Type of terrain								
	Tar road			Earthen road			Freshly harvested field		
	Draught (N)	Speed (m/s)	Power (kW)	Draught (N)	Speed (m/s)	Power (kW)	Draught (N)	Speed (m/s)	Power (kW)
Tare	223	0.8	0.2	269	0.8	0.2	345	0.8	0.3
500	367	0.8	0.3	436	0.8	0.3	744	0.7	0.5
1,000	515	0.8	0.4	583	0.7	0.4	1,020	0.6	0.6
1,500	700	0.7	0.5	880	0.6	0.6	1,225	0.4	0.5
2,000	867	0.7	0.6	1,054	0.6	0.6			
2,500	1,062	0.6	0.6						

The results obtained were further analyzed for determination of regression equations for draught force and speed.. A straight-line equation was found to represent the experimental data very well with coefficient of determination R2, more than 0.95 in all cases.

$D = a_1 + m \times$ (5)

$S = a_2 = m \times$ (6)

where:

D – mean draught force in N; S – mean speed of operation, in m/s; × – payload, in kg and a_1, a_2 and m are constants.

Values of 'a_1, a_2' and 'm' were commuted and are given in Table 5. Equations shown in Table 2 revealed that the draught force (D) increased with increase in payload (×) of cart on all terrain conditions, i.e. tarmacadam road, earthen road and field terrain. The draught increased significantly in field terrain as compared to tarmacadam road. The speed of operation decreased with increase in the payloads on all terrain conditions.

The decrease in speed was more on the field terrain as compared to the earthen and tarmacadam roads.

Table 5. Regression equations for variation of draught and speed on different terrain conditions.

Terrain surface	Parameters	
	Draught (N)	Speed (m/s)
A. Developed pneumatic wheel ox-cart		
Tar road	D = 34.7 + 168.0 (×)	S = 0.9 + 0.01 (×)
Earthen road	D = 39.7 + 201.3 (×)	S = 0.9 + 0.1 (×)
Field terrain	D = 94.0 + 220.0 (×)	S = 0.9 + 0.1 (×)
B. Conventional wooden wheel ox-cart		
Tar road	D = 50.0 + 102.0 (×)	S = 1.0 + 0.0 (×)
Earthen road	D = 69.0 + 139.0 (×)	S = 1.0 + 0.1 (×)
Field terrain	D = 151.5 + 268.1 (×)	S = 0.9 + 0.1 (×)

The draught power to pull the conventional wooden wheeled cart was 550, 700 and 1200 N at payload of 800 kg on tarmacadam road, earthen road and field terrain, respectively. Equations given in Table 2 revealed that the speed of the oxen decreased from 0.93 to 0.7 m/s, 0.9 to 0.62 m/s and 0.85 to 0.45 m/s, as the payload on the cart increased from tare weight of cart i.e. 80 kg to 800 kg under tarmacadam road, earthen road and field conditions, respectively. The oxen gave the maximum power output of 0.58, 0.50 and 0.45 kW at payload of 800 kg on tarmacadam road, earthen road and in field terrain, respectively.

During the field trials at the farmer's field it was observed that the load transported by the developed and conventional cart varied from 1.0–1.6 tonne and 0.6–0.8 tonne, on the earthen road and in field conditions, respectively. The average increase in capacity and earning/day were 95% and 80% for the pneumatic wheeled cart as compared to the conventional wooden wheel cart (Table 6).

Conclusions

The components of the ox-cart viz, wheels, axle, bearings, brake, beam, yoke and sections of mild steel were standardized and a pneumatic wheeled ox cart was developed by adopting the commercially available parts to encourage centralized manufacturing and improved quality of carts. A pair of oxen pulled 2500, 2000 and 1000 kg payloads with the developed pneumatic wheel cart on tarmacadam road, earthen road and in harvested field, respectively, during three hours of sustained working and developed 0.58 kW power. The developed carts resulted in 95% and 80% increase in payload capacity and earning/day as compared to the conventional wooden wheeled cart. A standardized pneumatic wheeled cart would facilitate efficient use of animal energy for haulage of small consignments at short distances for rural and urban transport in the country and would reduce the drudgery involved in human-animal transport system.

Table 6. Comparative performances of pneumatic wheeled and conventional wooden wheeled cart at a farmer's field

Particulars	Conventional wooden wheel cart	Standardized pneumatic wheel cart
Transport capacity, tonne	0.8	2.0
Nos of passenger transported	3–6	6^{-8}
Material loaded, tonne	0.7 ± 0.1	1.5 ± 0.5
Distance travel, km	17.5 ± 5.0	17.5 ± 5.0
Time taken, h	8	8
Avg load transported, ton-km/h	1.54	3.0
% increase in load carrying capacity	–	95
Cost of cart, Rs	6,000	15,000
Average earning, Rs/day	125	225
% increase in earning/day	–	80

References

Deshpande, S.D., Ohja, T.P. (1985). Theory and design of animal-drawn vehicle. *Technical Bulletin No. 46*, CIAE, Bhopal, India.

Livestock Census (1987, 1992). Indian Livestock Census Reports. Directorate of Economics and Statistics (Ed.), Department of Agricultural & Cooperation, Ministry of Agriculture, Government of India.

Ramaswamy, N.S. (1987). *Draught Animal Power in the Third World*. Proc. National Seminar on Utilization and Economics of Draught Animal Power (Ed.), Central Institute of Agricultural Engineering, Bhopal, India, pp. 11-21.

Singh, G., Singh, R.C. (2003). Animal transport devices. *Harnessing Animal Power* (Ed.), Central Institute of Agricultural Engineering, Bhopal, India, pp. 194-229.

Starkey, P. (ed) (1995). *Animal Traction in South Africa*: Empowering rural communities Development Bank of Southern Africa, Halfway House, South Africa 160p

Thapar, K.L. (1996). Present status of non-motorized transport in India. Non-motorized Transport in India – Current Policies and Issues (Ed.), Asian Institute of Transport Development, New Delhi, pp.12-22.

(b) India

Constraints faced by the farmers in draught animal use in Southern India

N.Akila and Mahesh Chander

Division of Extension Education, Indian Veterinary Research Institute, Izatnagar 243 122, India

Abstract

The constraints in management and use of draught bullocks by farmers were assessed in Tamil Nadu state of south India with 210 respondents (70 small, 70 medium and 70 large farmers). A list of potential constraints was prepared and categorized under the major areas namely economic, technological, management and situational problems and the responses were assessed with the farmers. The results revealed that management constraints with a total score of 3,312 were ranked first followed

by situational constraints (score 2,625), economic constraints (score - 2456) and technological constraints (score 1,428) by the respondents. The main constraints identified in each category were shortage of agricultural labourers, diminishing pool of draught animal power (DAP) experience, low purchasing power (small farmers), high cost of feed with (medium and large farmers) and lack of technical knowledge.

Introduction

Animal rearing in India is done mostly by small and marginal farmers and landless labourers with holding size of 2–3 animals per farm household. These small and marginal farmers prefer to maintain female stock for milk production and male bullocks for draught purpose. But motor mechanisation, maintenance cost of bullocks and cross breeding programmes threaten the existence of draught breeds. The average farm power availability in 2001 was 1.35 Kw/ha. In 1996-97, the contribution from animal power fell to 14% while mechanical and electrical power increased to 79%. But in terms of area covered, draught animals continue to dominate with more than 54% area cultivated by them and only 20% by tractor and power tiller (Singh, 1999). With nearly 83 million land holding (more than 75% of the land holding) being less than 2 ha in size, the animal power can play a very important role in Indian agriculture (Rao and Dass, 2005). Though the draught bullock is playing an important role in many places, its population is declining day by day and the farmers who own draught bullocks are facing several constraints. To assess the constraints faced by the farmers in using the draught bullocks in agriculture a study was carried out in Tamil Nadu of India.

Methodology

Tamil Nadu is comprised of seven agro climatic zones based on rainfall distribution, irrigation pattern, soil characteristics, cropping pattern and other physical, ecological and social characteristics (Ghosh, 1991). To assess the constraints of draught bullocks, one district was selected from each zone of Tamil Nadu based on bullock population, Villupuram for North Eastern Zone, Krishnagiri for North Western Zone, Erode for Western Zone, Sivagangai for Southern Zone, Tanjavur for Cauvery Delta Zone, Kanyakumari for High Rainfall Zone and Kolli Hills for Hilly Zone, thus, comprising seven districts from all zones of Tamil Nadu. From each district, three village panchayat were selected and from the cluster of villages, the farmers possessing draught animals were stratified into small (up to 5 acres), medium (5–10 acres) and large farmers (>10 acres) based on land size and from each strata 10 farmers were selected randomly to represent different socio economic strata. Thus, the final sample from 7 districts was 210 with 70 small, 70 medium and 70 large farmers. A list of potential constraints was prepared and categorized under the major areas namely economic, technological, management and situational problems. The same was administered to the respondents on a 4 point with a score of 3 (most) ,2 (medium),1(least) and 0 (not a constraint). The scores for each constraint were added and the total constraints score was obtained for each category.

Table 1. Potential constraints faced by farmers (SF- small farmers; MF medium farmers;LF large farmers, see text for details of land holdings)

S.No.	Constraints	Rank		
		SF	MF	LF
	I Economic constraints			
1	High cost of feed	III	I	I
2	High cost of treatment	VI	IV	V
3	Low purchasing power	I	VI	VI
4	No access to credit facility	V	V	III
5	High cost of animal	II	II	II
6	High cost of implements & spares	IV	III	IV
	II Management constraints			
1	Lack of adequate feed	V	V	V
2	Lack of good breed	VII	VI	VII
3	Lack of suitable implements	VI	VII	VI
4	Lack of labour	I	I	I
5	Work associated problems	VII	IX	VI
6	Limited use throughout the year	III	IV	IV
7	Drudgery associated with implements	IX	X	X
8	Poor management	VIII	VIII	IX
9	Seasonality of agricultural work	IV	III	III
10	Requirement of high time	II	II	II
11	No insurance facility	X	XI	VII
	III Technological constraints			
1	Lack of technical knowledge	I	I	I
2	Poor supply and marketing of implements	II	II	II
3	Inadequate research and demonstration	III	III	III
4	Lack of co-ordination between govt and other organisation	V	V	V
5	Lack of trained extension staff	IV	IV	IV
6	Lack of access to training and extension services	VI	VI	VI
7	Lack of diffusion of technology	VII	VII	VII
	IV Situational constraints			
1	Reduction in demand of draught animal	IV	IV	IV
2	Changes from traditional farm practices	III	III	III
3	Negative image of DAP	V	V	V
4	Diminishing pool of DAP experience	I	I	I
5	Lack of commonly accepted rental system	VI	VI	VI
6	Less utility because of mechanization	II	II	II

Results and discussion

The potential constraints felt by the farmers were ranked based on their response (Table 1).

Economic constraints

Fifty-four per cent of the small farmers felt their low purchasing power is the most serious constraint followed by high cost of feed (43%) and high cost of animal (39%). The scores were ranked and low purchasing power of the farmers was ranked first among the small farmers followed by high cost on animal and high cost of feed, high cost of implements and spares, no access to credit facility and high cost of treatment.

Among the medium scale farmers (37% felt most serious constraint and 47% felt as a constraint) and the large farmers (79% felt as a most serious constraint) the main constraint was the high cost of feed followed by the high cost of animals. This might be because they are aiming to maintain a good breed and providing good quality feed. When the farmers aimed to provide good quality and sufficient quantity, then they have to spend a minimum of Rs 100/- to a maximum of Rs 250/pair/day. Farmers are facing a problem in investing a huge amount of money in feeding their bullocks.

The reduction in population of bullocks has caused a rise in the price of bullocks and increased demand for good animals. A similar finding was reported by Venkatasubramanian and Fulzele (1996). This became another economic constraint for small farmers; they depend mainly on draught animals for their agricultural work and the increased price of bullocks makes it difficult to purchase a good pair. A good pair of indigenous breed bullock currently costs between Rs 40,000/- to Rs 60,000/-. If the farmer does not want to maintain the bullocks in the off season, then it becomes difficult for them to buy a good pair again at nominal cost for the next work season.

Management constraints

Out of eleven potential management constraints, lack of agricultural labour was the foremost constraint faced by all the respondents followed by high time requirement for agricultural work and limited use of bullocks throughout the year. The majority of the small farmers (89%), medium farmers (89%) and large farmers (93%) felt lack of agricultural labourers was the main constraint in using draught bullocks followed by high time requirement for work (80% of small farmers), medium farmers (59%) and large farmers (64%). Poor management of the bullocks and drudgery associated with implements were the least important constraints felt by the respondents.

Lack of agricultural labour was a serious constraint not only in the use of bullocks but in general throughout agricultural work. The farmers face problems in engaging labourers for agricultural works because of the movement of labour population to factories and other industries. Another important problem of labour is the high cost of wages and lower work hours per day. A similar finding was also reported by Wanders and Stevens (1999) and Kumwenda (2000). The farmers feel instead of giving high wages and struggling in getting labour, it is better to hire a tractor, so that the work will be easily finished with less labour and in a shorter time than with draught animal power (DAP).

The seasonality of agricultural work is also one of the major constraints in using bullocks. It is a burden to maintain the bullocks in the idle period, if they do not have any other work. The farmers also did not know how to improve the work days of bullocks apart from agriculture. This caused limited use of bullocks throughout the year. Only very few farmers who had carting as an occupation, used bullocks throughout the year, whereas the majority of the farmers who owned bullocks for agricultural work did not use them throughout the year. Ramaswamy (1985), Shetto *et al*. (2000) and Anonymous (2003) also thought bullocks can be underworked where there is only limited work available.

Lack of adequate feed was the constraint ranked fifth under the management constraints. No farmer provided the complete balanced ration to their bullocks that they provided to their milch animals. Those farmers who were keeping bullocks for prestige and using them for carting in addition to field work provide oilcakes, cotton seed with bran and straw as supplements. The major complaint of the respondents was the high cost of feed which prevented them from providing adequate feed. However, the farmers felt that whatever feeding practice they were following was sufficient for the bullocks.

Since keeping draught animals is an old tradition, the farmers had good practical knowledge of maintaining the bullocks, if not scientific technical knowledge per se. They used implements made by the local artisans. Hence, except for feeding, they did not face any constraint in managing the animals. Lack of good breeds lack of suitable implements, work associated problems, poor management, drudgery associated with implements, no insurance facility were not felt by the farmers to be serious constraints.

Technological constraints

Among the constraints, lack of technical knowledge by farmers was reported as a major constraint by all categories of farmers (ranked first) followed by poor supply and marketing of implements, inadequate research and demonstration. Lack of co-ordination between government and other organisations, lack of access to training and other extension services and lack of diffusion of technology were felt by the farmers to be less serious constraints.

Owing to increased mechanization, most of the farmers felt that use of DAP was outdated and in future there would not be any role for draught bullocks in agriculture. Hence, there was lack of interest in the new research and demonstration on DAP that exists in the state. People using bullocks were continuing with the traditional practices, but they felt they were lacking in scientific knowledge. Their implements were designed by local artisans, since they were facing difficulty in getting the implements from the agricultural co-operative society or any other institutions dealing with agricultural machinery. But, overall the farmers did not prioritise and potential technological constraints. This may have been because they did not know much about any new technology, if at all it existed. Since they were not aware, all categories of farmers regarded potential technical constraints at the same low rank. Since there were no programmes, research, training or demonstration on DAP, the users may have been also ignorant about the new technological improvements. They might not have been aware of the problems they were facing while working with the draught

bullocks and how best they could make use of the animals. The negligence on the part of the policy makers was mainly responsible for this situation. To overcome the problems, first, proper co-ordination should be made among the different departments involved with DAP. Relevant research should be carried out to increase the efficiency of the bullocks (Karanjkar and Patil, 2008). Mwenya *et al*. (1992) also identified that inadequate research and demonstration of animal traction technologies and poor supply and marketing of animal traction implements were constraints. Similarly, lack of coordination between government and other organisations engaged in developing, manufacturing, marketing and promoting animal traction was a technical constraint stated by Desta (1994), ranked fifth in the findings of this present study.

Situational constraints

The diminishing pool of DAP experience was considered a major situational constraint reported by the majority of the respondents (76% of small farmers, 79% of medium farmers and 73% of large farmers). This might be due to increasing dependency of farmers on mechanization for many reasons, and the decline in the draught bullock population. The skilled labour that operates draught bullocks is also on the decline. Though draught bullocks play a vital role in agriculture, the agricultural scenario has changed much in recent years and farmers need not depend only on bullocks. The rapid operation by tractors attracted many farmers and as a result especially the younger generation lacks knowledge and experience in using DAP. These are the reasons for the diminishing pool of DAP experience. Less use of bullocks because of mechanization was a major constraint felt by the farmers. The same finding was also reported by Venkatasubramanian and Fulzele (1996) and Selvakumar (1996). But this was true mainly for medium and large farmers, but became a constraint for small farmers as well, because they could no longer work in others' fields and hence their income from DAP was reduced.

The respondents reported that the lack of a commonly accepted rental system of DAP was not a major constraint. This might be because the small and marginal farmers who owned bullocks had an additional occupation and income from commercial ploughing in others' field during the season. Even the agricultural labourers purchase bullocks from markets during the season and dispose of them in the market at the end of the season. Though such practices prevail in the state, farmers who did not have bullocks faced problems in hiring the bullocks because of a reduced population. Due to the reduced population and increased seasonal demand for bullocks, the commercial ploughmen exploit the situation by increasing their rate even up to Rs 700/day from the large farmers. Also, the farmers who keep bullocks as an income generator use them for carting also. Hence the farmers felt the lack of commonly accepted rental system was not a constraint.

The farmers felt situational constraints were important in using DAP, because they could not totally dispose of the bullocks to depend fully on tractors, while at the same time, the labour problems and time consuming nature of bullocks compelled them to go for mechanization. But, the unsuitability of tractors in many places and its high cost for the small and marginal farmers make the choice between bullocks and tractors difficult for them.

Overall constraints

The total ranking of scores of the respondents for all the potential constraints identified (Table 2) ranked management constraints first, followed by situational constraints economic constraints and technological constraints. Among management constraints, shortage of agricultural labour was ranked first with the total score of 203 by large farmers followed by small farmers (total score 200) and medium farmers (total score 198). Among situational constraints, diminishing pool of DAP experience was ranked first with the total score of 193 by small farmers followed by medium farmers (total score 191) and large farmers (total score 188). Among economic constraints low purchasing power was ranked first among small farmers (total score 176), In the case of medium farmers (total score 153) and large farmers (total score 189) high cost of feed was ranked first. Among technological constraints lack of technical knowledge was ranked first with the total score of 121 by large farmers followed by small farmers (total score 100) and medium farmers (total score 85).

Table 2. Overall constraints faced by farmers

Constraints	Score	Rank
Economic	2,456	III
Management	3,312	I
Technological	1,428	IV
Situational	2,625	II

The results indicate that lack of agricultural labour, time required when using bullocks and seasonality of agricultural work were the main management constraints for the farmers in using bullocks whereas, the diminishing pool of DAP experience and less availability of bullocks because of mechanization were the situational constraints for the farmers in using DAP, followed by the economic constraints which were ranked third overall. This might be because users were not providing adequate feed and did not feel the importance of it. Besides, the farmers were not aware about the new technological developments concerning the implements they were not having any technological constraints. Actually their needs in these areas were not felt by them due to their lack of awareness about the technological developments in this area.

References

Anonymous (2003). http://www.hinduonnet.com/seta/2003/06/12/stories/2003061200080200.htm

Desta, K. (1994). Development and transfer of animal traction technology in Ethiopia. Improving animal traction technology, 454-455. http://www.animaltraction.net/Improving92/CountryExperiences/Counrtyexperiencesp454KDesta.pdf

Ghosh, S.P. (1991). Agro-climatic zone specific research: Indian perspective under NARP. Indian Council of Agricultural Research, New Delhi.

Karanjkar, L.M. and Patil R.A. (2008). Draught ability of bullocks: A Review. *Indian Journal of Animal Sciences* **78**(9):1002-1018.

Kumwenda, W.F. (2000). Animal drawn implement supply, distribution and services in Malawi. Empowering farmers with animal traction into 21st century, 76-81. http://www.atnesa.org/Empowering99/Empowering99-Kumwenda-MW-www.pdf

Mwenya, E., Mwenya, W.N.M., Dibbits, H.J. (1992). *Animal Draft Power in Zambia*: Constraints to development and possibilities for improvements. ATNESA workshop. 18-23 January 1992. Lusaka, Zambia. 469-473. http://www.animaltraction.net/Improving92/CountryExperiences/Countryexperiencesp469EMwenya&WNMMwenya&HJDibbits.pdf

Ramaswamy, N.S. (1985). Draught Animal Power – Socio economic factors. In *DAP for Production*. Proceedings of an international workshop held at Jamescook University, Australia.

Rao, M.K., Dass, D.N. (2005). Genetic improvement of draught cattle and buffaloes in India. In: Proceedings of the National symposium on *Draught Animal Breeding and Development for Efficient Utilization under Indian Farming Systems*. April 20-21,Bangalore, Karnataka, India. pp4-8.

Selvakumar, K.N. (1996). Growth dimensions of livestock sector in Tamil Nadu – An economic analysis. Unpublished Ph.D. thesis, University of Agricultural Sciences, Bangalore.

Shetto, R.M., Mkomwa, S., Simalenga, T.E. (2000). Entrepreneurship in animal traction: empowering rural initiatives. Empowering farmers with animal traction into the 21st century. 194-200. http://www.atnesa.org/Empowering99/Empowering99-ShettoMkomSim-TZ-www.pdf

Singh, G. (1999). Characters and use of draught animal power in India. *Indian Journal of Animal Sciences* **69**, 621-627.

Venktasubramanian, V., Fulzele, R.M. (1996). Draught power utility of crossbred bullocks as perceived by farmers of Tamil Nadu. *Indian Journal of Dairy Science* **49**, 307-313.

Wanders, A.A., Stevens, P.A. (2000). Technology transfer and on farm evaluation of animal powered equipment: approach and experience of IMAG-DLO. Empowering farmers with animal traction into the 21st century. 52-60. http://www.atnesa.org/Empowering99/Empowering99-Wanders-www.pdf

(c) SE Asia

Capacity building in ruminant production in smallholder farming systems

Mai Van Sanh[1], Seng Sokerya[2], Asep Sudarman[3], Endang Baliarti[4] and R. Anne Pearson[5]

[1]National Institute of Animal Science (NIAS), Vietnam, [2]Centre for Livestock and Agricultural Development (CelAgrid), Cambodia, [3]Bogor Agricultural University Centre for Tropical Animal Studies, Indonesia, [4]Faculty of Animal Science, Gadjah Mada University, Indonesia, [5]Royal (Dick) School of Veterinary Studies, Edinburgh University, UK

Introduction

Following on from a successful programme in 2005 in Vietnam (DAN 43, 19-20), British Council have funded a training programme in SE Asia under their Development Programmes in Higher Education (DelPHE) between the organisations listed above. The purpose of the project was to work together to develop course plans and design training materials on feeding, management and use of ruminants for farmers and people working with farmers. The project aimed to improve the knowledge and skill of the farmers, trainers, scientists and students involved in the project as well as working with them to produce training and education materials for continued dissemination after the end of the project. Most of the smallholder farmers in hilly and mountainous areas in SE Asia continue to use draught animal power either alone or to complement small tractors. The farmers value the independence in crop cultivation that ownership of a buffalo or cattle team or individual brings. Many farmers use female buffalo in the rice fields and expecting them to also produce a calf as well as work. Many large ruminants are multipurpose on smallholder farms being kept for work, meat or calf production although increasingly some farmers are specializing in smallscale dairy

production. The project aimed to address all these productive outputs with scientists from all specializations coming together to share experiences.

Activities

A general manual was compiled in English bringing together each organization's experiences. From this and from the feedback gained from farmers and extension agents (some as a result of other British Council funded activities) in Vietnam, Indonesia and Cambodia, new short courses were developed and run for farmers and those working with farmers to improve management practices and health care of large ruminants in Indonesia, Cambodia and Vietnam. People who attended these courses included extension workers, community development workers, village animal health workers, NGO and University staff and post graduate students as well as farmers. During the course of the project, training materials have been developed on multipurpose ruminants in Khmer, dairy and beef production in Bahasa Indonesian and dairy cattle, multipurpose buffalo and beef production in Vietnamese. The demand for these mean that already the Vietnamese booklets have been reprinted by a printing company at their own expense for wider sale and we hope other organisations will fund reprinting in the other countries. Small research projects were undertaken by MSc students in-country and a research proposal was completed for submission to an International donor.

Plate 13. Project team discussing problems with smallholder farmers in Cambodia (S Sokerya)

Plate 14. Training in Indonesia organised by Gadjah Mada University (E. Baliarti)

Anyone wishing copies of the training materials should contact the individual project leaders in the respective SE Asian countries:

- Dr Mai Van Sanh: National Institute of Animal Science (NIAS), Thuy Phong, Tu Liem, Hanoi, Vietnam, mvsanh@netnam.vn
- Dr Seng Sokerya: Centre for Livestock and Agricultural Development (CelAgrid), Office: #05, Street 181, Sangkat Tumnup Teuk, Khan Chamka Morn, Phnom Penh, Cambodia, ssokerya@celagrid.org.
- Dr Asep Sudarman: Bogor Agricultural University Centre for Tropical Animal Studies, Indonesia. A_sudarman@yahoo.com.
- Prof Endang Baliarti: Faculty of Animal Science, Gadjah Mada University, Gedung Pusat LtII, Sayap Timur, Bulaksumur, Yogyakarta 55281, Indonesia, bali_arti@yahoo.com.

(d) India

A study on economics of maintenance of mules

R.L. Srivastava
AICRP on Animal Energy, College of Agricultural Engineering, FMandP Engineering Department, Allahabad Agricultural Institute-Deemed University, Allahabad-211007, INDIA

Abstract
Mules can thrive on poor fodder and are less susceptible to disease than horses. The fixed cost for Project mules (T_1) and village selected mules (T_2) was 11% and 8% from

the total cost. The total cost Rs 96 and 58 respectively for T_1 and T_2 group mules. The net incomes were Rs 31,407 and 16,184 per year for Project mules (T_1) and village selected mules (T_2), respectively. Total cost / day /100 kg body weight was Rs 24 and Rs16.5, respectively for T_1 and T_2 group mules. There is more scope to increase the use of mules which will increase income from the present level.

Introduction

Approximately 175,000 mules are found in India (Livestock Census report, 2005). They are known for heavy duty and fast work. The mule is also known for its great capacity for endurance under adverse conditions of climate and food (Singh and Moore, 1982). Mules are considered as draught and pack animals. This important draught breed has strong muscle power and stamina. The mule has exceptional ability to work hard in an unfavourable environment (Fielding and Krause, 1998). This draught animal is mostly used in transport of sand, bricks and in passenger transport in India. The feeding and management practices prevailing among the owners play an important role in maintenance. The same general rules of feeding and stable management are applicable to them as to the horse (Singh and Moore, 1982). To improve the efficiency of the mule good management practices must be followed which will increase their power availability too. As a draught animal, the mule can be one of the alternative source of farm power to ruminants. It is important to know the best feeding and management practices when they are to be used for work. The present study will help farmers as well as research workers understand the economics of maintenance of this important work species.

Materials and methods

The survey was conducted in the area within a radius of 8 km around the Allahabad Agricultural Institute – Deemed University, Allahabad. Ten mules were selected for the study – eight mule owners from the nearby area of the university and two mules from the AICRP on Animal Energy Project. These mules were grouped in two groups (Table 1) to compare their economics, *ie*. Project mules (T_1) and village selected mules (T_2). Two mules in T_1 and eight mules in T_2 group were kept. Detailed information related to feeding and management practices and availability of feeding ingredients were collected (Tables 1 and 2). A list of questions was prepared and this was used to guide the interviews. The project mules were fed as per the recommended nutritional requirements. Collection of data regarding economics of feeding and management of mules was done by spot visits to the owners' houses and interviews at their working place once in a week. The survey work was carried out for a period of four months. Total cost was divided into fixed costs and variable costs. Fixed costs were calculated by the evaluation of cost incurred on purchase price, working life of mules, resale value, interest rate, cost of water and electricity and housing. Variable costs were calculated from information provided by the users regarding feeds and fodder provided by them, and labour charges. Data on cost of feeding, housing depreciation, interest and labour were calculated. The cost of medicines and income were also calculated. The calculation of income was based on work done in 1,000 hours for both the groups.

Table 1. Details of mules selected for the trials

	Group of mules	
	T_1	T_2
Type of work performed	Carting and agricultural works	Pack animal
Age group (years)	6	4–8
Weight (kg)	395	275–300
Feeding pattern: grazing/barn feeding	Barn feeding	Grazing
Type of fodders	Dub grass/green fodders	Grazing of dub grass
Grains (yes/not)	yes	occasional
Health status	Excellent	Good

Table 2. Composition of ration as per the availability of fodders

Ingredients for T_1 group	Ingredients for T_2 group
Wheat bhusa	Wheat bhusa
Dub grass	Grass (grazing)
Berseem	Grass (grazing)
Rice bran	Rice bran
Gram	Rice bran
Salt	Rice bran

Result and discussion

Housing system

Mules maintained under the AICRP on Animal Energy scheme were kept in the cattle shed head to head. Village selected mules were kept in the huts and for some time in an open area. They provide feeds and fodder in the feeding manger made for them.

Feeding pattern

The main source of nutrition of mules in this area is grazing. Mules maintained at the centre were offered feed to meet their nutritional requirements. Feeds and fodders were offered in the morning at 9 am and in the evening at 2 pm. Dub grass was put before them in the morning and watering was daily in the afternoon. The village selected mules were fed early in the morning i.e. at 4-5 am before work started. After finishing work the owners lose their mules and allow them to water and graze for the rest of the day in the summer season (Plates 15,16). In winter sometimes they also use them for work in the second shift, later in the day, depending upon the demand for work. They provid rice bran and sometimes gram as feed supplements.

Plate 15 (left). Village mules grazing after work (R.L. Srivastava)

Plate 16 (below). Owners in villages hobble their mules to prevent wandering and leave them to graze after the work (R.L. Srivastava)

Fixed costs

Fixed costs of T_1 and T_2 mules are presented in Table 3. The average fixed cost for project mules (T_1) was 11% and for the village selected (T_2) group was 8% of the total cost. The fixed costs for group T_1 were higher (Table 3) as compared to those of the

T_2 group because of the higher investment involved in initial purchase cost of T_1 group mules.

Table 3. Economics of maintenance of a mule.

	Groups	
Particulars	**T_1**	**T_2**
Body weight (kg)/mule	400±5	350±5
Purchase cost (Rs)	40,000	12,000
A. Fixed cost (Rs)		
(i) Depreciation	2,466	700
(ii) Housing charges	560	560
(iii) Equipment (two buckets, shovel and chain)	330	330
(iv) Interest on investment	402.7	190.8
Total fixed cost (i+ii+iii+iv)	**3,758.7 (11%)**	**1,780.8 (8.4%)**
B. Variable cost (Rs/mule)		
(i) Feeds and fodder expenses	16,372.6 (47%)	4,672.0 (23%)
(ii) Mineral and salt	273.8	110.0
(iii) Labour charges	13,140	13,140
(iv) Light and water charges (Rs 100/month)	1,200	1,200
(v) Medicine (@ 5% of the fixed cost)	187.9	89.0
(vi) Miscellaneous	100	100
Total variable cost (i+ii+iii+iv+vi)	**31,274**	**19,311**
Total cost (6+12) (Rs)	**35,033**	**21,092**
C. Income		
Sale of dung	3,940	3,942
Earnings (1,000 hr/year for both groups)	62,500	33,333
Total income (Rs)	**66,440**	**37,275**
Total cost/100 kg body weight/day (Rs)	23.99	16.51
Total cost/day (Rs)	96	58
Net income/year (Rs)	31,407	16,184

Variable costs

Variable costs in T_1 and T_2 mules are shown in Table 3. The break-up of the variable cost components indicate that feed and fodder cost alone incurred 47% and 23% of the total cost, respectively, for T_1 and T_2 groups. The cost of green and dry fodder was higher for the farm group (T_1) compared to the village (T_2) group mules (agreeing with Anonymous, 2004). This was because owners did not offer a balanced diet to their mules. They occasionally gave a small quantity of gram to their mules. A higher cost

of feeding was observed in the T_1 group as compared to the T_2 group of mules. It was because the T_1 group were fed up to their nutritional requirements while the village selected (T_2) mules did not receive feed to their requirements. Among the variable cost feeds and fodder cost were highest followed by labour costs for T_1 mules and this was reversed for village selected mules because village selected mules did not receive as per the recommended nutritional diet. The study clearly indicated that mules maintained at the UAE centre, registered a higher variable cost as compared to the village group mules.

Maintenance cost of a mule

The total maintenance cost incurred on a mule is presented in Table 3. The per day total cost was Rs 96 and Rs 58 respectively, for T_1 and T_2 mules. Total cost / day /100 kg body weight was Rs 24 and Rs 16.5 respectively, with T_1 and T_2 group mules. Maintenance cost of UAE centre mules was higher than that for village selected mules. This was due to higher purchase cost of mules and higher costs associated with good feeding practices.

Use and output

The yearly use and output in terms of money is presented in Table 3. The yearly use of mules was calculated and rounded for both group of mules for 1,000hr/ year. The per day use would be 2.7 hours. Per day output and maintenance cost was higher for UAE centre mules as compared to village selected mules. The carrying capacity of centre mules was high i.e. almost double that of farm mules. Therefore the centre mules accomplished almost double the work in a given time compared to that of village selected mules. The net income per year was Rs 31,407 and Rs 16,184 for centre and village mules, respectively.

References

Anonymous (2004). Biennial report of AICRP on Animal Energy, Allahabad Agricultural Institute – Deemed University, Allahabad, p. 6-65

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

17th Livestock Census Data (2005). India.

Singh, H., Moore, N.E. (1982). *Livestock and Poultry Production*. 2nd ed., Prentice Hall of India Private Limited, New Delhi-110001, p. 371.

(e) India

A study on effect of draught and duration of work on physiological responses of mules under hot-humid season conditions

R.L. Srivastava, A.K.A. Lawrence and Shibu Mathew

AICRP on Animal Energy, College of Agricultural Engineering, FM&P Engineering Department, Allahabad Agricultural Institute-Deemed University

Abstract

A study was conducted during the hot-humid season where two mules worked individually at 20% (D_1), 25% (D_2) and 27% (D_3) draught load for three hours continuous

work. A significant ($P<0.05$) effect on respiration rate, pulse rate and body temperature of mules were found due to draught and duration. A significant effect of draught x duration interaction was also observed on respiration, pulse and body temperature of mules. The increase in respiration rate was observed between 18 ± 0.44, to 49 ± 0.75, 19 ± 0.44 to 54 ± 0.87 and 18 ± 0.44 to 53 ± 1.15 respectively, at D_1, D_2 and D_3 draught load. Increase in pulse rate was observed between 36 ± 0.44 to 65 ± 0.44, 36–72 ± 0.87 and 37 ± 0.44 to 74 ± 0.44, respectively on the same draught and increase in body temperature was recorded between 36.3 ± 0.80 to 37.8 ± 0.04, 36.3 ± 0.09 to 38.0 ± 0.08 and 36.3 ± 0.04 to 38.4 ± 0.04, respectively at D_1, D_2 and D_3 draught load.

Introduction

The performance of draught animals depends on their physiological responses during work. Respiration rate, pulse rate and body temperature of draught animals are the major physiological norms which are affected greatly during work. These three parameters can be considered as the main indices for the study of draught animal stamina. Little work on performance of mules has been done in India. Variations in physiological responses during work have been observed in earlier studies of cattle (Sastry *et al*., 1970a; Adkine *et al*., 1977; Rautarary, 1985). The mule is a fast working draught animal. It is imperative to know their physiological response during work to know the effect of work load and duration of work on respiration rate, pulse rate and body temperature to avoid any adverse effect on their health. This paper presents the physiological responses of mules in hot-humid conditions during work at different draught forces.

Materials and methods

Two good medium-size mules were selected for study. Their age was six years and their body weight was 300 kg each. A Central Institute of Agricultural Engineering loading car was used to set the desired draught load for work. Modifications for hitching arrangement in the CIAE loading car were made with the help of two strong bamboos on either side of mule for the single mule at a time. The study was conducted continuously at different draught load for three hours daily on each draught setting. Trials were conducted on 20% (D_1), 25% (D_2) and 27% (D_3) draught load. Trials were conducted for three days at each draught setting. Experiments were carried out on a standard tarmacadam test track during the hot-humid season. Respiration rate, pulse rate and body temperature of mules were recorded at each hour during work. Respiration rate was recorded by putting the hand in front of the nostril and counting the expired air, pulse rate by feeling the coccygeal artery and body temperature was recorded by clinical veterinary thermometer. The average ambient temperature and relative humidity was recorded during the entire test period. The means and standard error for different observations as well as significance of duration, draught and draught × duration interaction effects were calculated using analysis of variance (Snedecor and Cochran, 1968).

Plate 17. Mule with CIAE loading car (R.L. Srivastava)

Results and discussion

Ambient temperature and relative humidity

The average ambient temperature ranged between 27 and 38°C and the relative humidity varied between 36 and 75% during the test period.

Respiration rate

The mean respiration rate, standard error and the percent increase from the initial level is presented in Table 1. The results revealed that in general respiration rate increased with increase in draught load and duration of work. The difference due to draught and duration was found highly significant ($P<0.05$) (Table 2). It confirms the finding made in Anonymous (2004). A draught × duration interaction on respiration rate was also observed (Table 2).

Pulse rate

Data on variations in mean pulse rate and standard error of mmean for the mules are presented in Table 1. Pulse rate of the mules increased with increase in draught load and duration of work. A significant ($P< 0.05\%$) effect of draught and duration of work on pulse rate was observed (Table 2). A similar trend was reported in Anonymous (2004). A significant increase, in pulse rate due to draught and duration of work in bullocks, was reported by Maurya and Devadattan, (1986) and Rao and Upadhyay, (1984). The

present study revealed a significant effect of draught × duration interactions also on the pulse rate (Table 2).

Table 1. Effect of draught and duration of work on respiration rate, pulse rate and body temperature of mules

Duration of work	Mean respiration rate (breaths/ min) ± SE	% Increase from initial value	Mean pulse rate (beats/ min) ± SE	% Increase from initial value	Mean body temp (°C) ± SE	% Increase from initial value
D_1 Draught (60 kg)						
Initial (T_1)	18.3±0.4	–	36.3±0.4	–	36.3±0.1	–
After 1 hr (T_2)	30.7±0.9	40	47.7±0.9	24	37.0±0.0	2.0
After 2 hr (T_3)	42.0±0.8	56	54.0±0.8	33	37.3±0.1	2.7
After 3 hr (T_4)	49.0±0.8	63	64.7±0.4	44	37.8±0.0	4.1
D_2 Draught (75 kg)						
Initial (T_1)	18.7±0.4	–	36.0±0.0	–	36.4±0.1	–
After 1 hr (T_2)	36.0±0.8	48	49.7±0.9	28	37.3±0.1	2.5
After 2 hr (T_3)	44.3±1.2	58	58.0±0.8	38	37.5±0.1	3.0
After 3 hr (T_4)	53.7±0.9	65	71.7±0.9	50	38.0±0.1	4.3
D_3 Draught (81 kg)						
Initial (T_1)	18.3±0.4	–	36.7±0.4	–	36.3±0.0	–
After 1 hr (T_2)	37.0±0.4	50	52.7±0.9	30	37.3±0.1	2.7
After 2 hr (T_3)	47.3±0.4	61	62.3±0.4	41	37.7±0.1	3.5
After 3 hr (T_4)	57.3±1.2	68	73.7±0.4	50	38.4±0.0	5.5

Table 2. ANOVA of respiration rate, pulse rate and body temperature, their Mean Squares (MS) and F ratio values

Sources of variation	DF	Respiration rate		Pulse rate		Body temperature	
		MS	F computed	MS	F computed	MS	F computed
Replication	2	5.8	9.2*	2.2	3.6*	0.0	1.2ns
Draught	2	76.8	122.6*	96.8	156.4*	0.3	34.1*
Duration	3	2,016.2	3,219.4*	1,801.2	2,911.4*	4.8	514.3*
Draught × duration	6	10.6	17.0*	13.9	22.5*	0.1	5.6*
Error	22	0.6		0.6		0.0	
Total	35						

*Significant $P < 0.05$; ns, Non significant

Body temperature

The results on variations in mean body temperature and standard error of means for the mules are shown in Table 1. Body temperature of mules increased with increase in draught load and duration of work. A significant ($P<0.05$) effect of draught and duration of work was observed (Table 2).

Conclusions

During the hot-humid season, respiration rate, pulse rate and body temperature of mules increased with the increase in the duration of work and draught load. Draught and duration of work had a significant effect on respiration rate, pulse rate and body temperature. There was also a significant interaction between the effect of draught x duration.

References

Adkine, B.C., Rapte, S.L., Acharya, H.S. (1977). Deoni, Red-Khandhri and Hol-Deo bullocks as draught animals. Paper presented at XV Annual Convention of ISAE, College of Agriculture, Pune.

Anonymous (2004). Annual report of All India Coordinated Research Project on Increased Utilization of Animal Energy with enhanced system efficiency. Allahabad Agricultural Institute, Allahabad, India, 6-66.

Sastry, N.S.R., Georgie, G.C., Razdan, M.N. (1970a). Studies on work performance of crossbred bullocks. *Indian Journal of Animal Production* **1**, 76.

Maurya, N.L., Devadattam, D.S.K. (1986). Comparative study of physiological changes of crossbred and local bullocks during work. *Indian Journal of Animal Science* **39**, 286-290.

Rao, M.V.N., Upadhyay, R.C. (1984). Work performance of crossbred bullocks. *Indian Veterinary Journal* **61**, 1050

Rautaray, S.K. (1985). Output of a pair of bullocks during tillage operations in summer. Proceedings Series No. 10, 51.

Snedecor, G.W., Cochran, W.G. (1968). *Statistical Methods*. 7th ed., Oxford and IBH Publishing Co., Bombay.

(f) Indonesia

Bali Cattle Bull Racing ('Grumbungan') in Buleleng Regency of Bali, Indonesia

I Wayan Kasa.

Dept. of Biology, Udayana University, Bukit Jimbaran, Bali, Indonesia

Introduction

Bali as a small island of the Indonesia archipelago has a number of sources of draught animal power: swamp buffalo, horses and Bali cattle. The Bali cattle is the only pure breed of cattle in Indonesia particularly on the island of Bali. Up to now these cattle has been employed for ploughing on both wet and dry fields. Bali island is an international tourist destination with a unique Balinese culture (*eg*. Balinese dance, painting, sculpture, music), different from other areas in Indonesia. One of the most interesting cultural activities is Bali cattle bull racing. Bali island comprises of eight regencies. Buleleng Regency lies at the northern part of the island, dominating almost half of the total area of Bali island. The Buleleng regency is the only place where the

Bali cattle bull racing has been investigating up to now. The racing started a long time ago, passed on from generation to generation, reported in local and international newspapers, but rarely in scientific reports. Bali cattle bull racing in Buleleng regency has decreased significantly recently. Therefore, this article aims to investigate why this is the case.

Materials and methods

Direct interviews were carried out with owners of Bali racing bulls at their homes as well as a literature search of books, journals and newspapers.

Result and discussion

Historical background of bull racing

Bali island has two seasons in the year. From October to April is the cool/humid (rainy) season and from the end of April to October is the hot/dry. Normally, during the rainy season farmers plant rice-paddy, based on agreements that have been developed among member of the irrigation organisation known as 'subak' in Bali. Such organisation of 'subak' is also famous among Balinese cultures, however its existance is threatened by the rice field being build on with houses for living and other buildings eg. hotels, shops.

Before the rice-paddy is planted farmers first plough the rice field and after somedays resting (usually one week) then level the ground. A pair of Bali cattle bull are yoked together and pull the leveler implement. Two to three pairs of bulls travel around the rice field until the surface of the ground is flat enough for planting rice-paddy. A man sit down on it firmly to control the implement while levelling take place on rice the field (Plate 18). While leveling each pair try to run faster than the others and this is the origin of bull racing ('Grumbungan'). The 'Grumbungan' is the local name of Bali cattle bull racing. Therefore, ground leveling is the origin of bull racing.

Plate 18. Bull racing in Bali, Indonesia (I.W. Kasa)

Bull racing

Bull racing among owners of Bali cattle takes place at the following events: intra and inter village competitions, in celebrating independent day and as a tourist attraction. Not all farmers have bulls for racing. Usually those who have such bulls are rich farmers, because the price of theses bulls is expensive. Intra village competitions are conducted when it is time for ground leveling during the rainy season. All farmers must come together to work on their own rice field property, due to time restriction (not more than a two-week period) based on the 'subak' regulation. During that time farmers

are very happy particularly those who have a racing bull. They help each others in ground leveling and this is the intra village competition. The bull pairs run and compete against each other and this competition is carried-out among owners in the village, while helping them to leveling their ground.

Inter village competition is the more official 'real' racing. Owners come from neighbouring villages to the village where the competition is, travel with the bulls is easy to the village. This type of competition can be conducted on a rice field with irrigation water. Conversely, it also can be done on a dry playing field with no water on it. During competition two pairs of bull race for about 100 to 200 meters distance from one end to the other on the playing field. When the competition is conducted on a rice field the pair run a shorter length based on the longest length of the field. The bull pair is controlled by a man while running and wearing Balinese traditional costume. These competition are usually done for prestige for farmers who have a lot of land as personal dignity in the village. They are really proud when they win and their good name is quickly spread all over the village and its surrounding. Therefore, the winner gets prestigue not prize money.

Competition can also be carried-out to celebrate independent day on August 17 each year. The competition is organised by the local government under the head of regency coordination and staff in chosen villages and the city of Singaraja as the capital city of northern part of Bali island. Such celebration is done on a playing field and this is the real performance of bull racing. The local government prepare prizes such as money, certificates and any others for the winner and in some instance the prize is given in the form of a good quality calf which can be used for racing later on. Villages which have been involved in bull racing from generation to generation are, Sangsit, Jagaraga, Sawan, Bebetin and Sekumpul on the east part of the Buleleng regency and Seririt, Tukad Sumaga, Lovina on the west part. Usually village people come down to the playing field to watch the bull racing including both local and foreign tourists. Competition goes on usually from 9.00 am. to 12.00 noon and involves five to ten pairs of bulls.

Bull racing is also conducted as a tourist attraction. In this case such a race is organised by a travel bureau in collaboration with the local committee of bull racing. The information can be found in the internet under 'Tourism and business information-Bali-Online.com'. The event is usually carried-out on 1 and 2 August each year at Lovina beach in Buleleng regency. In the 1990s such events were conducted almost every week, however, soon afterward in 2000s it gradually disappeared because of the difficulty in getting a playing field. A playing field must now be hired at high cost whereas formerly (in 1990s, Englan, 2006) it could be borrowed from the land owner. This fact is supported by Anon (2009) who scheduled the bull racing just one time in 2009 at Kaliasem village of Lovina. In addition, most of the agriculture land has changed its function to settlement area due to a significant increase in population. This is generally happening in the villages of Munduk and Lovina at Banjar sub-regency in the central part of North Bali.

Bull management
When not being used for ploughing the of Bali cattle bulls are trained for racing. The bull selected is given special treatment for example: exercising, enough rest, better feed and feeding, take bath twice aday, massage, good condition of space. Speaking about better feed and feeding, the bull is fed 2-3 time/day with good quality local and the introduced grass of kikuyu and elephant grasses. Moreover, in order to get better physical condition the bull is also fed additional extra food of rice bran, mollasses and chicken eggs, especially three days prior to racing. Such food is given daily. When not in racing competition the bull is treated with such extra food weekly. Sometime the bull has also been treating with a special traditional drink made from local fruit of certain plant plus honey from local bees. The farmers believe that this traditional drink is useful in increasing better physical condition before racing is conducted. Kasa (2008) found that kikuyu and elephant grasses are better quality of food for increasing body condition in Bali cattle. Training must be done before racing to accustome the animal. Jones (2008) stated that it is true that an animal (or human) not accostumed to loads will have more difficulty handling them. So another part of the formula is training, or at least accustomisation. Not all owners treat their bull in the same way, but management varies from one farmer to another based on custom inherited from their descendents. Therefore, the race bull is treated better than other cattle, although there are different ways of doing so.

Why is bull racing threatened recently?
Global economic crisis
There is a world economic crisis. This can be seen from the decrease in export and import activity of some commodities, and a decrease in tourist activity between countries. This has reduced numbers of foreign and local visitors to Bali. As a consequence fewer tourism commodities can be sold including the Bali cattle bull racing grumbungan in northern Bali.

Twice Bali bombing
Almost all people in the world have already known that Bali a paradise island and tourist desnination was bombed in years 2002 and 2005 by terrorists. One of the results of such inhumanism tragedy was a drastic decrease in the number of foreign and local tourists visiting Bali. This has affect the activity of Bali cattle bull racing.

Land degradation
World population is increasing each year by about 2%. Such a situation will affect every life sector for example, land degradation inclusively. More agricultural land is now being used for housing, hotels and shops in Bali. Data from Statistical Central Bureau of Bali clearly inform that about 1000 ha of agriculture land a year is lost to building each year in Bali. This situation will affect availability of land as a playing field for Bali cattle bull racing. At the present moment land for bull racing must be hired from someone (private), whereas in the past the land was usually borrowed from owners.

Funding
Money is needed to conduct bull racing, however, in certain instances such activity could not be carried-out due to a limit of funds. When racing is conducted within inter and intra villages, usually funding is not needed and it is absolutely due to consciousness among farmers.

References

Englan, K. (2006). The disappearing of Bali cattle bull racing in Buleleng regency, Bali island of Indonesia. (available in Indonesian language). *Bali Post* 15 November 2006.

Erawan, I.B.P., Darna, I.P., Bagiada, I.P. (2003). Sapi Grumbungan competition in Lovina. *Bali Travel News*.

Anonymous (2009). Bali Best Way's - Ubud accomodation.com - Your Gateway to Explore Ubud and Bali Paradise Islands.

Kasa, I.W. (2008). Buffalo racing in Jembrana regency, Bali Province of Indonesia. *Draught Animal News* **46**(1): 22-24. Centre for Tropical Veterinary Medicine, University of Edinburgh, UK.

Jones, P.A. (2008). Animal tolerance. *Draught Animal News* **46**(1): 17-19. Centre for Tropical Veterinary Medicine, University of Edinburgh, UK.

(g) India

Development of button types miniature load cells for study of load distribution on the neck of bullocks with different yokes and harness

C.D. Singh[1] and R.C. Singh[2]
[1]Instrumentation laboratory, Central institute of Agricultural Engineering, Nabibagh, Bhopal – 462038 (MP), India; [2]Agricultural. Mechanization Division, Central institute of Agricultural Engineering, Nabibagh, Bhopal – 462038 (MP), India

Abstract
Strain-gage load cells convert the load acting on them into electrical signals. The gauges themselves are bonded onto a beam or structural member that deforms when weight is applied. In most cases, four strain gages are used to obtain maximum sensitivity and temperature compensation. Two of the gauges are usually in tension, and two in compression, and are wired with compensation adjustments. When weight is applied, the strain changes the electrical resistance of the gauges in proportion to the load. Based on the above principle, we have developed button types load cells (0–500N) for measurements of load distribution on the neck of bullocks with local yoke, Nagpuri yoke and three-padded collar harness. The accuracy, non-linearity and hystersis of the cells were tested by an Instran universal testing machine and results showed that the load cells were working satisfactorily. The miniature button type load cells (capacity 0–500 N), were mounted on three planes (left, middle and right) of the contact surface of the yokes. The draught loads were applied using the CIAE animal-loading car on a standard test track (tarmacadam road). The mean vertical loads on the neck of oxen were higher at the middle planes of Nagpuri and local yoke and decreased towards the left and right side of the neck of oxen at draught loads of 800, 900 and 1,000 N. The mean loads at the left, middle and right planes on contact surface of the Nagpuri yoke were significantly less in comparison to local yoke, at 5% level of significance.

Introduction

The tractive power from the animals to the implement/cart is transferred through a yoke or harness. The rigid yoke tied or placed on the neck withers links animal and implement system for harnessing energy. The efficiency of the energy transmission depends upon the contact area and load distribution on the contact surface of the yoke. Mechanics of animal-implement hitching system was explained by Devnani (1981) and Srivastava and Ohja (1987). The pull developed by an ox/buffalo using the neck type yoke under working condition is shown in equation 1.

$$P = \frac{\mu W L_1}{(L - \mu h_2)\cos\theta - \mu L_2 \sin\theta} \quad (1)$$

where, P = Pull applied by the animal; W = Body weight of the animal; L = Horizontal distance between front and rear foot placed on the ground; L_1 = Horizontal distance between front foot and centre of gravity of animal; L_2 = Horizontal distance between front foot and point of action at the yoke; H_2 = Vertical distance between point of action and level of ground; μ = Coefficient of friction between ground and feet of the animal and; θ = Angle of pull.

The point of hitching from where force acts, is located in front of the centre of gravity of the body of the oxen and the line of action passes below or above the centre of the gravity. Therefore, each animal makes adjustment in its body during motion in order to overcome the rotating torque and maintains proper working posture as per the change of line of pull, which passes between point of hitching and centre of gravity (Shrivastava and Ohja, 1987). The yoke supports some of the weight of the implement and takes the pull force. The neck load is more in the dynamic condition compared to static condition. The load distribution pattern on the contact surface of yoke with neck of the animals is mainly responsible for discomfort and efficiency of their working. Load concentrated at a very small area leads to neck injury. The animal loses his working efficiency due to a pointed load, and loads on the neck during braking, besides galls due to rubbing of the yoke against the neck. There is a lack of scientific information about the load distribution between the contact surface of yoke and neck of oxen and (Ramaiyan *et al*., 1979; Singh and Singh, 2003). This study aims to find out the load distribution on the contact surface of the neck of the ox with a traditional and improved Nagpuri yoke/harness at different draught loads. An electronic load measuring system was used to measure the loads. This will generate data to enable the design of an appropriate harnessing system to reduce neck injury and enhance draught power of the animal without skin abrasion.

Methods

Measurement of contact area between yoke/harness and neck of oxen

The contact area between the neck of oxen and yoke/or collar harness was determined for proper mounting of load cells. A layer of black coloured ink (paste) was painted on the neck of the oxen. The yoke or harness clamped with white coloured drawing sheets was put on the neck of the oxen. The CIAE animal-loading car was used for measurement of draught load of the animals on a standard tarmacadam road. The

area of black spot on white coloured drawing sheets was determined using graph paper for each observation. Three replications were recorded for each test.

The mean contact length and width on the neck with Nagpuri are given in Table 1. and for the Allahabad three-padded double animal collar harness in Table 2. The mean contact area of the top pad was significantly higher than left and right side pads. The difference in contact area of left and right side pads were not significant (Table 2).

Table 1. Contact area between the neck of the oxen and yokes at draught load of 1000 N

Particulars	Mean	SD	SE
(a) Length of contact (cm)			
Nagpuri yoke	37.8[a]	0.8	0.3
Local yoke	28.7[b]	0.5	0.2
(b) Width of contact (cm)			
Nagpuri yoke	15.6[a]	0.7	0.3
Local yoke	18.2[b]	1.0	0.4
(c) Contact area (cm2)			
Nagpuri yoke	588.9[a]	2.2	0.8
Local yoke	521.9[b]	3.6	1.2
(d) Body weight of oxen (kg)	494.0	6.0	2.3

a and b significantly different at 5% level of significance (pair sample 't' test)

Table 2. Contact area between neck of the ox and Allahabad three-padded double animal collar harness

Particulars	Mean	SD	SE
i) Contact area of top pad (cm2)	375.8[a]	14.2	5.8
ii) contact area of left side pad (cm2)	166.7[b]	18.6	7.6
iii) Contact area of right side pad (cm2)	153.3[b]	18.6	7.6
iv) Body weight of oxen (kg)	494.0	6.0	2.3

a and b are significantly different but b and b are not at 5% level of significance

Measurement of vertical pressure/load on the neck of oxen

The pressures on the necks of the oxen were measured by using miniature load cells. The contact area helped in mounting of the miniature button type load cells (0–500 N) at the different (left, middle and right) planes of yoke and collar harness as shown in

Figure 1 and 2. The load cells' readings were recorded on a nine channel recorder to measure the load distribution at different points on the contact surface of yoke/harness. The specifications of the electronic load measuring system are given in Annex 1. Two pairs of oxen with yoke or harness were used to pull the CIAE animal-loading car on a tarmacadam road (standard test track) at draught loads of 800, 900, 1,000 and 1,200 N (equivalent to 8, 9, 10 and 12% of the body weight of oxen). The angle of pull was measured with an Abney level. The speed of the oxen was recorded using a radar sensor with 21× micro-logger.

Results and discussion

Load distribution on the Nagpuri and local yoke

The mean vertical loads at the left, middle and right planes on the contact surface of the Nagpuri yoke and the local yoke with the necks of the oxen are given in Table 3. The mean load values were more at the middle point 2 than the point 1 and 3 of the left, middle and right planes. The mean load values were always higher in the middle plane as compared to the left and right planes (Figure 3). The average speeds of operation recorded were 2.5, 2.2 and 2.0 km/h at the draught loads of 800, 900 and 1,000 N, respectively. The oxen had fatigue scores of 14, 17, and 20 points at these speeds in three hours of sustained working.

Table 3. Load distributions for the Nagpuri and local yoke at different draught loads and at different planes

Draught load		Load (N) distribution with respect to load cell position on the yoke								
		Left plane			Middle plane			Right plane		
N		1	2	3	1	2	3	1	2	3
A. Nagpuri yoke										
(i) 800	Mean	3.8	9.3	4.7	4.6	10.8	6.0	2.6	5.5	2.9
	SD	0.2	0.4	0.4	0.7	0.2	0.6	0.2	0.5	0.4
(ii) 900	Mean	4.5	13.1	6.2	7.1	14.1	7.3	4.7	7.5	4.9
	SD	0.2	0.8	0.5	0.6	0.8	0.4	0.3	0.5	0.5
(iii) 1,000	Mean	6.4	15.5	8.8	8.9	18.1	10.7	5.7	12.3	6.7
	SD	0.2	0.5	0.5	1.0	1.3	0.5	0.5	0.5	0.4
B. Local yoke										
(i) 800	Mean	4.9	9.5	7.7	5.4	12.0	8.5	3.5	6.0	3.6
	SD	0.3	0.5	0.5	0.7	0.7	0.4	0.3	0.6	0.5
(ii) 900	Mean	5.6	14.9	9.7	8.6	16.5	10.2	5.9	9.0	6.0
	SD	0.3	0.6	0.6	0.4	1.6	0.3	0.8	0.7	0.6
(iii) 1,000	Mean	6.7	17.0	12.0	9.3	20.3	12.1	7.4	13.5	7.6
	SD	0.3	0.7	0.8	0.8	1.0	0.4	0.3	0.3	0.7

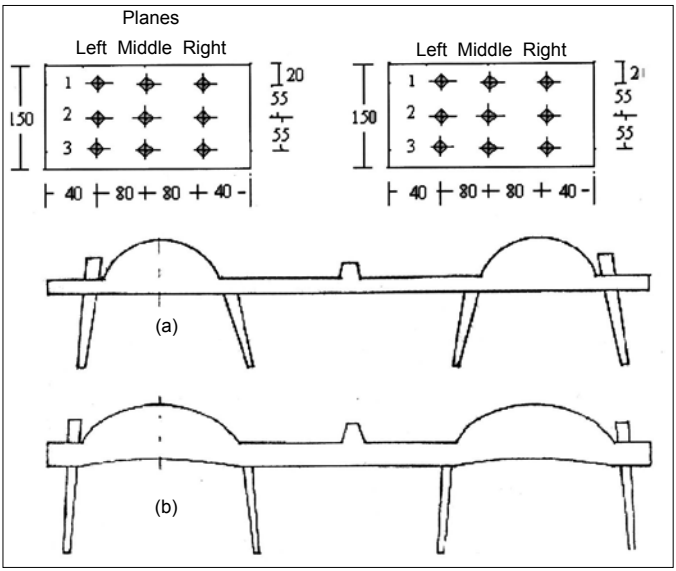


Figure 1.
Position of the load cells on the (a) local and (b) Nagpuri yoke. 1,2,3 are points on left, middle and right plane for mounting the load cells

Note:
all dimensions are in mm

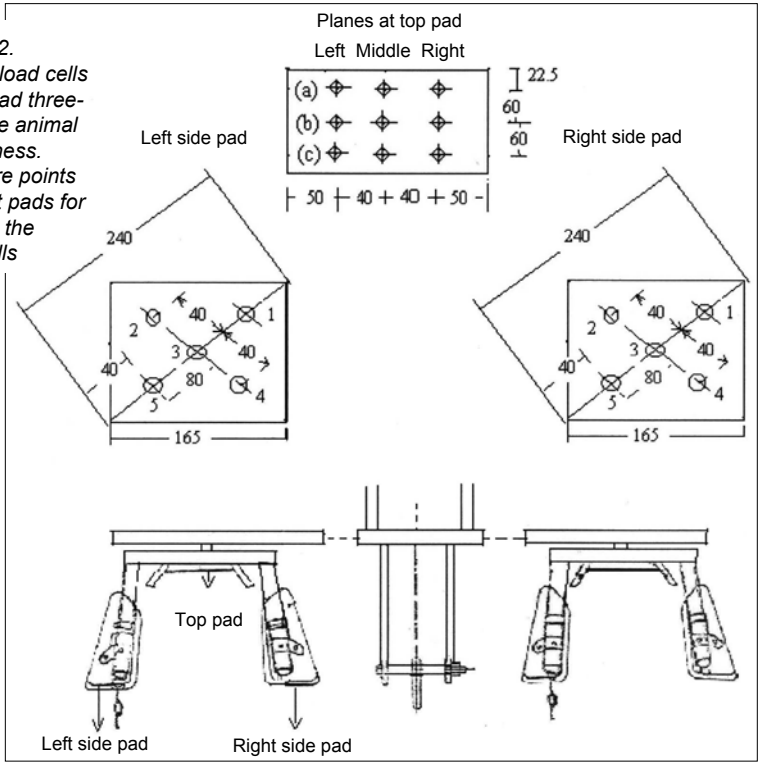


Figure 2.
Position of the load cells on the Allahabad three-padded double animal collar harness. 1, 2, 3, 4, 5 are points at left and right pads for mounting the load cells

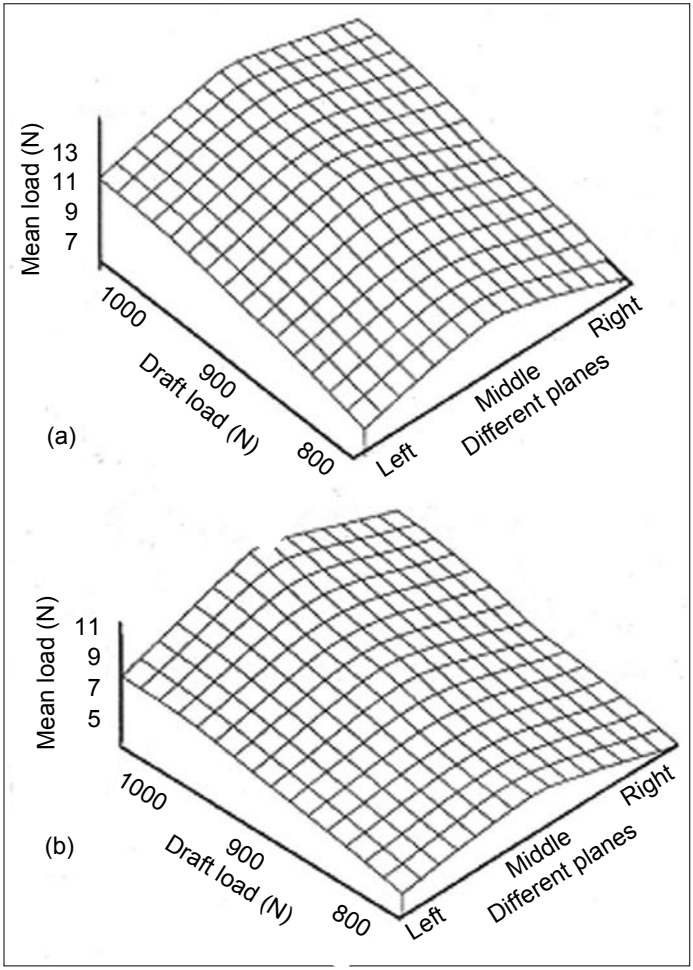


Figure 3. Load distribution at different points on left, middle and right planes of (a) local yoke and (b) Nagpuri yoke at different draught loads

It is inferred from Table 4, that the mean loads were not significantly different within middle to left planes, but these were siginificantly different within middle to right planes for both the yokes, ($p<0.05$). The load per unit area on the necks of the oxen were significantly less for the Nagpuri yoke as compared to the local yoke indicating that the Nagpuri yoke is more efficient and comfortable in comparison to the local yoke (Table 4).

Table 4. Comparison of mean load distribution at different planes of the Nagpuri and local yokes

Planes of Nagpuri/local yoke	Mean load difference (N)	SD	SE	df	t-value
A. Nagpuri yoke					
Middle plane to left plane	1.0	1.6	0.5	8	1.9
Middle plane to right plane	3.8*	1.9	0.6	8	6.2
B. Local					
Middle plane to left plane	1.1	2.0	0.7	8	1.7
Middle plane to right plane	4.2*	2.0	0.7	8	6.1
C. Nagpuri local yoke*					
Left plane to left plane	1.1*	0.7	0.7	8	5.1
Middle plane to middle plane	1.2*	0.7	0.2	8	5.2
Right plane to right plane	0.9*	0.4	0.1	8	6.9

Load distribution on the Allahabad three-padded double animal collar harness

The load distribution on the necks of the oxen at the different points of contact surface of the top pad of the Allahabad three-padded double animal collar harness are shown in Table 5. The mean load values were always higher at the middle plane as compared to left and right planes. Similarly, the mean vertical load values at different points on the left and right side pad were 12.8, 5.4, 4.8, 4.7, 4.8 N, and 15.6, 5.7, 5.7, 5.1, 5.6 N, respectively, at a draught load of 800 N (Figure 4). The mean load values increased as the draught load increased to 1,200 N. The mean load values were very high at point '1' in comparison to others points. This revealed that the left and right side pads need improvement in design for even distribution of the loads on the necks of oxen. The mean load values were significantly different within top to left and right side pads and left to right side pad. Similarly, on the top pad, differences in the mean load values were significant within middle plane to right plane, and left plane to right plane, but not significant within middle plane to left plane at 5% level of significance (Table 6). This suggests that the right plane of the top pad needs design improvement

The average speeds of operation recorded were 2.56, 2.28 and 2.12 km/h at draught loads of 800, 1000 and 1200 N, respectively and the oxen scored 13, 16 and 19 points on the fatigue score (fatigue score limit 20) under three hours of sustained working.

Conclusions

The mean vertical loads on the necks of oxen were higher at the middle planes of the Nagpuri and the local yoke and decreased towards the left and right side of the neck. The mean loads on the necks of oxen on the contact surface of the Nagpuri yoke were significant less in comparison to those on the local yoke. Thus, the Nagpuri yoke is more efficient and comfortable for the animals. The mean vertical loads on the necks of oxen at different contact points on the surface of top, left and right side pads of Allahabad three padded collar double animal harness increased as the draught

load increased and were higher on the contact surface of the top pad. On the left and right side pads the mean loads were significantly higher at one point than the other points. Therefore both the side pads require design improvement for even distribution of load.

Table 5. Load distribution on top pad of the Allahabad three-padded double animal collar harness at different draught loads and at different planes

Draught load		Load (N) distribution with respect to load cell position on the yoke								
		Left plane			Middle plane			Right plane		
N		1	2	3	1	2	3	1	2	3
(i) 800	Mean	13.8	13.6	15.5	17.6	18.7	20.1	13.8	14.9	17.8
	SD	0.4	0.2	0.7	1.0	0.3	0.2	0.9	1.0	0.4
(ii) 1,000	Mean	18.7	17.8	20.1	19.6	20.7	21.1	16.9	18.5	19.7
	SD	0.4	1.0	0.5	0.4	0.8	0.6	0.6	1.3	0.4
(iii) 1,200	Mean	21.0	22.3	23.5	22.2	24.4	27.9	22.0	24.1	24.4
	SD	0.8	1.0	1.1	0.5	0.7	1.8	0.3	0.7	0.7

Table 6. Comparison of mean loads difference within top pad to left and right side pads of the Allahabad three-padded collar double animal harness at draught load of 1,200 N

Pad/plane of Allahabad three-collar harness	Mean load difference (N)	SD	SE	df	t-value
(i) Top pad to left pad	11.8*	5.1	1.3	14	6.4
(ii) Top pad to right pad	11.2*	5.4	1.4	14	4.9
(iii) Left pad to right pad	0.6	0.3	0.1	14	2.8
On top pad					
(i) Middle plane to left plane	2.4	2.1	1.0	8	1.6
(ii) Middle plane to right plane	1.8	1.8	0.8	8	1.3
(iii) Left plane to right plane	0.6	0.1	0.0	8	0.6

References

Devnani, R.S. (1981). Design consideration for harnesses and yokes for draught animals. *Technical Bulletin No. 81/30*, CIAE, Bhopal, India, pp. 26-29.

Ramaiyan, G., Bagvati, P.P., Parthasarathy, N.S. (1979). Some design aspects to improve animal comfort in bullock-cart transport. In: Proc. of the National Seminar on Improved Bullock-cart Transport for Rural Roads in India. Dept. of Applied Mechanics and Hydraulics, Regional Engineering College Raurkela, India, pp. 55-62.

Singh, G., Singh, R.C. (2003). Harnessing animal power. *Technical Bulletin No. 2003/93*, CIAE, Bhopal, India, pp. 76-88.

Shrivastava, N.S.L., Ohja, T.P. (1987). Utilization and economics of draught animal power. *Technical Bulletin No. 87/51*, CIAE, Bhopal India, pp. 157-161.

Upadhyay, R.C. (1990). *Draught Animal and Efficiency Limiting Factor*. Suneel Publication, Mathura, India, pp. 1-22 (chapter 1).

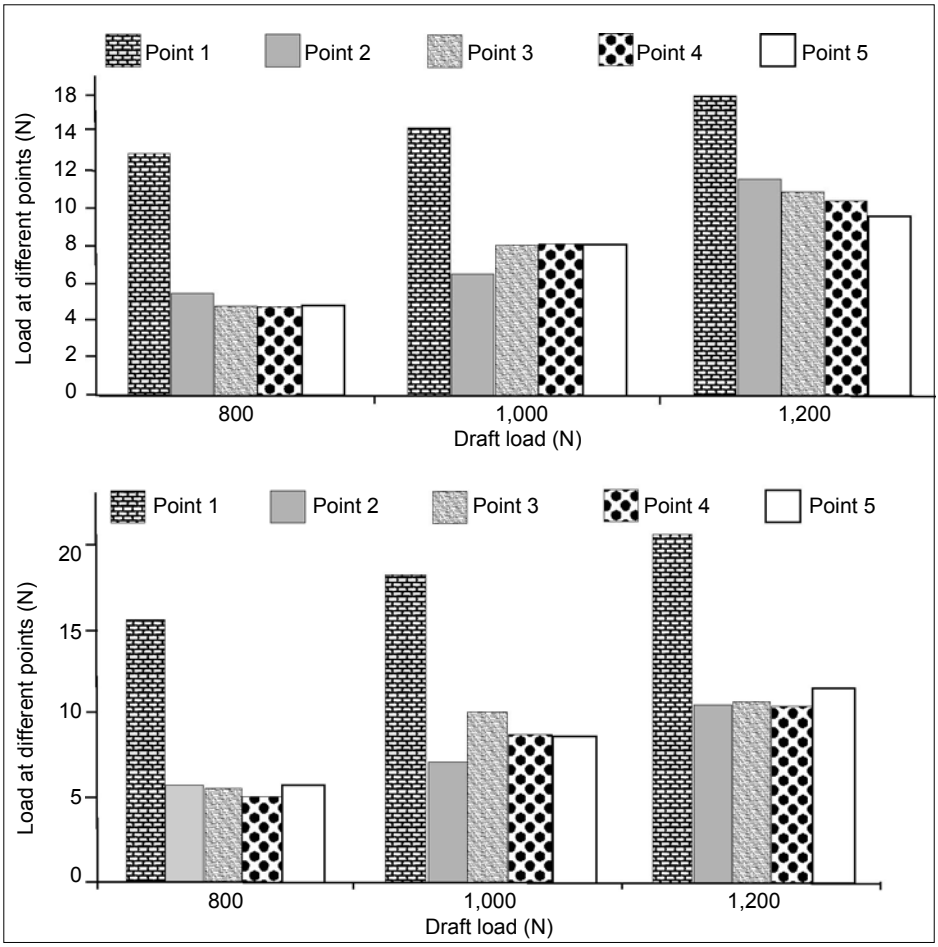


Figure 4. Effect of draught loads on load distribution at different points on (a) left and (b) right side pads of Allahabad three-padded double animal collar harness

Annex 1: The specifications of the electronic neck load measuring system

Miniature button type load cells

Make instron size diameter 11.3 mm, capacity 0–500 N, temperature range 50–120°C, sensitivity 1.8 mV/V, excitation voltage 5 V dc, accuracy ±0.25% FSO (full scale output), non linearity ±0.25% FSO, mode-compression, thermal zero shift ±0.02% °C, 9 nos.

Electronic data recorder

Make instron 8 digits, 9 channels for sensors/load cells (analog signal) data processor, excitation voltage 9–12 V, cable length 3 m for each load cell.

The miniature button type load cells with electronic data recorder were calibrated in the laboratory by applying known loads of 10, 20, 30, 40 and 50 kg in compression. Observations on sensors out put (N) were recorded for applied load at increasing and decreasing order with three replications. The calibration curve gave the sensor output of 9.6 N against each one kg of load applied in compression or tension mode.

(h) India

Utilisation of bullock draught power with traditional technologies in the Mewar region of Rajasthan, India

Rajeev Garg, G.S. Tiwari, M.S. Sevda and Lokesh Gupta
All India Coordinated Research Project on Increased Utilisation of Animal Energy with Enhanced System Efficiency, Department of Farm Machinery and Power Engineering, College of Technology and Engineering, MPUA&T, Udaipur-Rajasthan, India-313001

Abstract
Draught animal power still plays an important role in Indian agriculture. Traditional technologies based on animal power are still in use for different agricultural operations in the rural areas of Mewar region of Rajasthan. The traditional implements and equipment are manufactured at village level by local artisans. Different agricultural operations based on bullock power including land preparation, sowing, irrigation, interculture and post-harvest operation like threshing, oil expelling and sugarcane crushing have been described.

Introduction
Rajasthan is the largest state of India with a geographical area of 34.3 million hectares (10% of the total land area of the country). The Mewar region of the state is spread over Udaipur, Chittorgarh and Rajsamand districts. Agro climatically this region is categorised as sub humid southern plains and Aravali hills. The terrain is irregular with an average annual rainfall range of 500-900 mm. Frequent spells of drought are observed in most parts. The number of draught animals was estimated as 4.98 million in 1972, which has reduced to 3.68 million in 1997 in Mewar region (Anon. 2004a). The draught animal density is 1,772, 1,042 and 649 per 1,000 ha in Udaipur, Rajsamand and Chittorgarh districts, respectively (Anon. 2004b). About 68% of landholdings are less than 2 ha. Underground water is the main source of irrigation commanding about 80 % of the irrigated land (Anon. 2004a). Canal and tanks are the other sources of irrigation. The main crops are maize and wheat, other crops being sorghum, pulses, groundnut, chickpea, rapeseed and mustard. Sugarcane is also grown in some places. Farmers use traditional animal-drawn implements like the wooden plough, blade harrow and bund former for different farm operation and the Persian wheel and 'Charas' for water lifting (Tiwari et al. 2005). Local artisans easily manufacture these traditional implements and equipment using locally available material. This article provides information about the different animal-drawn traditional technologies used by the farmers of the Mewar region.

Methodology

A survey of the Mewar region was conducted to collect information about the use of draught animal power. Field capacity and draught requirement of the implements was evaluated under actual field conditions (Anon, 2004c). Other relevant information was also collected from users. Draught animal power is used for various farm operations – ploughing, sowing, irrigation and interculture. The draught animals are also used for post-harvest operations and transport.

Seedbed preparation, sowing and interculture

Indigenous plough

The indigenous plough is the most important multipurpose implement found in the inventory of nearly all of the farmers. It consists of a wedge shaped wooden body. A MS square bar sharpened at the tip is used as the soil working tool. This is used for tillage, sowing, interculture and harvesting of root crops. Village artisans fabricate it using locally available wood. Generally it is used with as a single working tool with a field capacity of 0.055 to 0.068 ha/day. The draught requirement varies between 65 to 75 kgf. The Pora (funnel) method is generally used for sowing. In the pora method a metallic/bamboo hollow pipe with a funnel at the top is attached to the indigenous plough (Plate 19). In some cases two metallic/bamboo hollow pipes with a funnel at the top are attached with indigenous plough having two soil working tools for sowing in two rows (Plate 20). Generally two people are required to perform the operations of handling the animals and metering the seeds, but some times even one person performs both the operations.

Plate 19. Sowing in single row with Indigenous plough (R. Garg)

Plate 20. Sowing in two rows with indigenous plough (R. Garg)

Plate 21. Bund former (R. Garg)

Bund former

A bund former, fabricated by local artisans, consisting of a wooden plank in the form of a beetle leaf is used for formation of bunds in the field. This beetle leaf shaped wooden plank is used as an attachment with the indigenous plough. A rope is used to fasten the plank diagonally between the beam and body of the plough (Plate 21). Forward movement of the plough helps to throw the soil in one direction and the bund is completed in the return pass by throwing the soil adjacent to the half bund thereby completing the bund in two rounds. Draught requirement of the bund former varies in the range of 45-55 kgf.

Blade harrow

A blade harrow is the most common implement used for moisture conservation and interculture operation. It consists of a wooden body frame in which a 'U' shaped MS blade is inserted (Plate 22). A wooden beam and handle is also attached to the wooden body. The draught requirement of the blade is quite low (20-25kgf) as compared to other implements. The field capacity depends upon the line spacing and varies in the range of 0.4 to 0.8 ha/day.

Plate 22. Blade harrow (R. Garg)

Water lifting

Animal power is an important energy source for lifting water from open wells in the Mewar region. The small land holdings and low economic status of the farmers often necessitates the use of animal power in water lifting. Persian wheel and rope and pulley operated self emptying buckets are the most popular water lifting devices of the region.

Persian wheel

The traditional Persian wheel consists of a long endless chain made from jute or coir and a series of earthen pots mounted on an open spoke drum. In the modified Persian wheel, sheet metal buckets fixed on chain made of Mild steel bars are used (Plate 23). A pair of bullock is hitched to a wooden beam, which transmits power through peg type gears and a long MS shaft to a large open-spoked wheel /drum used as a sprocket for driving a chain. Water is filled in the buckets as they submerge in water and move upward with the rotation of the sprocket. Water is discharged into a trough as the bucket reaches at the top of the sprocket. A ratchet arrangement prevents the reverse movement of the sprocket as it comes into the stationary position. The draught requirement ranges between 25 to 45 kgf for water lifting depth of 10 - 15 meter and discharge of 200 to 250 litres per minute.

Plate 23. Persian wheel (R. Garg)

Rope and bucket lift (self emptying type)

The self emptying type rope and bucket water lift (locally known as ‘charas’) is used in open wells up to a lifting depth of 25 to 35 feet. This system is normally operated by one or two pairs of bullocks (Plate 24). It consists of a sheet metal bucket of 150- 170 litres capacity. A square hole at the bottom of the bucket is provided with a flap to close it. A wooden hinge frame attached to the bucket helps in self emptying. The bucket is filled with water as it dips in the water through the square hole provided at the bottom of the bucket. As the bucket is lifted up the square hole is sealed with a flap provided inside the bucket. A rope is used to lift and tilt the bucket when it reaches at the top of the well and water is discharged in the trough. One cycle of operation is completed in 50-70 seconds depending on the depth of the water lift. About 0.15 to 0.2 ha of land can be irrigated in one day by using two pairs of bullock.

Plate 24. Rope and double bucket (R. Garg)

Plate 25. Threshing by two pair of bullocks (R. Garg)

Post harvest operations

Threshing

Threshing of different crops such as wheat, gram, paddy and black gram is done by trampling of bullocks. Locally this practice is known as 'Daman'. A single / double pair of bullocks is used according to their availability (Plate 25). The bullocks are tied with the help of rope at the neck and the innermost bullock is tied to a wooden post fixed at the centre of the threshing floor (7–8 m diameter). The floor is constructed on a uniformly compacted level ground by mud plaster to prevent dust formation. A muzzle is tied on the mouths of the bullocks to prevent them from eating (or destroying) the crop during the operation. The charge (harvested crop) is spread uniformly on the threshing floor and the bullocks are allowed to walk on a circular path continuously till the grain is detached from the plant. The positions of bullocks are changed at regular interval to provide equal comfort to each animal. About 350–400 kg grain can be threshed by a pair of bullock in 7–8 hrs.

Sugar cane crusher

This consists of three MS gear teeth rollers mounted vertically in a frame. The crusher is firmly fixed in the ground with the help of two wooden logs. A wooden beam (3–3.5 m long) is connected to the shaft of the driving roller. Two people, one for operating the animals and other for feeding the cane to crusher are needed to operate the crusher (Plate 26). The draught requirement varies in the range of 65–75 kgf. The capacity of an animal-drawn sugarcane crusher varies from 700-850 litres of juice per day (8 h) which can produce 80-90 kg of Jaggery.

Plate 26. Sugarcane crusher (R. Garg)

Oil Expeller

An age old practice is still in use for oil expelling in the rural areas of Mewar region. A single bullock-drawn oil expelling unit is installed in most of the houses. This consists of a base unit (a wooden log of 2.5–3 feet diameter and 5 to 6 feet in length), pestle and animal harnessing system (Plate 27). A conical cavity is made in the centre of the base unit in which the pestle rotates in inclined position. Crushing of seeds is done by rotation of the pestle and it helps in expelling of oil. Oil seeds are fed in batches of 5-6 kg into the cavity of the base unit, and oil is collected manually at regular intervals from the cavity. One batch of oil seeds requires 2- 2.5 hours for complete oil expelling with an oil recovery of about 35–40 %.

Plate 27. Oil Expeller (R. Garg)

Transport

Bullock cart

Traditional bullock carts used in the area are made of locally available wood. The carts consist of a wooden platform with two wooden-spoked wheels mounted on an axle (Plate 28). A ring made of MS flat is fixed on the periphery of the wooden-spoked wheels. The weight of the cart varies from 200-250 kg and it can carry 800–1,000 kg of load. It is generally used for transport of farm produce, fodder and passengers.

Plate 28. Bullock cart (R. Garg)

Conclusions

Draught animals are still dependable, reliable and the most common source of power used by the majority of the farmers in the Mewar region of Rajasthan, India. A continuous spell of drought for so many years has resulted in a reduction in their numbers. The draught animals have practically much less work in rain fed farming as compared to irrigated farming. The draught animals are underutilised as the efficiency of the traditional implements and systems is very low. This demands an improvement in the efficiency through introducing low cost efficient animal-drawn improved implements. Further more the idle time of the draught animals can be used in rotary operation mode to operate the gadgets likesthe chaff cutter, flour mill, winnower, maize sheller and seed cleaner cum grader.

References

Anonymous (2004a). Status report 'Sub-humid southern plane and Aravalli hill (Zone IVa)' Agricultural Research Station, Directorate of Research, MPUA&T, Udaipur.

Anonymous (2004b). *Small Farm Mechanisation*, Proceedings of national seminar on small farm mechanisation, Department of Farm Machinery & Power Engineering, College of Technology & Engineering, MPUA &T, Udaipur.

Anonymous (2004c). Annual Report, AICRP on Increased Utilisation of Animal Energy with Enhanced System Efficiency, Department of Farm Machinery & Power Engineering, College of Technology & Engineering, MPUA &T, Udaipur.

Tiwari G.S., Verma, R.N., Garg, R. (2005). Identification of technological gap in farm mechanisation in tribal area of Udaipur district. A project report submitted to Department of Science and Technology, Govt. of Rajasthan, India.

SHORT NOTES AND NEWS

Community of Practice for Pro-Poor Livestock Development (CoP-PPLD) website launch

The organisers say: 'The CoP-PPLD Secretariat in close collaboration with the CoP-PPLD Steering Committee is glad to announce that our Portal/Sharing Network is finally online. Please visit it at www.cop-ppld.net and officially register as a CoP-PPLD member.

Please check the website and content. The organisers would also greatly appreciate receiving your inputs, comments, photos, news, documents and useful links. Many components have been designed so everyone can participate. These tools include:

- *Ask & Answer* – an interactive interface where CoP-PPLD members can ask questions and get answers from members around the world;
- *Forum* – an open discussion area on the chosen pilot theme of the CoP-PPLD;
- *Knowledge Base* – a library database for downloading and uploading livestock-related documents;
- *On-line Roster* – a database where livestock experts can post and share their CV;
- *Wiki* – an area for collaborating writing;
- *Useful Links* – we adopted the innovative philosophy of the social bookmaking website 'Delicious' hence CoP-PPLD members can share their favourite bookmarks; and
- *Members* – a searchable list of CoP-PPLD members is fully available, also showing who is currently online.'

Well worth a visit and registering for updates. (Ed)

The International Buffalo Information Centre has news:

'The Buffalo Bulletin is always available at http://ibic.lib.ku.ac.th/e-ulletin/index.htm. For news of the conference of the 6th Asian Buffalo Congress. Please go to the website athttp://abc2009.org.

The Proceedings of the XXXVII Dairy Industry Conference – Dairying for Livestock and Growth which was held at Kala Academy Panjim, Goa on 7-9 February 2009 can also be found through the website www.idawz.org.'

• *Contact: Mr.Chalermdej Taterian, Information Specialist, International Buffalo Information Centre, Main Library, Kasetsart University, Thailand.*

HIS - India
Help In Suffering

HIS-INDIA

For helping suffering animals and all living things

Help in Suffering (HIS) in India has a new lightweight saddle for elephants. They report: 'We thought you would be interested to know that, as a result of much research, a new light-weight saddle is being trialled for the 116 captive working elephants in Jaipur. These elephants have had to carry a heavy, traditional, uncomfortable saddle with two people seated in it - originally it was four people, but due to the work of the HIS/elephant family project, this has now been reduced to two people. Additionally, the elephants are no longer allowed to carry the tourists downhill - it is now necessary for them to dismount at the top and walk back. The number of rides an elephant is allowed to take every day has been limited, together with many other improvements such as provision of shade facilities, etc. For more from HIS go to http://www.his-india.org.au/elephant.html.

Perhaps the greatest advantage of the new saddle is that it is much more comfort-able for the elephant. It weighs 20 kg. less than the present saddle weight which is more than 100kg. The girth will have a wool pad covered in vinyl that will protect the sensitive chest area from friction and resultant sores. The saddle will also have a foam padding for the comfort of the elephant. Each saddle will be specially fitted to suit the size of the elephant. The Jaipur elephants suffer so much. We really need your help so that we can lessen the burden they have to bear.'

Buffaloes on patrol in the Amazon

This was spotted by Pit Schlechter. Run by Roberto Lugones on Arte.TV Saturday 7 July 2009 – he says: 'Les habitants de Marajo, île brésilienne située dans l'embouchure du fleuve Amazone, utilisent un moyen peu ordinaire pour traverser les marais de la mangrove: ils montent des buffles d'Asie, imposants et (la plupart du temps) paisibles ruminants de plus d'une demi-tonne, coiffés de cornes joliment courbes.

Plate 29. Buffalo on patrol in the Amazon (R. Lugones, Arte-TV).

Selon la légende, un navire aurait fait naufrage en 1920 non loin de la côte. Quelques-uns des bovins qui en constituaient le chargement réussirent à gagner

la terre ferme et proliférèrent à tel point qu'aujourd'hui, ils sont près de 500 000 sur l'île. Animaux domestiques, de trait, de bât, ils rendent de nombreux services - même à la police locale. C'est ici qu'on peut voir la seule brigade montée à dos de buffle du monde ! 360° - GÉO a suivi Roberto Absolao, le capitaine de cette escouade insolite, dans ses interventions.' .

• *For more information on this article please see http://www.arte.tv/fr/Comprendre-le-monde/360_C2_B0--GEO/2718910.html*

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

helping to build a world without hunger

Animal welfare web portal launched – *one-stop shop for policy-makers, farmers, scientists and animal welfare organizations*

A new internet portal was launched on 22 May 2009 by FAO that will serve as a one-stop-shop for individuals and organizations searching for the latest information about the welfare of livestock.

The Gateway to Farm Animal Welfare is designed to provide a reliable information conduit on legislation and research findings in the sector, as well as on animal welfare standards, practices and policies. Expected users are farmers and government officials, lawmakers, researchers, the livestock and food industry and non-governmental organizations.

FAO says 'it is an important forum for animal welfare issues related to activities such as transport, slaughter and pre-slaughter management, animal husbandry and handling and the culling of animals for disease control.

Compliance with animal welfare standards can open access to international markets for products from less economically developed countries. The portal will also offer on-line conferences and seminars.

Key partner collaboration: FAO has developed the portal in collaboration with key international partners in animal welfare including: the European Commission, the International Fund for Agricultural Development, the World Organisation for Animal Health, Compassion In World Farming, the Latin American Poultry Association, Humane Society International, the International Fund for Animal Welfare, the Royal Society for the Prevention of Cruelty to Animals, the Brooke, the World Society for the Protection of Animals, the International Dairy Federation, the International Federation of Agriculture Producers and the World Veterinary Association.

• *Online news from FAO:* http://www.fao.org/newsroom/

Tools, Implements and Tillage practices in Africa

JUA KALI INFORMATION

Barney Muckle writes from Kenya with news of a website he has been involved in setting up: www.juakali.info. It contains much useful information on may difference aspects of cropping, tools and tillage techniques,

animal power, water harvesting and soil conservation. Please contact Barney if you need more information. Muckletb@africaonline.ke

New LEAD web site

On 2 July 2009 the FAO launched a new LEAD (Livestock, Environment and Development Web site. The new site covers:

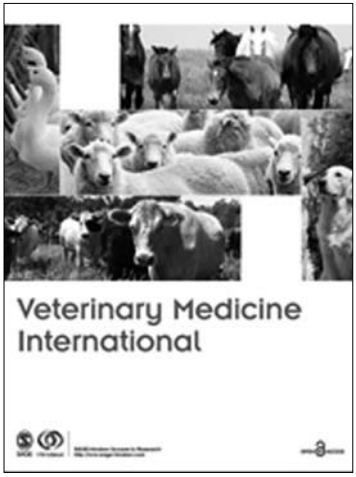
- Background to the LEAD initiative and its regional networks
- Summaries of LEADs decision support tools including the 'Livestock and Environment Toolbox'.
- Information on the role of livestock in climate change, deforestation, dryland management and water and soil pollution
- A resources section where there are publications and archives of the LEAD's newsletters and e-conferences as well as photographs related to LEAD's work.

The New LEAD Web site is available at http://www.fao.org/lead.

British Veterinary Association (BVA) Overseas newsletter

The Overseas newsletter is produced by the BVA Overseas Group at frequent intervals and contains a round-up of overseas news and activities. The newsletter is also posted on the BVA website at: http://www.bva.co.uk/overseas/Overseas_newsletter.aspx

NEW BOOKS AND JOURNALS



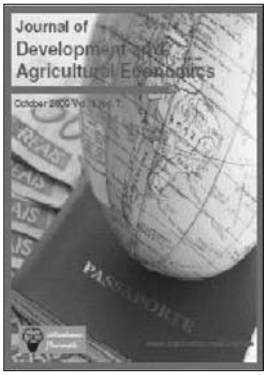
Mahmoud Salah writes about a new journal:

'The *International Journal of Veterinary Medicine*, provides a rapid forum for the dissemination of original research articles as well as review articles in all areas of veterinary medicine.

International Journal of Veterinary Medicine is published within the SAGE-Hindawi open access journal collection. An important aspect of the SAGE-Hindawi partnership is the open access publication model, which is used by all of the journals in the collection. Open access publishing offers a new model for disseminating scholarly articles by removing the access barriers imposed by the subscription model, in order to make the full-text of all published articles freely available for any interested reader. The journal does not require any page charges, colour charges, or article processing charges.

The journal has a distinguished editorial board with extensive academic qualifications, ensuring that the journal maintains high scientific standards and has a broad international coverage. A current list of the journal's editors can be found at http://www.sage-hindawi.com/journals/ijvm/editors.html.

Manuscripts should be submitted to the journal online at http://www.sage-hindawi.com/journals/ijvm/. Once a manuscript has been accepted for publication, it will undergo language copyediting, typesetting, and reference validation in order to provide the highest publication quality possible.'



Journal of Development and Agricultural Economics (JDAE)

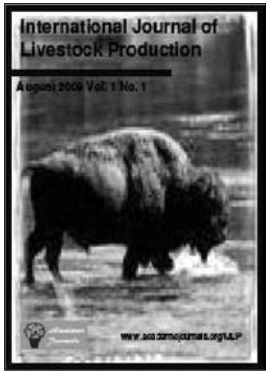
First issue April 2009

www.academicjournals.org/JDAE

International Journal of Livestock Production

First issue August 2009

www.academicjournals.org/IJLP



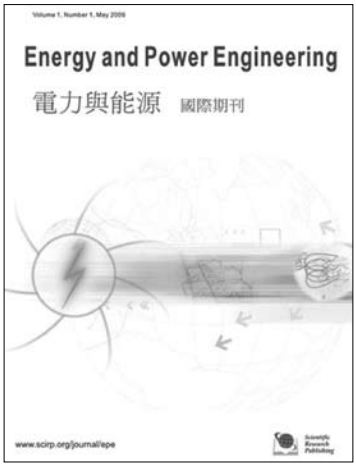
These Journals are multidisciplinary peer-reviewed journals to be published monthly by Academic Journals. JDAE and IJLP are dedicated to increasing the depth of the subject across disciplines with the ultimate aim of expanding knowledge of the subject.

JDAE and IJLP will cover all areas of the subjects. The journals welcome the submission of manuscripts that meet the general criteria of significance and scientific excellence, and will publish: Original articles in basic and applied research, case studies, critical reviews, surveys, opinions, commentaries and essays.

The journals invite submission of manuscript(s) to JDAE@acadjourn.org or to IJLP@acadjourn.org for publication The objective is to inform authors of the decision on their manuscript(s) within four weeks of submission. Following acceptance, a paper will normally be published in the next issue. Instruction for authors and other details are available on their website for JDAE; http://www.academicjournals.org/JDAE/Instruction.htm or for IJLP http://www.academicjournals.org/IJLP/Instruction.htm.

JDAE and IJLP are Open Access Journals - Open access gives a worldwide audience larger than that of any subscription-based journal and thus increases the visibility and impact of published works. It also enhances indexing, retrieval power and eliminates the need for permissions to reproduce and distribute content. JDAE is fully committed to the Open Access Initiative and will provide free access to all articles as soon as they are published.

For more information on JDAE please contact: Franklyn Monyei, Editorial Assistant, Journal of Development and Agricultural Economics (JDAE), E-mail: JDAE@acadjourn.org for information on IJLP please contact Michael Oruah, Editorial Assistant, International Journal of Livestock Production. IJLP@acadjourn.org.



Energy and Power Engineering (EPE)

(ISSN Print: 1949-243X).

Topics covered include Renewable Energy and Sustainable Energy Systems

EPE publishes research and review articles in all important and relatively immense aspects of energy and power engineering. Both experimental and theoretical papers are acceptable provided they report important findings, novel insights, or useful techniques in these areas. Accepted papers will immediately appear online followed by printed hard copy, which will be sent to over 200 scientific libraries around the world.

For more details about this journal, please visit http://www.scirp.org/journal/epe.

LETTERS TO THE EDITOR

Request for information on urban working horses – Colombia: Lina Maria Garcia Ospina an Industrial designer writes from Manizalesin:

'A Greeting – I have been investigating about the traction horses in the cities of the world. As a case of study, I am developing it in a Colombian city with the social conditions of working people, mobility and the design of multiple devices they used in their day to day labour.

Currently, I am a candidate to Environment doctorate of the University Complutense in Madrid Spain which is given by the Geography and History Faculty and the Institute IUCA. I'm writing my doctoral thesis after six years to come working the subject. I am writing to you to obtain information concerning the traction equine horses who are involve in this world: materials or people transportation inside the cities. It would be is a great contribution for my investigation if you can offer me information about real cases and/or statistics of this topic. I appreciate so much any help that provide me.

Thanks attentively from Lina Maria Garcia Ospina, Colombian citizen, Manizales. Industrial Designer. Aspiring to Doctor.'

Contact : emails: limgarci@ghis.vcm.es , or disenoyasesoria@etb.net.co.

- **Donkey welfare – Nigeria**: From Nigeria, D.J.U.Kalla is looking for books or training materials on donkeys for his work on donkey husbandry, management and welfare.

Contact: D.J.U.Kalla, Animal Production Programme, Abubakar Tafawa Balewa University, P.M.B0248 Bauchi, Bauchi State, Nigeria, Postcode 740001.
Phone: +2348028785578 • Email: demokalla71@yahoo.com.

- **Forage/Chaff cutters Zambia**: Isaac Salala from Zambia writes:

'Is there anybody with information on either hand held or ox-drawn forage cutters? I have a colleague of mine running a smallholder dairy project in Malawi involving smallholder farmers and was enquiring from me if ever I had information on such equipment.

If you have such information, you could provide me with information including name of supplier, type of equipment, addresses including e-mail. I will then pass on the contact information to my colleague in Malawi. Your help will be greatly appreciated.

Contact: Isaac Sakala, Agriculture Food & Environment Manager,
Africare Zambia, Box 33921, Lusaka, Zambia
Tel +260211 260939, +260211 264406 • Cell+260977 401454 • Fax +2601 264453
E-mail isakala@africare.org.zm. '

[Eds note: Isaac is not to clear whether he is looking for a mower to cut a standing crop or something to chop harvested forage in short pieces for ease of storage and feeding - on further questioning it seems like he is looking for a forage chopper for maize and sorghum stalks not a mower].

- **Request for support donkeys for development – new edition**: Peta Jones from South Africa writes:

'*Donkeys for Development* was first published about 12 years ago, with a print run of 1,000 copies and to good reviews (see DAN 28 for a review and the Author for other reviews). Although the South African Agricultural Research Council supported the production of the book, and was willing to print it, I found that this would entail copies of the book then sitting on their shelves without any marketing being done, so in the end I had it printed at my own expense and did the marketing myself.

The demand was slow at first, but has been growing in the last few years, as the demand for donkeys is clearly growing due to droughts and rising fuel prices. Both the American Donkey and Mule Society and the UK Donkey Sanctuary order batches of the book from time to time, not for themselves but for the folk they deal with in developing countries. In 2004 the UK Department for International Development Livestock Production Programme requested a version of the book to put on CD, so I duly updated my text and provided it for this purpose. Since then, a lot more updating has been done, and changes made, and I have been providing copies on CD as often as I could, as the print copies are running short.

While there are many people who can handle text on CD - and I find it rather useful as it allows me to update as I go along - the majority of users are rural agricultural extension officers who reiterate that they want print copies. Having been a bit inattentive, I find I am now down to 5 print copies.

So I am urgently looking for a publisher who can print a new edition cheaply, as I do not have the funds to do it myself. All editing and page lay-outs have been done (by me, as with the first edition). I have squeezed where I could to get it down to 206 pages - longer than the first edition - in A5 format, which is a size that I feel is most easily handled by users.

I would be quite happy to have someone else do the marketing of this book, merely allowing me to have a number to take to workshops for sale or distribution from time to time.'

Contact: Peta A. Jones, *Author of Donkeys for Development*, Donkey Power CC, Facilitation and Consultancy Services, PO Box 414, Tshitandani/Makhado 0920, South Africa +27 cell [0]83 686 7539 • tel [0]15 517 7011 • fax [0]15 517 7034 • Email: astute@lantic.net.

Request for topics or stories for TV programme in South Africa: This letter written by *Agriculture Today* was passed on by Dee Terblanche, Animal Issues Matter, email: capein@vodamail.co.za :

'We at *Agriculture Today* (Every weekday, 5h20am, SABC 2) would like to invite you to submit stories of interest for our program. Agriculture Today is a TV programme about agriculture in South Africa for farmers, Agri-businesses and other agricultural involved industries in South Africa.

Areas of focus include:

- Land affairs
- Agri BEE projects,
- Imports and exports
- Agri Businesses and finance
- Interesting developments in research/ farming practices
- Relevant current affairs
- Launches, meetings, farmer days and award ceremonies.

Please be so kind as to forward any information in the following broad guidelines:

1. A short description or press release of the event/activity you would like to invite us to for broadcast
2. Your contact details (phone and email if possible)
3. Possible people we can interview on the topic
4. Date, time and place of event.

Please note that Media World (the production house of *Agriculture Today*), reserves the right to choose stories for broadcast. Due to the natural limitations of production such as the availability of cameramen, distances to travel and time on the show, the sooner you let us know, the better we can plan and accommodate you. A good time for advance notice is between 3-4 weeks.

If interested, please send your information (as detailed above) to info@agritoday.co.za (Subj: Insert: the name of your insert). If in doubt, please phone and we will assist you with the process. Thank you for your cooperation and effort with this project.

Contact: *Agriculture Today*
Tel: (011) 791 5330 • Fax: (011) 791 5319 • info@agritoday.co.za

Bullock cart transport in India: Rohit Pawar writes:
'We are a agro based co. from India. We have a sugar factory due to which we are connected to 12,000 farmers directly. In Indian sugar industry we transport harvested cane through tractors/trucks and also through bullock carts thus create a living for the small farmers from dry areas who do harvesting and transportation business for their living. We would be glad to know more about research on bullock carts. Hoping for a positive reply.'

Contact: Rohit Pawar • Email: :rrp@baramatiagro.com

FORTHCOMING EVENTS

Excella Orbit, a division of Sambodhi Research & Communications Pvt. Ltd,

is pleased to announce the following bouquet of trainings during the first quarter of 2010.

Jan 5 - 7	Process Documentation of Development Interventions, New Delhi
Jan 19 - 22	Participatory Monitoring & Evaluation in Development Projects, New Delhi
Feb 8 - 13	Certificate in Data Analysis Using SPSS, New Delhi
Mar 2 - 4	Monitoring & Evaluation of Developmental Projects, New Delhi
Mar 5 - 6	Proposal Development & Report Writing for Development Projects, New Delhi

Please see the brochures for the programme details of the above mentioned trainings by visiting the link http://www.excellaorbit.com/UpcomingProgDisplay.do. If you are interested in the training please send a request mail for a registration form.

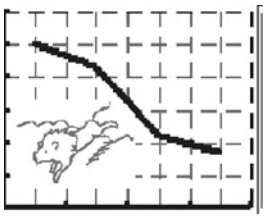
Sambodhi's earlier programmes have been subscribed by leading agencies and projects across the globe. Sambodhi clientele include bilateral and multi-lateral aid agencies, governments, projects, academic institutions and independent consultants including UNDP, UNICEF, UNIFEM, UNESCO, CRS, GTZ, Worldvision, Actionaid, CARE, BBC WST, CRY, IGSSS, FHI, PSI, SNV Bhutan, RMoL, Winrock, Norweigan Church Aid (NCA), Afghanistan , Royal Education Council Bhutan,Ministry of Education. Govt. of Botswana, Ministry of Plan Implementation Srilanka, State Govt. of Madhya Pradesh, Orrisa, Chattisgarh, Jharkhand, Uttarakhand, Maharastra, Karnataka, Andhra Pradesh, IAMR, IWMI, NCAER, IDRC, ICMR.

For further information please contact:.
Anish Kumar Sahay, Excella Orbit, Sambodhi Research &
Communications Pvt. Ltd, O2, 2nd Floor, Lajpat Nagar - II, New Delhi - 110024
+91 11 40560734, 65492502 • www.sambodhi.co.in • www.excellaorbit.com

Recent Advances in Animal Welfare Science

UFAW Animal Welfare Conference

30th June 2010
York Merchant Adverturers' Hall, UK



As part of its on-going commitment to improving the way we understand and care for animals, the Universities Federation for Animal Welfare is holding the second of a series of one day conferences on 'Recent advances in animal welfare science' on 30th June 2010.

This meeting, which they intend will become a regular event, aims to provide a forum at which the broad community of scientists, veterinarians and others concerned with animal welfare can come together to share knowledge and practice, discuss advances and exchange views.

Call for papers:
They would like to hear from anyone interest in making a contribution to the conference on the open subject of recent advances in applied ethology, veterinary and physiological science and the other disciplines that inform our understanding of animals and their welfare.

They hope that this meeting will feature talks from both established animal welfare scientists and others and from those beginning their careers. Early submission of a provisional title and abstract would be appreciated. Submissions should feature the title of the proposed presentation, the name and full contact details of all contributors and an abstract, which must be in English, should be no longer than 400 words.

Registration:
As part of UFAW's commitment to providing a forum for the exchange of ideas and to ensure that the meeting is accessible to widest range of those with an interest in animal welfare, the registration fee to attend this conference is kept low, this time at just £20. Note: This price includes refreshments but delegates will need to make their own arrangements for lunch.

For further information see: www.ufaw.org.uk/animal-welfare-conference.php

The 6th International Colloquium on Working Equids

29th November - 2nd December 2010 (optional field visit - 3rd December)
India Habitat Centre, New Delhi, India

The 2010 Colloquium on Working Equids will take place in New Delhi India from 29th November to 2nd December 2010.

The theme of the Colloquium will be 'learning from others' to explore approaches to benefit working animals and animal owners in the developing world.

This colloquium will appeal to an international audience of veterinary and animal scientists, agricultural researchers and practitioners, community development workers, policymakers, educators and trainers, project managers, technical advisers and equine welfare NGOs.

Conference sessions will include papers under the following themes:-

- Facilitating human behaviour change
- Effective project planning, monitoring and evaluation
- Livelihoods, rural transport and the global context
- Balancing the needs of humans and animals - the ethics of animal use
- Education to engage the next generation
- Decision-making in health and disease
- Animal health and husbandry systems
- Lessons from working oxen, buffalo and camels

The 2010 colloquium will be hosted by the Brooke (www.Thebrooke.org). The colloquium committee are inviting submission of short papers under the identified themes.

For further information please see the official colloquium website:
www.icwe2010.com.
Or contact for general requests: creative@travel2india.com
Phone: 24679192, 26872257-58-59, 26114281 • Fax: ++91-11-26885886 / 26889764, USA Fax: +1-646-349-1614 • EUROPE Fax : ++44-20-7681-1242

Postal Address: Plan it ! by Creative Travel
Creative Plaza, Nanakpura, Moti Bagh, New Delhi 110021. INDIA

This release from: Dr Yalini Chandramohan, Research Coordinator at
The Brooke: 30 Farringdon Street, London, EC4A 4HH, UK.
Tel: +(44) (0)203 012 3456 • Fax: +(44) (0)203 012 0156.

MEETING REPORTS

International Draught Horse Meeting ‘PferdeStark 2009’ in Germany

Biennial European draught horse meeting becomes more and more successful

Peter Herold, Urbach, Germany

Since 1997, teamsters and draught horse enthusiasts from all over Europe meet every second year at open air museum in Detmold, North-Rhine-Westphalia, Germany. Meanwhile, this event has become the most important in Europe concerning modern horse work.

Nearly 20,000 spectators found there way to PferdeStark on August, 29th and 30th, 2009, more than ever before. A clear sign that draught horses in Europe have become a ‘real topic’. 220 draught horses of more than 20 breeds from all over Europe competed in various contests like ploughing, logging, driving and pulling and realized a varied show programme.

Plate 29. Action at the PferdeStark2009 (Stockpaard - Arjan Wijnstra).

Demonstration of modern horse work

The outstanding character of PferdeStark is the demonstration of modern horse-drawn equipment in agriculture, viticulture and forestry. Nearly non-stop around the two days of the event people could see a vast variety of modern machines from Europe and the US. A lot of newly developed equipment was shown for the first time. Experienced presenters explained the machinery to the spectators and gave information about the numerous advantages of draught horses in agriculture, forestry and beyond.

For the first time, the German Draught Horse Association (IGZ, www.ig-zugpferde.de) provided a special offer for children and teenagers: they were given the opportunity to make their 'first steps on the reins'. IGZ wants to enhance the efforts to gain the interest of young people for draught horses as a sustainable alternative in various work fields. Therefore some of IGZ's young teamsters brought their horses and taught their contemporaries how to drive a horse.

Several new machines were given an 'IGZ-innovation-award'. The first prize went to Albano Moscardo, Italy, for his 'Multi', a tool-carrier that can be equipped either with a plough or a spring-tooth harrow.

Plate 30. The Italian innovation-award winning 'Multi'. (Stockpaard - Arjan Wijnstra).

A new publication was presented: 'Draught horses in nature conservation work'

One of the highlights of this year's PferdeStark was the presentation of 'Draught horses in nature conservation work' to the public. In 2008/2009, the German Draught Horse Association (IGZ) had conducted a survey about draught horse use in nature conservation work on behalf of the Federal Agency for Nature Conservation (BfN,

www.bfn.de). The president of BfN, Prof. Dr. Beate Jessel, presented the results of this survey at Detmold.

On nearly 130 pages, the authors show the different possibilities to use draught horses in combination with modern horse-drawn equipment for nature conservation purposes and beyond. Numerous presented examples of already existing projects in Germany give inspiration for the praxis of nature conservation. The aim of the publication is to enhance and spread the knowledge about the advantages and possibilities of modern draught horse work for nature conservation and beyond. Thereby a broader use of this innovative working method, which is concurring to a high degree with the aims of nature conservation, shall be promoted. The contacts of the introduced projects as well as an extensive list of contacts of amongst others the manufacturers of modern horse-drawn equipment provide inevitable support to initialize further projects.

A wide spreading of the publication is desirable to help realize more and more modern draught horse use. Copies of the publication can be ordered free of costs at BfN or IGZ. Additionally, a free download is possible on the internet site of BfN: http://www.bfn.de/fileadmin/MDB/documents/service/Skript256.pdf

IGZ is looking for financial support to translate and publish the study in English and French as well. Any idea from DAN-readers to realize this is welcome. If you can help, please contact IGZ on the address given below.

A variety of pictures and videos as well as all the information about PferdeStark is available on www.pferdestark.de. The next event will take place at Detmold on August, 27th and 28th 2011. Hope to see you then!

Plate 31. More action at the PferdeStark2009 (Jean Leo Dugast).

Contact: Interessengemeinschaft Zugpferde e.V. (IGZ), Uferstr. 29, D - 73660 Urbach, Germany
phone: +49-7181-8878953 • Email: info@ig-zugpferde.de

EU Equus 2009 ‘The Future Horse Industry in Rural Areas and Society’

The conference was organized during the Swedish Presidency of the EU - as a post-event to the conference ‘Rural Areas Shaping the Future 2009’. It was held on 29th and 30th October 2009 at The Swedish University of Agricultural Sciences in Uppsala, Sweden.

The organizing committee says:

‘*Network for the EU equestrian sector – objectives for Equus 2009*
The equestrian sector in Europe needs to re-group. The sector has great potential to contribute to increased growth and employment in the countryside, but is still not always regarded as an integral part of societal development. A European network that includes sport, breeding and horse-related businesses is therefore planned for the future.’

The aim of this year’s meeting was to lay the foundations for ‘EU Equus - the European Horse Network’. The task of this network will be to promote the sustainable growth and development of the European equestrian sector, a development that can be beneficial to the industry itself and to society.

At Equus 2009 this issue plus many other matters relevant for the European equine industry were discussed. Delegates from 18 countries enrolled for the conference. During the two days of the conference, there were status reports on subjects including the equestrian sector in Europe at present, the economic importance of the sector and the opportunities and challenges facing horse-related businesses.

A number of issues concerning education, research and innovations were also covered. In addition, relevant matters of strategic significance on the EU agenda were discussed.

‘The equestrian sector in Europe would be helped by us working together in order to influence European regulations. For example, we have a shared interest in how the countryside programme with guidelines for EU support is formulated’, says Camilla Linder at the Federation of Swedish Farmers (LRF), chairperson of the organising committee for Equus.

EU Equus 2009 was organised by the Federation of Swedish Farmers, the Swedish Board of Agriculture, the Swedish University of Agricultural Sciences and the Swedish Equine Foundation. Equus was held for the first time during the Swedish presidency of the EU in 2001 and then by Austria in 2005.

More information concerning the Conference is available on the website http://www.equus2009.eu.

RECENT PUBLICATIONS

Acharya, R.M. (2009). Buffalo-India's black gold – need for better appreciation, prioritization of future research and development programmes. *Indian Dairyman* **61**: 5, 25-30.

Ahmed, M.I., Tijjani, A.N., Mustapha, A.R. (2008). Survey for common diseases and management practices of donkeys (*Equus asinus*) in Borno, State Nigeria. *Nigerian Veterinary Journal* **29**: 3, 1-5

Akila, N., Chander, M. (2009). Farmers' attitude towards utilization of draught bullocks in Indian agriculture. *Livestock Research for Rural Development* **21**: 5, 76.

Alemayehu Lemma, Meron Moges (2009). Clinical, hematological and serum biochemical reference values of working donkeys (*Equus asinus*) owned by transport operators in Addis Ababa, Ethiopia. *Livestock Research for Rural Development* **21**: 8, 127.

Alves, F.R., Bombonato, P.P., Mariana, A.N.B., Guerra, P.C., Machado, P.P., Cruz-Pinto, C.E., Machado Junior, A.A. (2008). Tendon and ligament anatomy of the distal forelimb region in donkeys (*Equus asinus*) used to traction role and relations with the domestic equine anatomy. *Brazilian Journal of Veterinary Research and Animal Science* **45**: 2, 101-108.

Ayo, J.O., Dzenda, T., Zakari, F.O. (2008). Individual and diurnal variations in rectal temperature, respiration, and heart rate of pack donkeys during the early rainy season. *Journal of Equine Veterinary Science* **28**: 5, 281-288.

Baum, A.W., Patzek, T., Bender, M., Renich, S., Jackson, W. (2009). The visible, sustainable farm: a comprehensive energy analysis of a midwestern farm. *Critical Reviews in Plant Sciences* **28**: 4, 218-239.

Behera, B.K., Behera, D., Mohapatra, A.K., Swain, S. (2009). Assessment of draughtability of bullocks of Orissa in test track and field condition. *Indian Journal of Animal Sciences* **79**: 1, 63-67.

Benard, C., Faye, B., Moulin, C.H., Kolher-Rollefson, I. (2008). A typology of the camel keepers in the Jaisalmer district, Rajasthan, India. *Journal of Camel Practice and Research* **15**: 2, 231-238.

Berg, M.M. van den, Hengsdijk, H., Wolf, J., Ittersum, M.K. van, Wang GuangHuo, Roetter, R.P. (2007). The impact of increasing farm size and mechanization on rural income and rice production in Zhejiang province, China. *Agricultural Systems* **94**: 3, 841-850.

Birhanu Hadush, Gobena Ameni, Girmay Medhin (2008). Equine histoplasmosis: treatment trial in cart horses in central Ethiopia. *Tropical Animal Health and Production* **40**: 6, 407-411.

Burn, C.C., Pritchard, J.C., Farajat, M., Twaissi, A.A.M., Whay, H.R. (2008). Risk factors for strap-related lesions in working donkeys at the World Heritage Site of Petra in Jordan. **Veterinary Journal 178**: 2, 263-271.

Cacic, M. (2009). The authentic horsebreed Croatian Coldblood. *Stocarstvo* **63**: 2, 135-149.

Camps-Ramirez, A.M., Claro-Gonzalez, J.N., Cuesta-Guillen, A. (2006). Topical application of Oleozon as an alternative treatment in lesions caused by friction in draught horses, considering some haematologic indicators. *REDVET* **7**: 12, 120610.

Castillo, J.C., Cepero, O., Silveira, E.A., Casanova, R., Quinones, R., Monteagudo, E., Gutierrez, I. (2006). Traction horses of Santa Clara City, Cuba. II some hematological parameters.. *REDVET* **7**: 9, 090617.

Castillo, J.C., Cepero, O., Silveira, E.A., Casanova, R., Quinones, R., Monteagudo, E., Gutierrez, I. (2006). Traction horses of Santa Clara City, Cuba. I some biometrical parameters. *REDVET* **7**: 9, 090616.

Chaudhary, J.L., Tiwari, G.S., Lokesh Gupta (2008). Effect of feeding different levels of dietary energy on nutrient utilisation, draught performance and physiological reactions of camels. *Journal of Camel Practice and Research* **15**: 2, 195-200.

Chaudhary, J.L., Lokesh Gupta, Tiwari, G.S., Rajiv Garg (2008). Effect of feeding different levels of energy along with groundnut straw (*Arachis hypogea* L.) as a sole diet on nutrient utilization in draught camels. *Indian Journal of Animal Sciences* **78**: 5, 557-559.

Doshi, C.P., Tiwari, G. (2008). A review of draught animal power as a prime mower for site specific operations. *AMA, Agricultural Mechanization in Asia, Africa and Latin America* **39**: 3, 37-41.

Farooquee, N.A., Budal, T.K., Maikhuri, R.K., Singh, S.P (2008). Contribution of pack animals in reducing CO2 emission in Central Himalaya, India. *Current Science* **95**: 1, 59-63.

Ganapathi, P., Rajendran, R., Subramanian, A. (2009). Distribution and population status of Bargur cattle. *Indian Veterinary Journal* **86**: 9, 971-972.

Gatta, D., Casini, L., Magni, L., Liponi, G.B. (2009). Apparent digestibility of three diets in the Amiata breed donkey during lactation. *Italian Journal of Animal Science* **8**: Supplement 2, 706-708.

Gebreselassie, S., Peden, D., Haileslassie, A., Mpairwe, D. (2009). Factors affecting livestock water productivity: animal scale analysis using previous cattle feeding trials in Ethiopia. *Rangeland Journal* **31**: 2, 251-258.

Griffin-Kremer, C. (2009). Dynamics of informal networking: two studies of cattle draught in the perspective of deeper time. (Special Issue: Heritage and the environment.) *International Journal of Heritage Studies* **15**: 2/3, 192-208

Guthiga, P.M., Karugia, J.T., Nyikal, R.A. (2007). Does use of draft animal power increase economic efficiency of smallholder farms in Kenya? *Renewable Agriculture and Food Systems* **22**: 4, 290-296.

Herold, P. (2008). Moderner arbeitspferdeeinsatz im ökologischen Landbau. *Okologie & Landbau* **147**: 3, 39-41.

Jetana, T., Suthikrai, W., Usawang, S., Vongpipatana, C., Sophon, S., Liang, J.B. (2009). The effects of concentrate added to pineapple (*Ananas Comosus linn. Mer*) waste silage in differing ratios to form complete diets, on digestion, excretion of urinary purine derivatives and blood metabolites in growing, male, Thai swamp buffaloes. *Tropical Animal Health and Production* **41**: 4, 449-459.

Josiah, M.N., Bani, R.J., Mahama, A.A. (2008). Availabilty of energy and agricultural mechanization in Ghana. *Journal of Food, Agriculture & Environment* **6**: 2, 170-172.

Khanvilkar, A.V., Kulkarni, M.D., Yadav, G.B., Samant, S.R., Thorat, V.J., Shisode, M.G. (2009). Desert friendly animal - the camel. *Veterinary World* **2**: 6, 240-241.

Kidane, N.F., Stuth, J.W., Tolleson, D.R. (2008). Predicting diet quality of donkeys via fecal-NIRS calibrations. *Rangeland Ecology & Management* **61**: 2, 232-239.

Leimgruber, P., Senior, B., Uga, Myint Aung, Songer, M. A., Mueller, T., Wemmer, C., Ballou, J.D. (2008). Modeling population viability of captive elephants in Myanmar (Burma): implications for wild populations. *Animal Conservation* **11**: 3, 198-205.

Maloiy, G.M.O., Rugangazi, B.M., Rowe, M.F. (2009). Energy expenditure during level locomotion in large desert ungulates: the one-humped camel and the domestic donkey. *Journal of Zoology* **277**: 3, 248-255.

Minero, M., Canali, E. (2009). Welfare issues of horses: an overview and practical recommendations. (Special Issue: Criteria and methods for the assessment of animal welfare.) *Italian Journal of Animal Science* **8**: Supplement 1, 219-230.

Mohammed, A.K., Sackey, A.K.B., Tekdek, L.B., Gefu, J.O. (2007). Comparative assessment of draught performance of the one humped camel (*Camelus dromedarius*) and Bunaji work bulls in Zaria, Nigeria. *Journal of Camel Practice and Research* **14**: 2, 199-202.

Ngowi, E.E., Chenyambuga, S.W., Gwakisa, P.S. (2008). Socio-economic values and traditional management practices of Tarime zebu cattle in Tanzania. *Livestock Research for Rural Development* **20**: 6, 94.

Pritchard, J.C., Burn, C.C., Barr, A.R.S., Whay, H.R. (2008). Validity of indicators of dehydration in working horses: a longitudinal study of changes in skin tent duration, mucous membrane dryness and drinking behaviour. *Equine Veterinary Journal* **40**: 6, 558-564.

Rajendran, R., Panneerselvam, S., Thangaraju, P., Nainar, A.M. (2009). Reproduction performance of native draught cattle under field conditions. *Indian Veterinary Journal* **86**: 4, 371-372.

Ramesha, K.P., Pradhan, V.K., Kataktalware, M.A., Rajkhowa, J., Manajit Bora, Krishnan, G., Nirbhay Kumar, Saravanan, B.C., Biswas, T.K., Bhattacharya, M. (2009). Effect of pack at high altitude on yaks (*Poephagus grunniens*). *Indian Journal of Animal Sciences* **79**: 5, 487-488.

Reichmann, P., Dearo, A.C. de O., Rodrigues, T.C. (2008). Occurrence of ophthalmologic diseases in horses used for urban cart hauling in Londrina, PR, Brazil. *Ciencia Rural* **38**: 9, 2525-2528.

Sackbouavong, K., Koike, M., Takigawa, T. (2008). Engineering aspects of farm mechanization and institutional systems in Laos (Part 2) - Local features of socio-economic characteristics for irrigated farming. *Journal of the Japanese Society of Agricultural Machinery* **70**: 6, 59-68.

Sanni, S.A. (2008). Animal traction: an underused low external input technology among farming communities in Kaduna State, Nigeria. *Tropicultura* **26**: 1, 48-52.

Shrikhande, G.B., Rewatkar, S.G., Deshmukh, S.S., Maske, O.K., Raghorte, Y.M. (2009). The incidence of helminth parasites in donkeys. *Veterinary World* **2**: 6, 224.

Singh, R.C., Singh, C.D. (2009). Effect of age and body size on the work output of Malvi and crossbred oxen. *Indian Journal of Animal Sciences* **79**: 8, 850-852.

Soukup, B., Hoffmann, H., Herold, P. (2008). Arbeitspferde im Gemüsebau. *Landtechnik* **63**: 5, 296-297.

Spugnoli, P., Parenti, A., Masella, P., Melani, E. (2008). Test of an animal drawn field implement cart. *Journal of Agricultural Engineering* **39**: 2, 1-5.

Sushil Sharma (2009). Status of farm power availability in the selected villages of Jammu District (J & K States). *AMA, Agricultural Mechanization in Asia, Africa and Latin America* **40**: 1, 41-45.

Suss, K., Storm, C., Schwabe, A. (2009). Is the different diet selection by sheep and donkeys a tool for the management of threatened sand vegetation? *Tuexenia* **29**, 181-197.

Tadich, T., Escobar, A., Pearson, R.A. (2008). Husbandry and welfare aspects of urban draught horses in the south of Chile. *Archivos de Medicina Veterinaria* **40**: 3, 267-273.

Tiwari, G.S. (2008). Comparative performance of different types of pneumatic types used in camel carts under sandy terrain condition. *Annals of Arid Zone* **47**: 2, 191-196.

Toit, N. du, Burden, F.A., Dixon, P.M. (2008). Clinical dental findings in 203 working donkeys in Mexico. *Veterinary Journal* **178**: 3, 380-386

Toit, N. du, Burden, F.A., Dixon, P.M. (2009). Clinical dental examinations of 357 donkeys in the UK. Part 1: Prevalence of dental disorders. *Equine Veterinary Journal* **41**: 4, 390-394

Toit, N. du, Burden, F.A., Dixon, P.M. (2009). Clinical dental examinations of 357 donkeys in the UK. Part 2: Epidemiological studies on the potential relationships between different dental disorders, and between dental disease and systemic disorders. *Equine Veterinary Journal* **41**: 4, 395-400.

Yash Pal, Legha, R.A. (2008). Socio-economic status of mule producers and management practices of mule production in rural areas. *Indian Journal of Animal Sciences* **78**: 11, 1281-1284.

CONTRIBUTORS TO DAN 47

- **N.Akila and Mahesh Chander**
  Division of Extension Education, Indian Veterinary Research Institute, Izatnagar 243 122, India
  Email: nakila@rediffmail.com.
- **Rajeev Garg *et al*.**
  All India Coordinated Research Project on Increased Utilisation of Animal Energy with Enhanced System Efficiency, Department of Farm Machinery and Power Engineering, College of Technology and Engineering, MPUA&T, Udaipur-Rajasthan, India-313001
  Email: tiwarigsin @ yahoo.com
- **Peter Herold**
  Interessengemeinschaft Zugpferde e.V.- Bundesgeschäftsstelle, Uferstr. 29, D - 73660 Urbach, Deutschland
  Email: info@ig-zugpferde.de
- **Peta A. Jones**
  Donkey Power Facilitation and Consultancy, Po Box 414, Tshitandani/Makhado 0920, South Africa
  Email: asstute@lantic.net
- **M Ouassat *et al*.**
  Institut Agronomique et Vétérinaire, Hassan II, Rabat, Morocco
  Email: m.ouassat@iav.ac.ma
- **C. D. Singh and R. C. Singh**
  Instrumentation Laboratory, Central Institute of Agricultural Engineering, Nabibagh, Bhopal – 462038 (MP), India
  Email:cdsingh@ ciae.res.in
- **R.C. Singh *et al.***
  Agricultural Mechanization Division, Central Institute of Agricultural Engineering, Bhopal, India – 462038
  Email: cdsingh@ciae.res.in
- **R.L. Srivastava**
  AICRP on Animal Energy, College of Agricultural Engineering, FM&P Engineering Department, Allahabad Agricultural Institute-Deemed University, Allahabad-211007, India
  Email: rlsrivastava-64@yahoo.co.in
- **R.L. Srivastava, A.K.A. Lawrence and Shibu Mathew**
  AICRP on Animal Energy, College of Agricultural Engineering, FM&P Engineering Department, Allahabad Agricultural Institute-Deemed University, Allahabad-211007, India
  Email: rlsrivastava-64@yahoo.co.in
- **R. Trevor Wilson**
  Bartridge Partners, Bartridge House, Umberleigh, Devon, EX37 9AS, UK
  Email: trevorbart@aol.com