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USE OF DONKEYS AND THEIR DRAUGHT PERFORMANCE IN SMALLHOLDER FARMING IN ZIMBABWE

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SUMMARY

Animal traction constitutes the most important source of power for agricultural work in smallholder farming in Zimbabwe. Two studies, a survey and a short term on-farm trial were conducted to evaluate the use of donkeys as draught animals. The survey covered 59 households in 2 smallholder farming areas. For the on-farm trial, 12 donkeys and 12 cattle were spanned separately in teams of 4 animals to plough 40 m × 70 m plots of medium textured soil.

The survey findings highlighted the drought tolerance of donkeys compared to cattle. Mortality rates of donkeys were lower. Results of the draught performance trial indicated that donkeys ploughed less area per day ($P < 0{\cdot}05$) and their walking speed was slower ($P < 0{\cdot}05$) than cattle. There was no significant difference ($P < 0{\cdot}05$) in draught force between the 2 species. The work rate per hour for ploughing with donkeys was 65% of that of cattle.

It was concluded that donkeys play a critical role in providing draught power for smallholder farmers but that their potential is not fully utilised.

INTRODUCTION

Livestock are a key component in the smallholder farming sector of Zimbabwe (Shumba, 1985). They provide critical inputs such as manure and draught power (GFA, 1987). However, frequent droughts and the resultant high cattle mortality substantially decreased the availability of draught power during the past 2 decades (LeRoux, *et al.*, 1978; Rusike, 1988; Tembo, 1989). The trend of declining draught supply is expected to continue into the next century (FAO, 1984). The veld (natural pasture) which is the mainstay for animal production in Zimbabwe cannot support body weight gains in the dry season due to its declining nutritive value (Elliot, 1984). As a result the oxen are weak at the onset of the rains when they are most needed for tillage work.

Farmers often respond to the challenge of draught shortage by using donkeys for land preparation (Prasad *et al.*, 1991). There are about 300,000 donkeys in the smallholder sector or Zimbabwe used for operations like carting, cultivation and tillage. However, there is inadequate information on the draught ability of donkeys for tillage work.

This study examines the present use of donkeys as draught animals in the smallholder farming sector and compares the draught ability of donkeys with that of cattle for tillage work.

MATERIALS AND METHODS

Two studies, a survey and an on-farm experiment were conducted in 1992–93.

Study 1—Survey

A survey was conducted on 59 smallholder farmers who own and use donkeys in 2

districts in semi-arid Zimbabwe. The districts, Gokwe in Midlands, and Chivi, in Masvingo Province, are located in Natural Regions IV and V which are characterised by low rainfall and infertile granite soils (Vincent and Thomas, 1960). Donkeys are traditionally used in both areas for agricultural work. Respondents were selected at random and were interviewed with the help of pretested and structured questionnaire schedules on different aspects of the use of donkeys.

Study 2—Draught performance trial

The objective of this on-farm trial was to evaluate the draught performance of donkeys and cattle at ploughing. It was conducted in a resettlement village in Natural Region IV in southern Zimbabwe.

Twelve donkeys and 12 Mashona oxen with an average liveweight of 144 kg and 367 kg respectively were used. The donkeys and oxen were spanned separately in teams of 4 to plough 40 m × 70 m plots on a clay loam soil for 3 consecutive days. Donkeys were harnessed with low-cost collar harnesses to which belts with back swingles were attached (Jones, 1991). Oxen were yoked with traditional wooden yokes. The local "Inkunzi" single furrow mouldboard ox-ploughs were used with new ploughshares. Spans with ploughs were operated by local farmers who were specifically instructed to plough in their usual way in terms of depth of ploughing and animal handling. The animals were worked till they showed signs of fatigue and declined to move. Measurements included speed of work, area ploughed, draught force, depth of furrows and number of furrows per metre. Work and power outputs were derived (Prasad *et al.*, 1991).

Statistical analysis of the survey data was carried out in SPSS (statistical package for social sciences) Version 3.0. Analysis of variance was performed on the data from the on-farm experiment.

RESULTS

Study 1—Survey

Donkey ownership distribution

The frequency distribution of the number of donkeys held by respondents is presented in Table I. The largest group (37%) of farmers owned 3 to 4 donkeys, and only 29% of the respondent households owned more than four. There were 239 donkeys across 59 households with a mean holding size of 4·05 (± 2·34 s.d.).

The number of donkeys in households across different land-holding categories is presented in Table II. There were a total of 100 in the 6 to 8 acres land-holding category

TABLE I

Frequency distribution of donkeys across households—survey

No. of donkeys	Households (No)	(%)	(Cumul. %)
1–2	20	33·8	33·8
3–4	22	37·3	71·1
5–6	10	17·0	88·1
7–8	04	06·8	94·9
9–11	03	05·1	100·0
Total	59	100·0	100·0

TABLE II

Distribution of donkeys across households in different land-holding categories—survey

Arable land-holding (acres)	No. of households (No)	(%)	Number of donkeys No	(%)	Donkeys/ household	Donkeys/ acre
0–2	1	1·7	2	0·8	2·0	2·0
2·1–3	4	6·8	8	3·3	2·0	0·8
3·1–5	14	23·7	54	22·6	3·9	0·9
5·1–8	23	39·0	100	41·9	4·4	0·6
8·1–12	15	25·4	71	29·7	4·7	0·5
12·1–15	2	3·4	4	1·7	2·0	0·1
Total	59	100·0	239	100·0	—	—

followed by 71 in the 9 to 12 acre land-holding category. There was a significant ($P < 0{\cdot}05$) cubic response of the arable land-holding size on the number of donkeys per household. The number per household (Y) when regressed on the land-holding size in acres (X) gave the following relationship:

$$Y = 1{\cdot}88 - 1{\cdot}32X + 1{\cdot}20X^2 - 8{\cdot}76X^3 \; (R^2 = 0{\cdot}95)$$

The number of donkeys per acre per household showed a curvi-linear response ($P < 0{\cdot}05$) with the increase in land-holding size from zero through 12 to 15 acres category. The following equation accounted for the distribution of donkeys per acre per household (Y) and the land-holding size categories in acres (X) in the sample;

$$Y = 1{\cdot}93 - 5{\cdot}12X + 6{\cdot}71X^2 - 2{\cdot}91X^3 \; (R^2 = 0{\cdot}96)$$

Prasad *et al.* (1991) indicated that the mean draught animal holding in Natural Regions III, IV and V increased with increasing cultivable land from 0·3 to 1·3 ha through 2·5 to 3·3 ha and decreased thereafter. A similar trend was noticed in the present study.

Age distribution of donkeys

Figure 1 shows the percentage distribution of different age groups of donkeys in the sample. The majority (51%) are in the age group of more than 8 years, followed by the 6·1 to 8 year age group (20%). The percentage of donkeys in the age group of more than 6 years is disproportionately larger than that of younger ones because of the failure of the production system to cull old animals. Unlike that of cattle and small ruminants, donkey meat is not eaten by communities in Zimbabwe, and old animals are left to die from natural causes. The failure of the donkey to serve purposes other than the provision of draught power has disadvantaged their rearing in favour of multipurpose livestock, especially in the allocation of feed resources. The low number of donkeys in the age range from 2 to 6 years indicates high mortalities, possibly due to traction and nutrition stresses.

Drought tolerance

The mortalities of cows, oxen, donkeys and goats in the 2 districts during the extreme drought in 1992 were assessed in the survey. Highest mortality was recorded for oxen (56%) followed by cows (44%). Low drought-induced mortality rates were 15% for donkeys and 8% for goats. The periodic droughts and epidemics have

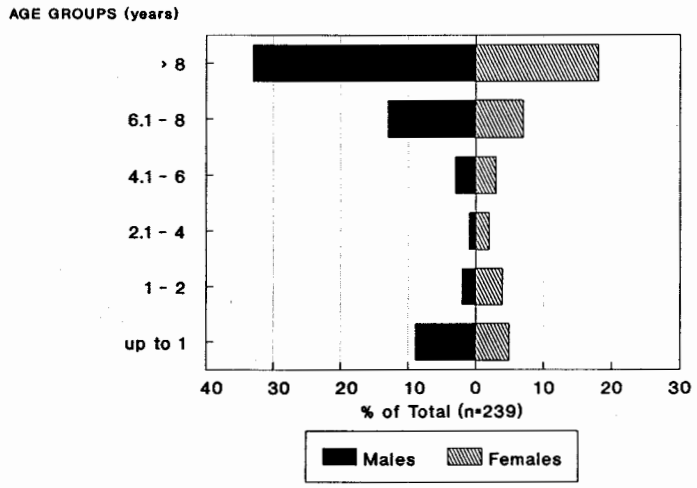

FIG. 1. Age distribution of donkeys (approx. ages as reported by farmers).

reduced the cattle population in the smallholder sector over the past 2 decades (Tembo, 1989). As a result the number of cattle per cultivated hectare came down from 1·4 to 1·2 (Rusike, 1988). The 1992 drought further eroded the limited draught animal pool.

The relatively higher drought tolerance and hardy nature of donkeys make them an important and critical component in food production in the cattle-deficient smallholder sector of Zimbabwe. They serve as alternative sources of draught power particularly in the post-drought recovery period. Attitudes towards and valuation of donkeys changed drastically after the drought. Prices tripled over 6 months from approximately ZW$ 100 to ZW$ 300 to 400 per donkey in 1992/93.

Ploughing duration

Frequency distribution of ploughing duration per day across sample households is presented in Table III. More than half (53%) of the respondents indicated that they usually plough for 2 to 4 hours per day with donkeys. The remaining 47% used them for 5 to 6 hours per day for ploughing. The mean ploughing duration was 4·96 (± 1·71 s.d.) h/day. All the households ploughed both during the mornings and afternoons. On the days donkeys were used for ploughing they were not used for other tasks.

TABLE III

Total duration of ploughing with donkeys per day (hours) as reported by respondents in two sessions of morning and afternoon–survey

Duration (hours)	Respondents (No)	(%)	(Cumul. %)
2	8	13·6	13·6
3	8	13·6	27·2
4	15	25·4	52·6
5	25	42·3	94·9
6	3	5·1	100·0
Total	59	100·0	100·0

TABLE IV

Perceptions of respondents about the relative performance of donkeys and cattle—survey

Variable	Donkeys	Cattle
Drought tolerance	more	less
Heat tolerance	more	less
Disease tolerance	more	less
Weight loss in dry season	less	more
Training for work	not needed	needed
Labour requirement at work	less	more
Speed of work at ploughing	slower	faster
Depth of work at ploughing	shallower	deeper
Scotch cart	suitable	suitable
Cultivation	more suitable	suitable

Perceptions on the performance of donkeys

Perceptions of respondents on the relative performance of donkeys and cattle are summarised in Table IV. Specific aspects are outlined below.

The major health problems named by the respondents were poor eyesight (27%) and wounds (14%). Respondents explained that wounds were caused by yoking donkeys or by the use of unsuitable harnessing. The majority (59%) did not mention the occurrence of any health problems.

Training of donkeys for draught purposes is not considered necessary and none of the respondents applied special training methods. The major training tool is the whip, although good training could increase their work effort and output (Jones, 1991).

Farmers indicated that labour requirement during work is low, as controlling of donkeys at work is less demanding. Whereas 3 persons are generally employed to plough with oxen, only 2 are required with donkeys as these tend to walk in straight lines. This was also mentioned as an advantage during weeding operations as crop damage would be less than with oxen.

Donkeys were found to be suitable for various tasks. According to 75% of the respondents donkeys are most suitable for pulling a scotch cart. However, 15% of the farmers found them more suitable for ploughing and 10% for weeding.

Grazing/feeding requirements of donkeys are very modest, grazing mainly on couch grass (*Cynodon dactylon*) and most respondents (92%) never give them any supplementary food.

TABLE V

Draught performance of harnessed donkeys at half-hourly intervals—on-farm trial ($n = 9$)

Variable	Half-hours 1	2	3	4	5	s.e.m.
Distance covered (km)	$1{\cdot}2^{a}$	$1{\cdot}1^{a}$	$1{\cdot}2^{a}$	$0{\cdot}9^{ab}$	$0{\cdot}7^{b}$	0·013
Speed (m/s)	$0{\cdot}8^{a}$	$0{\cdot}8^{a}$	$0{\cdot}8^{a}$	$0{\cdot}7^{ab}$	$0{\cdot}6^{b}$	0·08
Draught Force (N)	730	730	730	730	730	—
Work output (KJ)	876^{a}	803^{a}	876^{a}	657^{ab}	511^{b}	11·1
Power (W)	584^{a}	584^{a}	584^{a}	511^{ab}	438^{b}	22·9

Means within rows with different superscripts are significantly different ($P < 0{\cdot}05$)

TABLE VI

Comparative work performance of oxen and donkeys—on-farm trial (n = 9)

Variable	Donkeys	Oxen	SE of diff.	Signific. of diff.
Duration of work (h)	2·6	3·6	0·29	**
Distance worked (km)	5·5	8·6	0·79	*
Area ploughed (m^2)	1340	2857	161	**
Work rate (ha/h)	0·051	0·079	0·003	*
Speed (m/s)	0·8	1·0	0·05	*
Depth of furrows (cm)	11·4	11·7	0·59	NS
No. furrows/metre	3·9	2·9	0·20	**
Draught force (N)	730	800	60·80	NS

* = $P<0·05$, ** $P<0·01$, NS = Not significant

A major problem in the management of donkeys is security. Almost all respondents (95%) mentioned serious theft problems. After the drought in particular, donkey thefts were on the increase and farmers would favour the introduction of laws like registration and/or branding. At present, the only protection they indicated is the putting of the animals in a kraal.

Extension on donkeys is generally poor and 93% of the respondents had never been advised on donkey use and management by extension workers. This explains the low technology and care applied to donkeys (no health care, yoking instead of harnessing, no training, no supplementary feeding, etc.) and requires serious consideration for any future promotion of donkey use.

Study 2—Draught performance trial

Draught performance of donkeys used for ploughing

The distance covered and speed of donkeys during half hourly intervals was significantly different ($P<0·05$) from that of cattle. The draught force was, however, constant at 730 Newtons (N). The work output was highest at the first and third half-hour and lowest in the fifth half-hour (Table V).

The comparative work performance of donkeys and cattle is presented in Table VI. Cattle worked for a longer duration ($P<0·05$) than donkeys. The speed of cattle was higher ($P<0·05$) and they covered greater distances ($P<0·05$) compared to donkeys. There was no significant difference ($P>0·05$) in draught force between the 2 species. The number of furrows per metre was higher (3·9) with donkeys compared to cattle (2·9) ($P<0·05$).

DISCUSSION

On the basis of proportion of donkeys to total draught animals in different surveys (Mombeshora *et al.*, 1985; Shumba, 1985; GFA, 1987) the number of donkeys in Zimbabwe was estimated at 0·3 million (Prasad *et al.*, 1991). Given the fact they are drought tolerant and are not slaughtered for meat, the relatively smaller population size of donkeys versus other draught animals reflects a lower population growth rate which, in turn, could be due to the lower reproductive rate. The donkey population in the survey was rather old which would support this hypothesis. This area requires serious attention if donkeys are to be promoted to maintain animal draught power.

Several studies (Monnier, 1965; Slingerland, 1989; Prasad *et al.*, 1991) reported a

tractive effort of 200 to 250 N per donkey. However, in the present study the four-donkey span produced 730 N thus giving an average draught force of 183 N per donkey which is far below the reported values. The discrepancy between the draught force reported in the present study and that of others could be due to harnessing the animals together which results in greater overall power output, but a loss per animal. Another reason could be differences in power requirements for the tasks performed. The draught force reported in other studies referred to the pulling of sledges and loads while in the present study the donkeys were used for ploughing. Ploughing at a shallow depth does not require more than up to 800 N, so that the donkey spans did not have to generate the maximum of their power.

The draught force of 800 N for a span of 4 cattle as noted in the study is also much below the range of values reported in the literature (Goe, 1983; Mupeta *et al.*, 1990; Prasad *et al.*, 1992). The low draught relates to the farmers' practice of shallow ploughing (Shumba, 1986). It is therefore an independent ploughing characteristic and does not relate to the species of the animal in question. That explains why, although the respondents of the survey perceived that cattle could plough deeper than donkeys, no such difference was noted in the on-farm trial.

The lower number of furrows per metre with cattle ($P < 0{\cdot}05$) was due to the larger width of furrows compared to ploughing with donkeys. The major difference in work performance was the larger area ploughed per day in the case of cattle. On average donkeys ploughed 47% of the area compared to that of cattle due mainly to greater duration of work, speed of walking and width of the furrows with cattle. The work rate per hour with donkeys reached 65% of the efficiency of cattle. Provided donkeys had worked the same number of hours per day as cattle in the experiment, which, according to the respondents in the survey, is often the case with smallholders, the area ploughed would have been about two thirds of that of cattle.

Prasad *et al.* (1991) indicated that the inability of donkeys to work beyond 2 hours was because they were yoked and speculated that a suitable harnessing device would enable them to work longer. In the present study, in spite of the fact that donkeys were harnessed with collar harnesses, they could not work beyond 2·5 hours. However, the respondents in the survey indicated that they could use the donkeys for ploughing for an average period of almost 5 hours per day by putting them to work both in the morning and afternoon. Notwithstanding that donkeys used in the on-farm trial were weak and recovering from drought, working the animals both in the morning and afternoon with sufficient rest in between seems to be the only option to prolong the duration of work (FAO, 1972).

The collar harnesses used in the present study were produced with low-cost material by farmers who attended a course of harness-making. It turned out that the strain on the animals due to poor-quality collars was high, resulting in wounds and discomfort. Therefore, despite the fact that with good-quality collar harnesses the work output can be optimised (Dibbits, 1991), the most appropriate harnessing technology to be recommended under farmers' conditions is perhaps the simple and cheap breast band as described in Jones (1991).

Donkeys continue to be increasingly important as alternative draught animals in the smallholder sector of Zimbabwe. The survey and the on-farm experiment have shown that donkeys can be a viable power source for tillage work. However, extension and research support to exploit the potential and the draught ability of donkeys is inadequate. Long term studies on the draught output of donkeys that are used daily for several weeks are required. Their performance on different soils and with different implements has to be quantified. Breeding and nutritional inputs to sustain and

increase the draught output of donkeys are an urgent requirement as well as the establishment of a system to register donkeys in order to reduce theft.

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UTILISATION AU ZIMBABWE DES ANES POUR LA TRACTION ANIMALE CHEZ LES PETITS FERMIERS

Résumé—Au Zimbabwe, la traction animale constitue la source de travail la plus importante pour les travaux agricoles chez les petits fermiers. On a mis en place deux études, une enquête et un essai à court terme sur site, pour évaluer l'utilisation des anes comme animaux de traction. L'enquête a touché 59 foyers de deux regions de petits fermiers. Pour l'essai sur site, 12 anes et 12 bovins ont été utilisés séparement en groupes de 4 animaux pour labourer des parcelles de 40 m × 70 m, avec des sols de texture moyenne.

Les résultats de l'enquête ont mis en lumiére la tolérance à la sécheresse des anes par rapport aux bovins. La mortalité a été moindre chez les anes. Les résultats des essais au travail ont montré que comparativement aux bovins, les ànes labourent journellement une surface inférieure ($P < 0,05$) et que leur vitesse est moindre ($P < 0,05$), Il n'y a aucune différence significative ($P > 0,05$) entre les deux espèces en ce qui concerne la force de traction. Le taux de travail horaire pour le labour avec des anes a été de 65% de celui avec des bovins. Il est conclu que les anes jouent un rôle crucial dans la mise a disposition d'une force de traction animale pour les petits fermiers mais que leur potentiel n'est pas pleinement utilisé.

UTILIZACION DE BURROS COMO ANIMALES DE TIRO EN PEQUEÑAS EXPLOTACIONES AGRICOLAS DE ZIMBABWE

Resumen. Los animales de tiro son la principal fuente de energía para el trabajo en las explotaciones agrícolas de pequeño tamaño de Zimbabwe. Se llevaron a cabo dos estudios -una encuesta y un experimento corto sobre el terreno- para evaluar el uso de burros como animales de tiro. La encuesta incluyó 59 explotaciones en 2 zonas agrícolas distintas. Para el experimento sobre el terreno se utilizaron 12 burros y 12 bueyes que se distribuyeron separadamente en grupos de 4 animales para arar parcelas de 40 m × 70 m de suelo de textura media.

La encuesta puso de manifiesto la toleracia de los burros al trabajo comparados con los bueyes. La tasa de mortalidad de los burros fue má baja. Los resultados del experimento indicaron que los burros araron menos superficie por dia ($P < 0{\cdot}05$) y andaron más lentamente ($P < 0{\cdot}05$) que los bueyes. No hubo diferencias significativas ($P < 0{\cdot}05$) en la fuerza de tiro entre las 2 especies. El rendimiento del trabajo por hora al arar con burros fue equivalente al 65% del rendimiento obtenido con bueyes.

Se concluyó que los burros juegan un papel crítico como fuente de energía para el trabajo en explotaciones pequeñas pero su potencial no está suficientemente explotado.

CTVM PUBLICATIONS

Donkeys, Mules and Horses in Tropical Agricultural Development. D. Fielding and R. A. Pearson (Eds). C.T.V.M. Publications. 336 pp. £20.00

The proceedings of an international colloquium organised by the Edinburgh School of Agriculture and the CTVM in September, 1990. This is the first book which brings together work and thinking on the use of tropical equines for work. The main sections are: economic and social importance of equines; nutrition; environmental and reproductive physiology; health and disease; husbandry, management and training; use of equines for work, promotion and communication.

Draught Animal News. R. A. Pearson (Ed.).

Available free to research workers and others interested in draught animal research in developing countries. A subscription of £6.00 is payable by those in Europe, North America, Australia and any other developed countries.

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BOOK REVIEW

The Arthropods of Humans and Domestic Animals. A guide to preliminary identification. Alan Walker. Chapman and Hall, London. 1994. 213 pp. 144 line drawings. Spiral bound soft back. £22.50. ISBN 0-412-57280-X.

Among the aims of *Tropical Animal Health and Production* is the promotion of improved health and productivity of livestock and better utilisation of animal resources. This aim, coupled with the need to assist in the improvement of human health, has also guided Dr Alan Walker in developing the concept of this book.

It is only too obvious that most field veterinary surgeons and medical practitioners are familiar with the pathogenic effects of arthropods, including the diseases they transmit, but they are less than happy to attempt their identification. The problem is even greater for livestock owners and the public at large exposed to risk. The origins of this unwillingness in the health professional probably lies in the belief that identification is based on taxonomy and that taxonomy is a dead discipline instead of the dynamic expression of the sum of millennia of evolutionary pressures on the organism.

Taxonomy has to be at the heart of any attempt to alleviate arthropod-mediated health problems because the identification of the organism assists in a diagnosis of the condition and a false identification leads to a false solution. So often the uncertain professional plays safe by assuming an arthropod to be the vector of the most serious disease and thereby will embark on the most expensive treatments and may cause governments to institute wholly unnecessary control measures.

This book has been produced to enable the field professional to make an identification as far as the genus. This is already a giant step and gives the worried vet or medical doctor the assurance that he is dealing with a *Boophilus* sp. and not *Rhipicephalus appendiculatus* or *Chrysops* and not *Glossina*. The basis of the book is the abundance of illustrations purpose drawn by the author—an abundance of numbers and detail in what must have been a labour of love. The text has a light touch and should not frighten the nervous novice. Nevertheless, the coverage is extensive and it was good to see that *Gyrostigma* and *Cobboldia* were not forgotten.

An important aspect of the text, apart from the descriptions, is the attention given to distributions and biology as these can be an early guide in identification. The disease aspects combine human and domestic animal conditions in a way that is often missed in more specialised publications.

This book itself is a paper-back, which makes for a reasonable price and has a metal ring binding that allows an immediate flat opening on the bench.

It appears that this is a book without flaws and I must admit that my enthusiasm for the concept of Alan's work may have blinded me to them. Having seen so many otherwise outstanding workers demonstrate a massive mental block when faced with arthropod identification I can only hope that this field guide will give them and their successors the courage to tackle this essential aspect of field work.

R. J. Tatchell