The challenges in using donkeys for work in Africa

by

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Abstract

A succession of dry years in sub-Saharan Africa has seen an increase in the use of the donkeys for transport and cultivation, particularly in areas where draft cattle numbers have declined. The challenges facing users of donkeys are to make the best use of the resources they have available. The challenges to livestock researchers and extension officers are to provide information that will help the user optimise resource use. The present state of knowledge and the main issues which would benefit from further understanding are discussed under the topics of management (nutrition and health), working practices (implements and harnesses) and the promotion of the donkey. Some issues need a better understanding in order to advance eg, strategic feeding and disease control, while other issues can largely be overcome by better communication, training and exchange of knowledge.

Introduction

Despite the increase in mechanisation throughout the world, donkeys are still well deserving of the name 'beasts of burden'. They have an important role to play in transport of people and goods in arid and semi-arid areas and where roads are poor or non-existent. This is shown by the widespread use of donkeys in rural and urban areas in Africa, as well as parts of central America and Asia (Table 1). In West, South and East Africa donkeys are used to power activities associated with crop production as well as transport. A series of dry years in sub-Saharan Africa has seen a notable increase in the use of donkeys for tillage, as draft cattle numbers on small farms have declined. This has resulted in changing perceptions of the value of the donkey in many rural communities that rely on animal power for crop production. A good example of this is in Zimbabwe. The drought in 1991/92 resulted in the death of many cattle and therefore a shortage of oxen at plowing time. Other than family labour, donkeys are the only alternative to oxen on many smallholder farms in this country. The price of a donkey in communal areas in southern Zimbabwe increased from about 80 $Zim in 1990 to 600 $Zim in 1995, and donkey theft became a severe problem in rural areas, especially near plowing time. A similar situation has been reported in South Africa, where demand for donkeys exceeds supply.

For donor agencies and development organisations the donkey represents an attractive 'package' for promotion. It is the cheapest form of farm power other than human labour, and therefore within reach of the 'poorest of the poor'; it is 'available' to women in cultures where men usually manage the draft animals and can alleviate the drudgery of women's household activities such as water and firewood carrying.

These two situations have resulted in an extraordinary increase in interest in the donkey since 1990 by both farmers and aid agencies as well as a realisation that little is understood of donkeys' requirements, potential for improvement and contribution to rural livelihoods. The challenge facing farmers is to make the best use of the resources that they have available, while the challenge to livestock researchers and extension officers is to provide information that will help farmers do this. In this paper the issues that need to be addressed to assist farmers and urban donkeys owners make the best use of their donkeys are discussed.

The performance and capabilities of donkeys

The size of a donkey is a limitation to the amount of work that it can do. Most adult African

Table 1: Countries with the most donkeys in 1993, in the world and in Africa

World			*Africa*		
Country	*Donkeys (thousands)*	*1990s trend*	*Country*	*Donkeys (thousands)*	*1990s trend*
China	10 983	-	Ethiopia	5 200	n
Ethiopia	5 200	n	Egypt	1 550	n
Pakistan	3 775	+	Nigeria	1 000	+
Mexico	3 190	+	Morocco	946	n
Iran	1 900	+	Sudan	670	-
India	1 550	n	Mali	610	+
Egypt	1 550	n	Niger	462	+
Brazil	1 364	+	Burkina Faso	436	+
Afghanistan	1 180	n	Senegal	364	+
Nigeria	1 000	+	Somalia	356	n
Morocco	946	n	Algeria	340	n
Turkey	895	-	Chad	271	n

Key: + increasing, - decreasing, n no change
Source: FAO, 1994

donkeys fall in the weight range of 90–210 kg, which is less than the live weight of most cattle used for draft work (Pearson and Ouassat, 1996; Nengomasha, Jele and Pearson, 1995). However, if donkeys are well managed they can do many of the tasks undertaken by oxen, provided that they are teamed in sufficient numbers to provide the necessary draft force required to complete the task. Studies in Zimbabwe have shown that well-fed, well-trained donkeys teamed in fours are capable of sustaining a combined draft force of over 1 kN for a 4-hour working period. This power output is sufficient to plow relatively deep soil with a mouldboard plow, as well as complete most other agricultural tasks associated with crop production, in an acceptable time. However, animals are not always in such good condition, nor is it always possible to use a team of four animals. These problems can be alleviated by improving the management of the animals to improve the power supply or by reducing the demand for power by modifying the implements or tillage practices.

Management of donkeys

Although donkeys are known to survive with little management, their body condition may fluctuate during the year as feed supply fluctuates. For example in Zimbabwe body condition of donkeys falls in the late dry season when forage becomes scarce (Nengomasha et al, 1995). Seasonal patterns of disease incidence and morbidity have also been noted in some areas in Africa (e.g. parasitic diseases associated with rainfall patterns; Panday, Khallaayoune, Ouhelli, and Dakkak, 1994), suggesting that some form of seasonal disease management may also be beneficial.

Nutrition

Proper feeding of adult donkeys can enable them to resist disease challenge better, live longer, and have a higher rate of reproduction to provide replacement animals. In the growing donkey adequate feeding will allow it to reach its maximum growth potential, thus providing

Table 2: The energy costs of various activitites associated with work in donkeys

Observation	*Location*	*Site*	*Energy cost*	*Source*
Walking (J/m/kg liveweight)	Tunisia	sandy/gravel tracks	1.37	Dijkman, pers.comm
	Niger	laterite tracks	1.43	Pearson, 1994
	USA	gravel roads	0.98	Yousef, Dill and Freeland, 1972
	UK	treadmill	0.97	Dijkman, 1992
Carrying (J/m/kg carried)	Tunisia	sandy/gravel tracks	1.8–2.3	Dijkman, pers. comm.
	UK	treadmill	1.1	Dijkman, 1992
Pulling (J/m/kg pulled)	UK	treadmill	31.2	Pearson, 1994
	UK	treadmill	26.5	Dijkman, 1992

maximum working capacity. Some donkey users in Southern Africa, recognising the value of their animals, have been feeding supplements throughout the dry season; however, whether or not this expense returns value in increased work output or improved crop production has not been assessed. The challenge to scientists is to develop nutritionally sound recommendations on feeding strategies for donkeys that enable donkey users to make economically viable decisions regarding feed inputs and management. These decisions can be very different for different users. For example the urban donkey users working their animals daily are more likely to have to rely on purchased fodder, and have money to purchase it, than the rural users, who are more likely to have grazing land and time available to use it.

Energy requirements of donkeys for work have been determined under laboratory conditions (eg Dijkman, 1992) and under experimental conditions in the field (Yousef, Dill and Freeland, 1972). The data is summarised in Table 2. However, little information is available on donkeys' daily nutrient needs for work on farms in tropical conditions. Energy requirements can be estimated from the energy costs of the different activities associated with work (Lawrence and Stibbards, 1990) and a knowledge of the amount of work done and distance travelled (eg Table 3). Until recently little data has been available on the daily work done by donkeys in soil preparation and weeding, but data on distances covered and loads carried during transport operations are more readily available. For example Wilson (1991) reported that donkeys used in the salt trade in Ethiopia carried 50 kg salt loads distances of 160 km climbing 3000 m over four days. Loads of 60–80 kg are commonly carried for periods of 3-4 hours by donkeys carrying goods to markets in Mexico (A S de Aluja, pers. comm.).

Donkeys seem able to digest high fibre forage diets better than do horses, while maintaining similar or higher intakes of the feed. For example donkeys eating 15.3 g dry matter (DM)/kg live weight of an oat straw diet showed an apparent digestibility coefficient of organic matter (OM), neutral detergent fibre (NDF) and acid detergent fibre (ADF) of 0.52, 0.49 and 0.44 respectively. Horses eating 13.7 g DM/kg live weight of the same diet showed apparent digestibility coefficients of OM, NDF and ADF of 0.48, 0.41 and 0.37 (Cuddeford, Pearson, Archibald and Muirhead, 1995). Donkeys also seem able to compensate very accurately for the water deficit when drinking following a period of water deprivation (Yousef, Dill and Mayes, 1970). The mechanisms behind these two observations are not understood, but may account for the donkey's seemingly good body condition despite eating poor

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Table 3: Three examples of the energy requirements for work for a donkey

Carrying a load over level ground on dirt tracks	
Liveweight of donkey	120 kg
Distance travelled	15 km
Load carried	40 kg
Energy cost of walking (1.40 J/m/kg)[1]	2520 kJ
Energy cost of carrying (2.3 J/m/kg carried) [1]	1380 kJ
Total net energy of work	3900 kJ
Proportion of total energy cost of work used in walking	65%
Total net energy cost of work as a proportion of maintenance requirement	**0.31**
Plowing a field for 2.6 hours at an average draft force of 730N with a team of four[2]	
Liveweight of donkey	120 kg
Distance travelled	5.5 km
Work done per donkey	1004 kJ
Efficiency of pulling	0.25
Energy cost of walking (2.0 J/m/kg)	1380 kJ
Energy cost of doing work pulling	4016 kJ
Total net energy cost of work	5336 kJ
Proportion of total energy cost of work used in walking	25%
Total net energy cost of work as a proportion of maintenance requirement	**0.42**
Carting a load over level ground at an average draft force of 140 N on laterite roads[3]	
Live weight of donkey	120 kg
Distance travelled	15 km
Work done	2100 kJ
Efficiency of pulling	0.35
Energy cost of walking	2520 kJ
Energy cost of doing work pulling	6000 kJ
Total energy cost of work	8520 kJ
Proportion of total energy cost of work used in walking	30%
Total net energy cost of work as a proportion of maintenance requirement	**0.67**

[1.] *Data from Dijkman (personal communication).* [2.] *Data from Hagmann and Prasad (1994)*
[3.] *Data from Slingerland (1989)*

quality feeds. Effects of frequency of watering on intake and digestibility of feeds and also on work output have not been determined under tropical conditions. Comparative studies of donkeys and ponies at Cornell University, USA showed that donkeys reduced food intake to a lesser degree that ponies when subjected to water deprivation for 36 hours (Mueller and Houpt, 1991). The suitability

of different supplements as complements to forages and grazing, and the best time to feed in relation to work in tropical areas, have not been investigated. These are just some of the issues that need to be resolved so that recommendations on feeding systems for donkeys in the tropics can be made.

Health

The economic impact of disease on productivity of ruminants has been determined for some of the major diseases that affect livestock in the tropics. In 1984 in Africa for example, trypanosomosis caused an estimated annual loss of US$ five billion (excluding milk and hide losses) and theileriosis killed approximately three million cattle over the year (Murray and Gray, 1984). Chronic subclinical parasitism, usually accompanied by acute viral and bacterial diseases, may be the most important economic burden (FAO, 1991; Hansen, 1996). Virtually no information is available on the economic impact of any donkey diseases. This lack of information hinders development of policy decisions on disease control and prevention. The acquisition of this type of data provides a challenge to both economists and veterinarians.

Donkey disease agents

Donkeys harbour myriad infectious and parasitic agents, not all of which have been thoroughly investigated in this animal. Identification and treatment is often taken from knowledge of the disease in the horse. However, susceptibility or resistance to the effects of disease agents are not necessarily the same in the donkey as in the horse. The trypanosomes are some of the most important protozoal organisms affecting the well-being of livestock in the tropics. Horses do not survive long in the presence of infected tsetse flies, whereas donkeys are more tolerant of tsetse-transmitted trypanosomes and frequently appear to thrive in lightly infested habitats (Connor, 1994). Nevertheless *Trypanosoma brucei* causes acute disease in donkeys, as well as being a serious pathogen of horses. Donkeys, together with horses, mules and zebras, are susceptible to both the protozoan organisms *Babesia equi* and *Babesia caballi* (De Waal and van Heerden, 1994, Sahibi and Bakkoury, 1994). The South African vector the red-legged tick *Rhipicephalus evertsi vertsi*, is often observed on donkeys (De Waal and van Heerden, 1994).

Donkeys appear less susceptible to African horse sickness than are horses (Coetzer and Erasmus, 1994). Local indigenous animals usually undergo clinically inapparent or subacute infections, recover and are not normally vaccinated. However, introduced and imported exotic animals develop overt sign of the disease and if not vaccinated can die. Donkeys in the Middle East for example appear more susceptible to the disease than Southern African donkeys living in endemic areas (Alexander, 1948). Sometimes this is overlooked when donkeys are moved from one area to another and higher levels of mortality can result when animals encounter an unfamiliar serotype (Walton and Osburn, 1991). This should not be forgotten when development projects are planned involving the translocation of donkeys from one African country to another. Other diseases worthy of mention that donkeys are susceptible to are equine herpes virus, equine influenza, rabies, horse pox, mange and glanders.

Studies have shown that donkeys are host to a wide diversity and high prevalence of helminth parasites, which can lead to disease when the animals are underfed or overworked. Helminths reported from donkeys in Southern Africa include nematodes (roundworms), cestodes (tapeworms) and trematodes (flukes). Nematodes predominate and represent five taxonomic families and more than 40 different species (Theiler, 1923; Malan, Reinceke, and Scialdo-Krecek, 1982; Svendsen, 1989; Pandey and Eysker, 1990). Six species of the botfly also inhabit the gastro-intestinal tract of the donkey (I J Horak, pers comm).

The clinical effects of helminth disease on donkeys are less well known than in horses. This situation is exacerbated by the shortcomings of the diagnostic methods used to identify internal parasites. Worm egg count (eggs per gram, epg) is the main diagnostic tool used to identify internal parasites; this technique, however, does not necessarily provide an accurate assessment of the infection in the live animal. Despite this it is possible to make some comparisons between the donkey and horse. If a horse has a nematode egg count of 300–600 epg, treatment with an effective antiparasitic agent would be recommended (Krecek, Guthrie, van Nieuwenhuizen and Booth, 1994), but in African donkeys egg counts well above this (1600–2000 epg) are not uncommon

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(Vercruysse, Harris, Kaboret, Pangui and Gibson, 1986; D Wells, pers. comm). The challenge to the veterinarians is to establish whether this difference reflects the host's response to the parasites, the high fecundity (egg-laying ability) of some worm species or simply an ability of the donkey to tolerate higher worm burdens without ill-effect than can the horse. The latter explanation would mean that the donkey resembles the zebra, which seems to have a high tolerance for internal parasites. Large numbers of blood-sucking worms are present in all zebra species in southern Africa and inhabit many of their organs including the liver. Whether this indicates a high tolerance to these worms or some symbiotic relationship that may exist in the zebra between the host and the parasites remains to be investigated (Scialdo-Krecek, 1983; Krecek, Malan, Reinecke and De Vos, 1987).

Further research to identify differences between donkeys and the other equids in their tolerance of common diseases would seem to be appropriate and would help in the development of low cost treatments.

Treatment and control of disease in donkeys

The production of disease control methods and disease treatments that are acceptable to the donkey owner presents a major challenge to the animal health specialist. Identification of the constraints to disease control or prevention in donkey owning communities can help in the development of acceptable methods. The role of good husbandry in disease control is frequently underestimated (Connor, 1994), although it may offer the donkey owner a financially more attractive alternative to expensive drug treatment at a later stage. Nutrition can play an important role and the provision of supplementary feed, especially during the dry season, can help in resisting or mitigating disease. In certain cases well-fed animals seem better able to resist the effects of trypanosome infections (Connor, 1994), and many animals attain an equilibrium with the parasites.

Trypanocides, one of which is toxic to donkeys, anthelmintic drugs and vaccines are often not available or are too costly to purchase, even when the need is recognised by the donkey owner. Simple local remedies warrant investigation, along with other simple management techniques to reduce contact between the animal and the vector or disease agent. A few examples are already available and the challenge to the veterinarian, livestock scientist and extension agent are to identify other practices acceptable to the farmers.

The resistance of worm eggs to many anthelmintics has developed at an alarming rate in the Southern Hemisphere (Waller, 1993), necessitating the investigation other methods of control. Removal of faeces from pasture to reduce contamination of grazing resulted in a decrease in worm egg counts, and less clinical disease in horses compared to those treated regularly with anthelmintics (Herd, 1986). Similar successes have occurred on Thoroughbred farms in South Africa, where faeces removal from yearling's pastures every 2–3 months helped to reduce worm egg counts (Krecek, unpublished data). This is a simple, low cost method of reducing worm egg counts which could be an affordable, effective and therefore acceptable practice to control parasite burdens in donkeys. Keeping animals in fly-proof accommodation at least part of the day when vector flies are prevalent can also reduce the incidence of disease.

Working practices

Implements and tillage practices

Most of the implements used in crop production in Africa have been designed for use with oxen. While these implements many prove satisfactory for a team of four donkeys in good condition, they are likely to be too heavy for smaller teams or single animals. Increasing the number of animals in a team is not always the answer. Teams of more than four donkeys are difficult to use, unless fields are large, and work output per animal drops as the number of animals in a team increases (eg Karim-Sesay, 1993).

A major challenge to the agricultural engineers is to identify, design or modify implements that can be used effectively by donkeys in primary cultivation. This would enable the farmer to reduce his reliance on oxen for these tasks. The implement has to be technically acceptable by and affordable to farmers in order to be adopted by them. Secondary cultivation, weeding and carting require lower draft forces than plowing and the low live weight of the donkey is less of a constraint. This is also the case on light sandy soils

where conventional plowing is often unnecessary for crop establishment. The development of alternative tillage practices that require less power than conventional plowing in which the donkey can be used provide a further challenge to engineers and soil scientists.

Harnesses

Designs for suitable harnesses for donkeys are available, and consist of two types: collars and breastbands. The problem of harnessing is therefore not a technical one, but more one of acceptance, education and dissemination. This requires the expertise of the extension officer rather than the scientist. The challenge to the extension officer is to develop techniques to teach the farmers the benefits of using harnesses that are comfortable to the animal, and then encourage them to use these harnesses. The choice of harness depends on availability and cost in an area. In Africa this generally means a breastband harness, although there are a few areas where collar harnesses are available. Collar harnesses, while excellent for the donkey, are expensive for the farmers and require some training of artisans in their construction. Breastband harnesses are a cheaper alternative to collar harnesses, but these can cause bad sores if they are not made correctly or fitted correctly. The bands should be broad and of a material which will not readily rub the donkey, although padding of the harness with softer less abrasive material can overcome the latter problem. Fastenings should not be of a type that will rub the animal and adjustable straps over the back enable the size of the harness to be changed to fit different sizes of donkey. This is important if it is to be used on different animals.

Manufacturers of harnesses often make them too thin, to save on material and without adjustments or padding, in order to keep the price down. Purchase of such harnesses can prove a false economy to donkey users as they usually cause sores on the animals, thus reducing work performance. It is these messages that the extension officers need to get across. In areas where cattle deaths brought about by drought has meant that many farmers have to use donkeys rather than cattle for land preparation, farmers very often use the yokes they have for the cattle on the donkeys, despite such use being illegal in some areas. This can be the result of ignorance and/or unwillingness to purchase donkeys harness. Again education, of donkey users as well as of artisans producing donkey harnessing, is required, rather than technical developments.

Load carrying and pack saddles

Most of the comments regarding harnesses apply equally well to the use of pack saddles. The best saddles are those that do not cause sores because sores lead to days off work. These are not necessarily expensive or complex and often make use of simple materials. The long term solution to saddle sores on pack animals lies in education and encouragement of farmers to adopt preventative measures rather than waiting for a problem to develop.

Donkey promotion

The donkey has a generally poor image in many cultures, partly due to the fact that work is often the only productive output of a donkey. Although pastoralists in northern Kenya make use of donkey blood and milk (Twerda, 1994), milk, meat and manure of donkeys are only used in a few cultures. Hence until recently donkeys in most areas had a low monetary value compared to other stock and therefore did not attract the attention of scientists, extension officers and farmers. Similarly they are not included in government policy documents on agriculture or rural development, although in many countries, particularly in Africa, they can make a substantial contribution to the economy of the country. Ethiopia is usually quoted as the classic example of this hidden economy. Wilson (1991) estimated that the annual return on a donkey used for carrying firewood to Mekele in Ethiopia, exclusive of the drovers labour was 1,388%.

People keeping donkeys tend to recognise their worth, even if ignorance, necessity or poverty mean that the animals are worked in poor condition and ill health. Those who do not own donkeys, however, whether they be farmers or government officials, often place considerable emphasis on the frequently unsubstantiated negative aspects of donkey ownership and use. Their low productivity compared with cattle, since meat and milk are seldom marketed, and their small size for draft work are often emphasised by agricultural officials. Some of the sayings attached to donkeys do not encourage wider use or better management of the animals. For example

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Jones (1991) describes some of the negative sayings about donkeys that have arisen in Zimbabwe, partly as an indirect result of the introduction of legislation to control movement of animals in towns. Such sayings include the following: 'donkeys are dangerous, and kick people to death', 'donkeys destroy trees and the environment generally', 'donkeys are inedible except by lions'. Overcoming these prejudices offers a challenge to all those involved with donkeys.

Conclusions

Many challenges face those wishing to use donkeys for work. A better understanding of the issues surrounding working donkeys would help farmers to meet these challenges. For example the development of recommendations on feeding would benefit from a knowledge of what feeds are available to farmers, how farmers use these feedstuffs, the effects of work on the animal itself, and the effect of supplementary feeding on animal health, longevity and work output. Similarly, recommendations on working practices would benefit from a knowledge of the effects of donkey-driven tillage on timeliness of cultivation, weed cover and crop yield.

Other challenges in using donkeys for work include communication and transfer of knowledge to overcome ignorance and increase awareness of better practices. Acceptable messages are needed to prevent harness sores or lameness and to dispel the myths associated with donkey keeping.

Healthy animals, free from injuries associated with work, will live longer and be more productive. Providing information on health, management, and nutrition, and increasing the owners' awareness of the benefits of a healthy donkey, is a challenge to all. If the price of a donkey continues to rise in sub-Saharan Africa this task should become easier. The challenge may then become one of how to overcome the increasing incidence of donkey theft, or to produce larger donkeys rather than how to improve the management and use of those currently available. The challenges involved in donkey use are not fixed, but will change according to changes in attitude, prosperity and the needs of the donkey owning communities.

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