Draft animal power potential and utilisation in the Tonota District of Botswana

by

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This paper is published in: Starkey P and Kaumbutho P (eds), 1999. *Meeting the challenges of animal traction*. A resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA), Harare, Zimbabwe. Intermediate Technology Publications, London. 326p.

Abstract

This paper examines the status of draft power availability for crop production on traditional farms in the Tonota Agricultural District of Botswana with particular reference to draft animals. The results of a survey of 9 extension areas and secondary data from station records showed that 36% of the farmers owned donkeys while 17% and 2% owned cattle and tractors, respectively. Another 17% obtained draft power through hiring: donkeys (7%), cattle (3%), and tractors (7%). A substantial proportion (28%) of the farmers used other sources of power or a combination of various available resources.

Out of a total of 12,000 hectares plowed and planted in the 1990/91 cropping season 69% was plowed by animal traction, 25% by tractors and 6% by unspecified sources. However, in spite of the large potential power available on the farm only 37% of the available arable land was cultivated. Tractors constituted only 9% of the power resources but contributed 25% to the power needs in the district for crop production.

It was generally concluded that the available power sources are currently either unutilised or grossly under-utilised. Furthermore, the potential use of the fresh dung from draft animals as a source of renewable energy for fuel and manure as done in other parts of the world has not been exploited. The amount of dung available could produce substantial quantities of biogas or dung-cakes for fuel.

Introduction

Draft animals are the main sources of farm power in Botswana, especially for small-scale farmers. The animals are used mainly for field operations such as plowing, harrowing, planting and weed control. The major off-farm activity the animals are used for is transportation of water, farm produce, firewood and the farm family. For instance Baker (1988) reported that in the Shoshong and Makwate Districts of Botswana, 66% of animal traction hours were used for transportation during the 1983–84 season. In general, animals, especially donkeys, are used throughout the year for these off-field activities whereas tractors are used mainly for 3–4 months of the year, making them a grossly underutilised source of farm power.

Draft animals as potential sources of fuel and manure

Draft animals are also a valuable source of renewable energy as a potential source of biogas and manure from their wastes. Sahu (1986) reported that in the North-East Hill Region of India a total fresh dung output of 8134 tonnes yielded about 309 x 10^6 litres of biogas (927 x 10^6 kcal) or 2036 tonnes of dung-cakes (479.5 x 1^{06} kcal) per day. The quantity of manure available per day came to about 1952 tonnes. However, in Botswana, this potential source of fuel and manure is currently not being utilised. Development work being carried out by the Rural Industries Innovation Centre (RIIC) in Kanye on biogas technology may address this problem in future.

Current use of draft animals in Tonota District

Over 80% of the population in the Tonota Agricultural District are engaged in farming operations of one sort or another. The traditional system of farming, like in the rest of Botswana, is based on animal traction. Recent surveys (Chipo, 1992) have shown that over 80% of the farmers in Tonota still use animal traction for growing their crops. Animal traction contributesg 89% of the power needs for crop production in the district. Consequently the proportion of land area actually planted to available land is small. For instance Chipo (1992) reported that out of a total of 32,000 ha of de-stumped land available for crop

production in the district during the 1990/91 period only 37% was actually plowed and planted.

Tractor mechanisation

Tonota Agricultural District lies in the north-eastern part of the country where the predominantly clay soils have good potential for a fully mechanised farming system. However, the high purchase and hiring cost of tractors and the low levels of returns on investment because of low yields have tended to retard the development of tractor mechanisation. This is true not only in this region but throughout the country. The major contributing factor to the low yield is the low, poorly distributed and generally unreliable rainfall.

Materials and methods

Data were collected from the records of the Agricultural Demonstrators and surveys conducted in the District during the 1991/92 and 1992/93 cropping seasons. Ten farmers were randomly selected from each of the 9 'extension areas' within the District. Information was sought on ownership and use of draft resources and their contribution to the area of land cultivated. The total available power in the district was estimated using values previously quoted by Kemp (1987).

Results

Ownership and usage of draft power sources

The survey on draft power ownership and usage, presented in Tables 1 and 2, shows that approximately 63% of the farmers in the district owned or hired animal draft power (cattle 20%, donkeys 43%) for cultivating their fields. About 17% of farmers owned cattle while the remaining 3% obtained cattle draft power through hiring. A high proportion of the farmers (36%) owned and used donkey draft while 7% of them hired donkey power from local farmers. Another 9% of the farmers used tractor draft even though only 2% of the farming population owned tractors. A substantial proportion (29%) of the farmers used other sources or a combination of various resources.

The Matshelagabedi extension area had the lowest number of farmers who owned tractors (0.4%) followed by Matsiloge (1%). More farmers used their own tractors in the Mabesekwa area

Table 1: Ownership and use of draft power resources in Tonota District

		Percentage of households using the following power sources						
		Cattle		*Donkeys*		*Tractors*		
Extension area	*No. households*	*Own*	*Hire*	*Own*	*Hire*	*Own*	*Hire*	*Other*
Matsiloge	400	8	0	80	8	1	3	2
Mabesekwa	250	30	13	17	0	5	11	24
Matshelagaberdi	260	15	0	31	8	<1	4	42
Tonota West	550	28	4	27	9	2	5	25
Tati Siding	380	21	5	26	11	2	7	28
Shashe	650	15	3	33	6	1	14	27
Thalogang	500	18	1	40	10	2	6	23
Tonota East	435	13	2	29	7	2	2	44
Shashe Mooke	377	3	1	38	3	1	9	45
Means	422	17	3	36	7	2	7	29
Overall means	422	20		42		9		29

Table 2: Available draft power in Tonota District

Extension area	Total power available (kW)	Available draft power: Cattle Power (kW)	Cattle % of total	Donkeys Power (kW)	Donkeys % of total	Tractors Power (kW)	Tractors % of total	Power/unit of cropped area (kW/ha)
Matsiloge	552	240	44	211	38	101	18	0.6
Mabesekwa	580	175	30	0	0	405	70	0.4
Matshelagaberdi	310	52	17	224	72	34	11	0.4
Tonota West	1207	385	32	484	40	338	28	0.6
Tati Siding	732	228	31	268	37	236	32	0.7
Shashe	954	260	27	458	48	236	25	0.8
Thalogang	834	300	36	264	32	270	32	0.3
Tonota East	862	218	25	306	36	338	39	1.0
Shashe Mooke	551	151	27	265	48	135	25	0.7
Total	6582		30		39		31	0.6

Notes: Calculated on the assumptions that cattle can develop 0.5 kW but only 10% are available for work, donkeys can develop 0.4 kW and 70% are available for work whereas tractors develop an average of 40 kW and 75% are in use.

(5%) than the other areas. Shashe, with a farming population of 650 households showed the highest number of people (14%) who hired tractor power for plowing purposes.

Current status of draft power

The estimated draft power resources in the district are shown in Table 2. A total of 6,582 kW of power are available for crop production with an average of 730±270 kW per extension area. Sixty-nine percent of the known sources of power are provided by draft animals (30% from cattle and 39% from donkeys). Tractors contribute 31% to the total available power in spite of the fact that only 2% of the farming population own tractors. A maximum of 89% of the power available in Matshelagabedi was obtained from animals while Mabesekwa obtained 70% from tractors.

Tonota West had the highest amount of available power followed by Shashe while the lowest was from Matshelagabedi. The average draft power available per cropped area was 0.6± 0.2 kW/ha. Tonota East had the highest available power per cropped area (1.0 kW/ha) while Thalogang had the least (0.3 kW/ha).

Contribution of draft sources to cultivated areas

A total of 11,900 hectares, constituting 37% of the available arable land area, was cultivated during the period under review (Table 3). Draft animal power was used for cultivating 69% of the land area (23% by cattle and 46% by donkeys) while tractors cultivated 25% of the area. The remaining 6% was cultivated by other sources including hand tools and a combination of tractors and animals.

In the Matsiloge extension area 79% of the land was cultivated using donkey power with 8% and 11% being contributed by cattle and tractors, respectively. Tractor power contributed 51% to the land area cultivated in the Mabesekwa extension area whereas cattle contribution was highest (40%) in the Thalogang area.

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Table 3: Contribution of draft power sources to area cultivated, by extension area

Extension area	*Cultivated area (ha)*	*% of total area*	*Percentage of area cultivated with:*			
			Cattle	*Donkeys*	*Tractors*	*Others*
Matsiloge	870	25	8	79	11	1
Mabesekwa	1560	43	32	13	51	5
Matshelagabedi	840	31	24	56	12	8
Tonota West	2150	47	12	61	2	4
Tati Siding	1000	27	30	50	316	4
Shashe	1250	36	20	44	29	7
Thalogang	2500	37	40	40	14	6
Tonota East	900	30	16	35	38	12
Shashe Mooke	820	26	7	49	34	10
Mean per extension area	1320	37	23	46	25	6

Potential of draft animals as sources of energy for fuel and manure

The estimates for fresh dung produced by draft animals and its potential energy values are presented in Table 4. A total of 59,400 tonnes of fresh dung were produced which yielded 230×10^6 litres of biogas with a heating value of 680×10^3 kcal per day. The dung cake that could be produced amounted to 14,800 tonnes with a heating value of 390×10^3 kcal per day. The quantity of manure to be obtained per day amounted to 14,300 tonnes. There were large variations in the total amount of fresh dung produced in extension areas; the mean production was 6,600 tonnes with a standard deviation of 2,800 tonnes per day.

Discussion

The ownership and use of tractors is at a low level in Tonota and throughout the country and will continue to be so for quite a while. This is largely due to the high purchase price and running cost which most rural farmers cannot afford. The tractor is also considered uneconomical because of the low yields obtained as a result of the low and unreliable rainfall patterns (MoA, 1991). However, due to the drought relief programme in which the government pays for plowing, planting and support services more farmers are now hiring tractor for cultivating their lands. For instance in Shashe, 14% of the farmers use tractors even though only 1% of them own tractors.

The use of cattle for draft purposes will continue to drop because of the animals' susceptibility to drought and the high prices the Botswana Meat Commission is now offering for high quality meat. Farmers are turning to donkeys and tractors for plowing their fields. The power available per unit area of cropped land is quite high (0.6 kW/ha) as compared to the 0.4 kW/ha suggested by Giles (1975) for optimum crop production. This may be misleading as only 37% of the land is cultivated. The actual power for cultivating the available land area averages about 0.2±0.06 kW/ha per year, the highest (0.3 kW/ha) being observed in the Tonota East extension area.

The potential of the animals as sources of renewable energy and manure is enormous especially when the non-draft animals are included in the calculation. The large amount of fresh dung and its corresponding heat value serve as potential sources of domestic heat for cooking and other activities in the home. The dung-cake is a vital source of heat in India and other parts of the world where conventional fuel is scarce or where the continued use of wood fuel poses a threat to the environment. This could be an important alternative to the use of wood in the rural areas of Botswana where the vegetation is under constant

Table 4: Potential alternative energy sources from draft animals in Tonota District

		Energy through biogas/day[2]		*Energy through dungcake/day*[2]		
	Fresh dung[1] ***(t/day)***	***Biogas (x10³ l)***	***Useful heat (x10³ kcal)***	***Dung cake (t/day)***	***Useful heat (x10³ kcal)***	***Manure (t/day)***
Matsiloge	7100	270	809	1800	417	1700
Mabesekwa	5200	197	590	1300	304	1200
Matshelagaberdi	1500	59	175	400	90	400
Tonota West	11400	433	1300	2800	669	2700
Tati Siding	6700	256	769	1700	396	1600
Shashe	7700	292	877	1900	449	1800
Tlialogang	8900	337	1000	2200	521	2100
Tonota East	6400	244	733	1600	378	1500
Shashe Mooke	4500	170	509	1100	262	1100
Total	59,400	2258	6762	14,800	3488	14,300
Average/extension area	6600	251	753	1600	388	1600

Notes:
1) Calculated on the basis that cattle with an average size of 200 kg produce 5400 kg of dung per year, while a donkey weighing 150 kg produces 2700 kg/year (Stout, 1979)
2) 1 tonne of fresh dung yields 38 x 10^3 litres of biogas and 250 kg of dung-cake. One litre of biogas yields 3 kcal of useful heat while 1kg of dung-cake gives 235 kcal of useful heat (Pandya, 1980)

threat of drought, overgrazing by domestic animals and damage by wildlife such as elephants.

Conclusions

Although a large amount of power exists in the Tonota District for draft purposes, only a small proportion of the total land area is cultivated because of the unfavourable climatic conditions which restrict the plowing activities to a very short period, and the poor economic status of the rural farmers which prevents them from purchasing tractors to address this shortfall. However, as tractors are considered inefficient because of the high operating costs due to limited annual use, an appropriate solution would be to improve the animal traction technology through the development of appropriate tools and the selected use of power machine systems. As the continued use of firewood for fuel is detrimental to the already fragile environment, it is necessary to develop technologies that fully utilise the vast potential of draft and non-draft animals as sources of renewable energy, not only for the farm but for domestic use as well. To meet the future power needs of the farmers in the district requires an efficient use of the presently available power from draft animals, improved farm implements and a well organised tractor hiring service.

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