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EDITORIAL

This issue, Volume 4 (1) of the Journal of Applied Science in Southern Africa continues the now established tradition of publishing research articles of an applied nature and diverse in latitude. This issue contains six original research papers, one review paper and two book reviews. In the preceding issues there has been a preponderance of agricultural science papers albeit not by design. In the Southern African context and indeed in most less technologically developed regions of the world, agricultural research renders itself to the immediate application of the results of research because of the pressing demands for immediate solutions to the 'bread and butter issues', of the poor agrarian populace of these regions.

The current issue contains three articles from the agricultural sciences; two articles on industrial sciences; one article on plant pathology; and a review paper on 'gums of industrial value.' While it is encouraging that applied science manuscripts are being submitted to the JASSA, it is also disappointing that very few if any of the manuscripts come from the health sciences or veterinary science disciplines. The Editor's office would be very much pleased to receive manuscripts from these disciplines.

On the other hand, the book reviews display on open ended format of presentation. This in fact is deliberately encouraged. It is neither practical nor possible to come up with a rigid formula for review papers presentation in a journal which is neither 'specialised' nor 'general'. It is not easy to balance this act, hence the open-ended format.

Finally, the Editor-In-Chief's office thanks the JASSA referees for a sterling job and the JASSA subscribers who continue to support and promote the journal.

C F B Nhachi
Editor-In-Chief

Socio-economic aspects in draught animal-crop linkages: a diagnostic study of Tsholotsho, Chinyika and Mutoko smallholder farming areas of Zimbabwe

S. Chawatama¹, L.R. Ndlovu,¹ K. Dzama², R. Tsimba,¹
J.H. Topps,¹ and J. Mutimba³.

¹ Department of Animal Science, University of Zimbabwe, P.O. Box MP167,
Mount Pleasant, Harare, Zimbabwe.

² Department of Paraclinical Veterinary Science, University of Zimbabwe, P.O. Box MP167,
Mount Pleasant, Harare, Zimbabwe.

³ Department of Agricultural Economics and Extension, University of Zimbabwe, P.O. Box MP167,
Mount Pleasant, Harare, Zimbabwe.

A survey was conducted on 451 households in Tsholotsho, Chinyika and Mutoko smallholder areas to understand farmers' crop production constraints in relation to draught animal power (DAP) during the 1994/95 agricultural season. Farmers without DAP constituted 48.6 percent in the three districts. Of these, 54.5 percent had access to neighbours' or relatives' animals. The rest hired or worked in others' fields in exchange for draught animals. Animal diseases and shortage of grazing land were noted as the major constraints in animal production. Both farmer education and experience as well as household head were found to be associated with district ($p < 0.001$). Tsholotsho had the largest number of farmers (52.8 percent) with more than 10 years experience while Mutoko had the largest proportion (43.3 percent) of Master farmers. Farmer education and experience were found to be independent of sex. The average land holdings per farmer for Tsholotsho, Chinyika and Mutoko were 6.21 ha, 4.22 ha and 1.62 ha, respectively. Tsholotsho is a dryland communal area whilst Chinyika is a relatively wet area. Mutoko is a typical communal area with a high population pressure. Maize is the main crop in Chinyika and Mutoko whilst millet is the most common in Tsholotsho.

Keywords: smallholder; crop production; draught; constraints.

Introduction

There are close linkages between animals and crops in the smallholder farming areas of Zimbabwe. Crop production depends on livestock for draught power and manure while animals rely on crop residues and sometimes whole grain for dry season feed. Animal traction is a critical component of communal area cropping systems. Animals provide energy for ploughing, ridging, transport and cultivation for communal farmers. Farmers with cattle have been reported to have larger arable holdings, do more winter ploughing and apply manure (Shumba, 1984).

The constraints to adoption and utilisation of draught animals are usually complex. These may include technical or socio-

economic factors such as cost of feed and equipment, profitability of the farming enterprise, traditional land and labour divisions, poor infrastructure or lack of marketing opportunities (Matthewman *et al.*, 1993) and availability of draught power. If technical innovations are to be implemented on a sustainable basis, then they should function within the existing socio-economic framework. By identifying constraints specific to target populations defined in terms of socio-economic or agro-economic conditions, research efforts would have higher probabilities of developing appropriate technologies that would improve the conditions of target populations (Jones and Wallace, 1986).

It is in light of these observations that a diagnostic survey was conducted to study

the draught animal power (DAP) situation in three districts of the communal areas of Zimbabwe. It is intended that this work will provide reliable qualitative and quantitative data on draught power that will aid in developing a computer-based DAP simulation model for smallholder farming systems in Zimbabwe, that use oxen, cows or donkeys for crop production.

Material and Methods

A farmer diagnostic study was conducted using a questionnaire and informal interviews in three districts in the communal areas of Zimbabwe. The survey was carried out during the 1994 to 1995 growing season in Mutoko, Tsholotsho and Chinyika. Chinyika, Mutoko and Tsholotsho are in Natural Regions II, III and IV respectively. The average annual rainfall figures for the Natural Regions are 750 to 1 000 mm, 650 to 800 mm and 450 to 650 mm for Natural Regions II, III and IV, respectively. These areas were chosen so that they could be representative of the smallholder sectors of Zimbabwe which consist of communal, resettlement and small-scale commercial farming areas.

A total of 451 households were surveyed in the three districts. The households were randomly selected in each village. As a result, 172 households in Chinyika, 153 in Mutoko and 126 in Tsholotsho were enumerated. The specific villages that were selected for the survey were: villages 11, 16, 17, 18, 23, 24, and 25 (Chinyika); Chapeyama, Chimuti, Chibanda and Chingwena (Mutoko); and Mabele and Tshitatshawa (Tsholotsho).

Data was gathered on:

- a) farmer characteristics, for example, name, district, village, sex of farmer and household head, marital status, level of education and farming experience,
- b) crop production characteristics, for example, size of arable area for home, main and garden fields, crops grown in current and previous seasons with area and total yield,
- c) draught power needs, for example, type and frequency of operation for each crop, span size, species and sex of the animals

- d) used in both the previous and current seasons, other operations in which draught animals are used and the relative importance of the operations, livestock production characteristics, for example, livestock ownership before and after the 1992 draught with records of losses, herd composition, assessment of ability to restock after the drought, ranking of major constraints to livestock production, and identifying farmers' management practices with respect to animal nutrition, breeding and health.

The data was analysed using SAS General Linear Models Procedure (SAS, 1988). Frequencies, means and Chi-square tests for association were calculated for the respective characteristics. To complement the survey, an informal diagnostic discussion was held with the farmers. The farmers cited their production constraints and suggested possible solutions. This was done to establish the farmers' perceptions of their constraints so that research priorities would be formulated in light of their needs.

Results

Farmer characteristics

A statistically significant ($p < 0.001$) association was found between farmer education and district. In Tsholotsho ($n = 126$) 11.7 percent of the respondents were master farmers, 10.8 percent were trainee farmers and 77.5 percent were ordinary farmers. Chinyika ($n = 173$) had 3.7 percent master farmers, 35 percent trainee, and 61.3 percent ordinary farmers. On the other hand, Mutoko ($n = 153$) had the largest proportion of master farmers (43.3 percent) with 3.3 percent as trainee farmers and the remainder were ordinary farmers (Figure 1).

Farmer experience was also associated with district ($p < 0.05$). Tsholotsho had the most experienced farmers. Of the farmers surveyed in Tsholotsho, 52.8 percent had greater than 10 years farming experience compared to 4.4 percent for Chinyika and 42.9 percent for Mutoko. There were no significant associations between farmer education or farmer experience and sex. There was also an association ($p < 0.001$) between household head

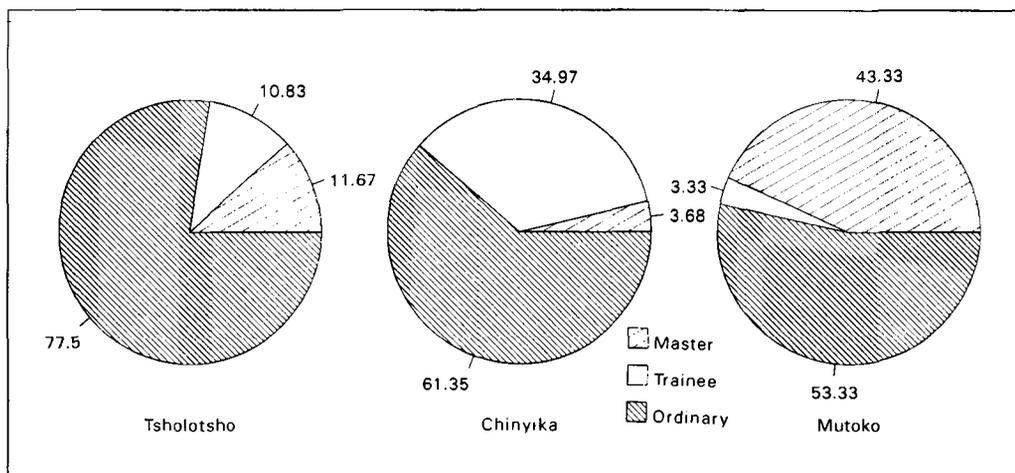


Figure 1: Proportion of the level of farmer training in the three districts in 1994.

and district. In Tsholotsho 62.2 percent of the households were headed by males compared with 84.3 percent in Chinyika and 80.4 percent in Mutoko.

Production constraints and coping strategies

Most farmers had a critical shortage of draught power. Out of 451 respondents, 48.6 percent did not have any draught animals. In Tsholotsho, Chinyika and Mutoko, 32.5 percent, 50.6 percent and 36 percent,

Table 1: Mean ownership (head ± se) of steers, bulls, cows and donkeys in the three districts in 1994.

	District		
	Tsholotsho	Chinyika	Mutoko
Steers	1.4±0.17	2.4±0.15	0.8±0.10
Bulls	0.1±0.03	0.4±0.07	0.01±0.01
Cows	1.9±0.26	0.3±0.22	0.8±0.01
Donkeys	0.9±0.15	0.02±0.02	0.00±0.00

respectively, had at least five animals. The majority of those who did not have DAP (54.5 percent) were allowed access to relatives' or neighbours' draught animals.

On the other hand, 36 percent of the respondents with less than two draught animals teamed up with relatives. The remainder hired draught or worked in others' fields in return for draught use.

Tsholotsho had the highest number of draught cows followed by Mutoko. Tsholotsho is the only district where a large number of donkeys are used for draught. There are no donkeys at all in Mutoko.

Of those farmers with cattle (232), the majority cited disease as the main constraint in cattle production. Of those who cited disease, 78.9 percent ranked it as the major constraint (Table 2). The major diseases were said to be tick-borne (redwater and heartwater) and eye infections in summer. Six farmers complained that they had constraints in contacting veterinary officials or that their response to emergencies was too slow.

Shortage of grazing was the second major constraint. Of those who mentioned grazing as a constraint, 60.7 percent ranked it as the most important constraint (Table 2). Most of the farmers alleged that grazing was particularly a constraint in the dry season. However, in Chinyika each farmer was allocated some land and there was no competition between grazing land and arable land. In a follow up discussion with 11 farmers in Mutoko all the farmers indicated shortage of grazing land as one of the main constraints in the area.

Other constraints mentioned were shortage of drugs, dipping, cattle rustling, drought and water shortage. One farmer

Table 2: The results of the discussion with farmers on their constraints with cattle (percent) and the rankings.

Rank	Grazing	Disease	Dipping	Labour	Drugs	Theft
1	60.7	78.9	41.1	40.0	50.0	18.6
2	31.6	16.4	44.6	40.0	40.0	65.1
3	7.5	4.7	14.3	20.0	10.0	16.2
n	79	152	56	20	58	43

mentioned the cost of hiring draught as prohibitive, and two farmers cited restocking, labour shortages and low calving rates as constraints to animal production. Fertiliser was also cited as one of the production constraints due to its prohibitively high cost. Those who have cattle use dung manure as an alternative. Restocking after the severe drought of 1992 was a particularly serious constraint with only 1.1 percent of farmers in Chinyika managing to restock. All respondents in Mutoko and Tsholotsho failed to restock.

Relationships between DAP use and tillage practices

Results in Table 3 show that most farmers in Mutoko and Tsholotsho plough their fields only once whilst the majority of farmers (75.6 percent) in Chinyika plough twice. Even though ridging has been found to be very

useful in low rainfall areas (in terms of moisture conservation), quite a substantial number (93 percent) of farmers in Tsholotsho were found not to have adopted this practice. In Chinyika, weeding using cultivators was common. Ownership of this ox-drawn implement is higher in Chinyika than in Mutoko, where one in every 12 farmers owned at least a cultivator.

Crop yield and hectarage

Although maize is the staple crop in Zimbabwe, millet was the most commonly grown in Tsholotsho (Tables 4 and 5) mainly due to the low rainfall in the area. Other crops are considered minor. In Chinyika, maize — bean inter-cropping was very common. The highest maize yields were obtained in Chinyika (Table 4).

Table 3: Frequency of ploughing, ridging and cultivation in Tsholotsho, Chinyika and Mutoko districts (percent).

Frequency	District								
	Tsholotsho			Chinyika			Mutoko		
	P	R	C	P	R	C	P	R	C
0	27.78	92.85	47.62	11.05	18.61	11.63	4.58	28.10	77.12
1	71.43	5.56	38.89	13.37	66.86	37.21	54.90	69.28	21.57
2	0.79	1.59	13.49	75.58	14.53	51.26	37.91	1.96	1.31
3	0.00	0.00	0.00	0.00	0.00	0.00	2.61	0.66	0.00
n	126	126	126	172	172	172	153	153	153

P = ploughing, R = ridging, C = cultivation.

Table 4: Mean crop yields for the 1993/94 growing season (kg/ha).

Crop	District		
	Tsholotsho	Chinyika	Mutoko
Maize	217.64	4502.12	335.81
Millet	383.23	0.00	0.00
Sorghum	49.02	0.00	0.00
Sunflower	15.79	366.76	49.30
Groundnuts	87.66	118.50	23.98
Bambara nuts	9.05	5.53	1.90
Beans	3.81	137.74	26.90
Tobacco	0.00	113.76	8.34

Table 5: Mean area allocated for each crop (hectares).

Crop	District		
	Tsholotsho	Chinyika	Mutoko
Maize	1.76	3.05	0.98
Millet	3.24	0.01	0.19
Sorghum	0.62	0.00	0.09
Sunflower	0.10	0.50	0.16
Groundnuts	0.32	0.19	0.20
Bambara nuts	0.07	0.03	0.00
Beans	0.10	0.44	0.00
Total hectare (ha)	6.21	4.22	1.62

Farmers from Mutoko were found to have the least arable land holdings. The average land holding was found to be 6.21 ha, 4.22 ha and 1.62 ha for Tsholotsho, Chinyika and Mutoko, respectively.

For maize production, the majority of the farmers in Tsholotsho (69.41 percent) used a span of four for tilling operations unlike in Chinyika (7.79 percent) and Mutoko (2.76 percent) where a two span size seemed common. There was a significant ($p < 0.001$) association between span size and total acreage in 1994. This indicated that farmers with larger holdings tended to use a larger span size. In the case of millet, 68 percent of the farmers in Tsholotsho used a span of four size whilst 100 percent and 90 percent of farmers in Chinyika and Mutoko used a span size of two, respectively.

Discussion

The fact that there was a significant association between farmer education and district suggests that there could be differences in extension efforts and arrangements in the three districts. In addition the lack of significant association between farmer education and sex implies that farmers receive the same education opportunities regardless of sex. The level of education of the farmers has a bearing on the agronomic practices and the ease with which new technologies can be adopted (Gobbins and Pranker, 1990). This proportion of trained farmers in Chinyika and Tsholotsho agrees with the findings of Francis (1993) who reported 10 to 15 percent of farmers in Chinamhora communal area as having some formal education.

The low level of farming experience in Chinyika may be attributed to the fact that it is a relatively new (1988) resettlement area. The proportion of male-headed households in Tsholotsho (62.2 percent) is below the national average of 76 percent (CSO, 1992). Except for Tsholotsho, the proportions are higher than those reported in Chikwamura (67 percent) and Gwebeni (61 percent) villages of Chinamhora communal area studied by Francis (1993). The household head is usually the principal decision maker and this has direct implications on the production system such as the type of crop grown. Crops such as groundnuts and beans are usually regarded as 'women's crops' (Truscott, 1991). Female headed households have been found to be poorer in terms of arable land ownership, DAP ownership, implement ownership and access to agricultural loans (Shoko and Sithole, 1995).

The majority of the farmers surveyed had a critical shortage of draught power. This confirms earlier work by other researchers e.g. Mudimu, (1983); Ndoro (1989); Francis (1993); Muvirimi (1995). That there is great variability in cattle ownership in the different Natural Regions has been reported elsewhere (Ellis-Jones *et al.*, 1994). Special arrangements for DAP use have also been reported by Muchena (1989) and Francis (1993) who

found that about a quarter of draught hiring involves helping relatives who have no cattle.

The high proportion of draught cows in Tsholotsho is intriguing. Cows have been reported to be 20 to 30 percent less efficient for draught than oxen (Howard, 1980). On the other hand, some workers (Zerbini *et al.*, 1992; Zerbini *et al.*, 1993) have argued that with adequate nutrition cows can be a reliable source of draught power.

According to the farmers, the implications of having no or inadequate draught were delays in planting and failure to carry out winter ploughing. This had an adverse effect on crop yields. They said that crops grown in winter ploughed fields had better chances of survival in seasons of drought. However, most farmers did not winter plough their fields since crop residues form an important livestock feed source particularly in the dry season.

Tick-borne diseases, which were cited in this study as one of the main constraints in cattle production, have also been reported elsewhere (GFA, 1987; Hagmann and Prasad, 1994) as important in animal health in communal areas. Shortage of grazing land was also mentioned as one of the main constraints in the area in follow up discussions with farmers. Most respondents suggested the use of winter supplements and paddocking of grazing areas as possible solutions. Farmers, however, could not afford the costs required to implement these programmes.

The finding that farmers in Chinyika ploughed their fields twice is due to the high adoption of winter ploughing in this area. The absence of ridging in Tsholotsho may be caused by the low crop yields obtained in this region (NR IV) relative to the effort required to construct the ridges as well as the shortage of DAP. Ridging has been described as very labour demanding (Hynes and Mashavira, 1995). The absence of the ox drawn cultivators tends to constrain the timely implementation of weeding. Weeding is a very labour intensive operation. However, some farmers said that they used ox-drawn ploughs stripped of the mouldboard in place of cultivators.

The highest maize yields were obtained in Chinyika. This was probably a result of

better rainfall and soil in Chinyika compared to the other two areas. The maize yields in Mutoko and Tsholotsho were low, falling below the range of 900 to 4900 kg/ha reported for communal areas by GFA (1987) and Waddington *et al.* (1991). The problem of poor maize yield in Tsholotsho is alleviated by production of other cereals like millet.

A span of two oxen takes about three and a half days to plough a hectare of land on a wet soil (Francis, 1993). The use of a two span size in Mutoko is most likely to be a result of the low draught animal numbers. There was a significant ($p < 0.001$) association between span size and total acreage in 1994. This indicated that farmers with larger holdings tended to use a larger span size.

Conclusions

Most smallholder farmers in Chinyika, Tsholotsho and Mutoko do not have adequate DAP. Non-owners make hiring arrangements for cash or in kind. Cattle were predominantly used for draught work such as ploughing, planting, cultivation, ridging and transportation. Donkeys were relatively uncommon except for Tsholotsho. Farmers with adequate DAP can carry out timely work and winter ploughing. Draught animals are an important source of manure. The main constraints of animal production were disease (mainly tick-borne) and grazing. Other constraints identified were cost of veterinary drugs, cattle rustling and the high cost of hiring DAP or restocking after droughts. This diagnostic study showed that there was a vicious cycle in the smallholder systems which links inadequate DAP, low crop yields due to small cultivated area, and inadequate nutrition.

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