Comparative draft performance of oxen and heifers in northern Sierra Leone

by

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Abstract

Twelve 2½-year-old N`Dama cattle were used to investigate the draft performance of oxen and heifers under the agroclimatic conditions of northern Sierra Leone. The results indicated higher feed intake of heifers over oxen during the working and non-working period. Feed intake (dry matter) increased by 53% during the working period in both sexes. Heifers consumed significantly more (+16%) feed than oxen. The work performance as measured by speed (m/s), draft force (kN), power (kW) and area plowed and harrowed in 4 hours (ha), was significantly lower in heifers by 26, 22, 24 and 42% respectively. On wet land less draft force (-14%) and power (-21%) was required, whereas speed (+11%) and work completed (+28%) increased in comparison to dry land.

Although there are some disadvantages in using female animals for draft work, their draft performance suggests that heifers could be successfully utilised as dual-purpose animals in many smallholder mixed-farming systems provided that the draft requirement is not very high and adequate feed is available.

Introduction

In Sierra Leone, oxen are the only important draft animal species. The cost of supporting oxen can be considerable because on average they are only used for 41 working days a year for plowing and 3 days a year on harrowing, with other operations being of negligible importance (Corbel, 1988). Trained oxen may therefore spend about nine months of the year doing little or no work, yet consume valuable feed throughout the year. The possibility of using females for draft as well as milk and calf production offers a way of overcoming the disadvantages of using oxen. Besides contributing to a better utilisation of scarce food resources, the use of female animals for draft purposes would allow males to be fattened and sold at a younger age. Fewer but more productive animals on farms could reduce stocking rates and overgrazing, thus contributing to the development of a more productive and sustainable farming system. It would seem appropiate therefore to consider seriously the use of female animals rather than oxen alone for draft purposes and to encourage this actively through extension programmes. Since there is a shortage of empirical data on the draft capacity of N'Dama heifers under the agroclimatic conditions of Sierra Leone, this study was undertaken to compare the draft performance of oxen and heifers.

Materials and methods

Twelve 2½ year old N'Dama cattle (six oxen and six heifers) were selected for this study. The animals were housed individually in a shed, had free access to water except when working and were trained for agricultural traction as described by Starkey (1982). The animals were fed local grass plus ground maize grain given at the rate of 0, 0.5 and 1 kg/head/day during the working period. Feed intake was measured during both the working and non-working period. Three groups of draft animals, each consisting of a pair of oxen and a pair of heifers were formed on the basis of body weight, physical fitness, size and compatibility. They were compared when they plowed and harrowed well-developed and partly-developed uplands and inland valley swamps for four hours a day during the dry season. The animals worked three days a week, at high (plowing) or low (harrowing) intensity following a change-over design. A different group of two teams worked every day beginning at 08:00h and finishing at 12:00h. Draft force, speed and area cultivated were measured. Power was calculated by multiplying force (kN) by speed (m/sec).

Least square means were obtained for the various work performance parameters, and differences between the means were tested for statistical significance using Student's t-test.

Table 1: Mean dry matter intake (grass) of oxen and heifers during the working and non-working period

	Dry matter intake (g/kg liveweight $^{0.75}$)		
Sex	***Non-working period***	***Working period***	***Average***
Oxen	91.86±0.45^{a}	136.12±1.12^{a}	113.99±0.79^{a}
Heifers	102.68±0.80^{b}	162.38±1.45^{b}	132.53±1.13^{b}
Average	97.27±0.63^{A}	149.25±1.29^{B}	123.26±0.96

a,b) Within column means with different superscripts are significantly different (p<0.05)
A,B) Between column means with different superscripts are significantly different (p<0.05)

Results and discussion

Table 1 shows the mean dry matter intake of grass by oxen and heifers during the working and non-working periods.

Heifers consumed 16% more dry matter (g per kg metabolic body size) than oxen. Both sexes consume more during the working period. This difference was more pronounced in heifers (58 vs 48%). The difference observed in feed intake between the two sexes may be due to the fact that heifers have a lower ability to mobilise body reserves, especially during work. The increase in feed intake during the working period indicates that the animals were able to meet their high energy requirements by eating more, since they did not lose weight during the working period.

The speed, draft force, power and area cultivated by oxen and heifers on dry and wet land during plowing and harrowing are presented in tables 2, 3, 4 and 5, respectively.

During plowing and harrowing the animals were able to generate an average speed of 0.50 m/sec, a draft force of 0.41 kN and a power of 0.22 kW. They cultivated an area of 0.41 ha/day.

Oxen had a significantly (P<0.05) faster speed of working than heifers. The type of land and work done significantly (P<0.05) affected the working speed. An 11% higher speed was recorded on wet land compared to dry land. The speed of harrowing was 15% higher than the speed of plowing.

Table 2: Speed (m/sec) of oxen and heifers during dry and wet land plowing and harrowing

	Dryland			***Wetland***			***Average***		
	Oxen	***Heifers***	***Mean***	***Oxen***	***Heifers***	***Mean***	***Oxen***	***Heifers***	***Mean***
Plowing	0.50 ±0.18	0.35 ±0.22	0.43^{bB} ±0.20	0.55 ±0.33	0.40 ±0.27	0.48^{Ab} ±0.30	0.53 ±0.26	0.38 ±0.25	0.46^{b} ±0.26
Harrowing	0.57 ±0.18	0.42 ±0.13	0.50^{aB} ±0.16	0.62 ±0.25	0.48 ±0.21	0.55^{Aa} ±0.23	0.60 ±0.22	0.45 ±0.17	0.53^{a} ±0.20
Average	0.54 ±0.18	0.39 ±0.18	0.47^{B} ±0.18	0.59 ±0.29	0.44 ±0.24	0.52^{A} ±0.27	0.57^{A} ±0.27	0.42^{B} ±0.21	0.50 ±0.23

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Table 3: Draft force (kN) of oxen and heifers during dry and wet plowing and harrowing

	Dry land			*Wet land*			*Average*		
	Oxen	***Heifers***	***Mean***	***Oxen***	***Heifers***	***Mean***	***Oxen***	***Heifers***	***Mean***
Plowing	0.56 ±0.18	0.45 ±0.15	0.51^{aA} ±0.17	0.50 ±0.22	0.41 ±0.20	0.46^{aB} ±0.21	0.53 ±0.20	0.43 ±0.18	0.48^{a} ±0.19
Harrowing	0.40 ±0.21	0.31 ±0.23	0.36^{bA} ±0.22	0.35 ±0.23	0.24 ±0.17	0.30^{bB} ±0.20	0.38 ±0.22	0.28 ±0.20	0.33^{b} 0.21
Average	0.48 ±0.20	0.38 ±0.19	0.44^{A} ±0.20	0.43 ±0.23	0.33 ±0.19	0.38^{B} ±0.21	0.46^{A} ±0.21	0.36^{B} ±0.19	0.41 ±0.20

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Table 4: Power (kW) of oxen and heifers during dry and wet land plowing and harrowing

	Dry land			*Wet land*			*Average*		
	Oxen	***Heifers***	***Mean***	***Oxen***	***Heifers***	***Mean***	***Oxen***	***Heifers***	***Mean***
Plowing	0.30 ±0.20	0.22 ±0.18	0.26^{aA} ±0.19	0.46 ±0.21	0.24 ±0.11	0.35^{bA} ±0.16	0.42 ±0.22	0.22 ±0.12	0.32^{b} ±0.17
Harrowing	0.24 ±0.16	0.20 ±0.13	0.22^{bA} ±0.15	0.19 ±0.12	0.13 ±0.05	0.16^{bB} ±0.09	0.22 ±0.14	0.17 ±0.09	0.20^{b} ±0.12
Average	0.27 ±0.18	0.21 ±0.16	0.24^{A} ±0.17	0.21 ±0.16	0.16 ±0.08	0.19^{B} ±0.12	0.25^{A} ±0.17	0.19^{B} ±0.12	0.22 ±0.15

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Table 5: Area cultivated (ha/d) by oxen and heifers

	Dry land			*Wet land*			*Average*		
	Oxen	***Heifers***	***Mean***	***Oxen***	***Heifers***	***Mean***	***Oxen***	***Heifers***	***Mean***
Plowing	0.38 ±0.22	0.20 ±0.13	0.29^{bB} ±0.18	0.46 ±0.21	0.24 ±0.11	0.35^{bA} ±0.16	0.42 ±0.22	0.22 ±0.12	0.32^{b} ±0.17
Harrowing	0.55 ±0.20	0.31 ±0.12	0.42^{aB} ±0.16	0.68 ±0.19	0.44 ±0.14	0.56^{aA} ±0.17	0.62 ±0.20	0.38 ±0.13	0.50^{a} ±0.17
Average	0.47 ±0.21	0.26 ±0.13	0.36^{B} ±0.17	0.57 ±0.20	0.34 ±0.13	0.46^{A} ±0.17	0.52^{A} ±0.21	0.30^{B} ±0.13	0.41 ±0.17

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Oxen exerted a significantly higher average draft force than heifers (oxen: 0.46 kN, heifers: 0.36 kN). This is because they were able to sustain the effort required over a longer period. On dry land, the animals had to exert a 14% higher draft force than on wet land. Plowing had a (31%) shigher draft requirement (0.48 kN) than harrowing (0.33 kN). Oxen developed a significantly higher tractive power (0.25 kW) than heifers (0.19 kW). A significant difference ($P<0.05$) was observed in the tractive power developed on dry and wet land, and during plowing and harrowing. Both sexes had to develop higher tractive power when working on dry land (oxen: 0.27 kW, heifers: 0.21 kW). The tractive power developed during plowing was 17% higher than that developed during harrowing.

The draft capacity of oxen was significantly ($P<0.05$) higher than that of heifers due to a difference of 0.15 m/sec greater working speed on a 0.06 kW greater generation of power. As a result, oxen plowed and harrowed significantly more area per day (0.52 ha/d) than heifers (0.30 ha/d).

These results indicate that heifers can be effectively used for light cultivation which does not require high draft force. Sex differences amounted to 48% in plowing but only 39% in harrowing. This finding agrees with that of Monnier (1965). However, in order to generate enough force two heifers must be used in a team, whereas a single ox could most likely be used for light work such as harrowing. Comparing our results with those reported previously, differences could be observed. This may be explained by our experimental procedure in which the animals used were young (2 years old) and had a low body weight. In turn, this would result in the work performance parameters that we have reported showing lower values.

Conclusion

Draft animals are clearly a drain on farm resources and their numbers should be minimised within a given work programme. This objective can be achieved by using females instead of males for work purposes. In summarising the results of this study, it is evident that oxen generally exhibit a better draft performance than heifers. However, heifers with the appearance of poor muscle development could match their work output. Although heifers perform less work for more energy intake compared to oxen, their low draft performance is compensated by the production of other products in addition to draft work. Their favourable work output suggests that they could be used for heavy work (such as plowing) for short periods of time without adverse effects or can be effectively used for light work that does not require high draft force.

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