

Relationship Between Husbandry Practices, Animal Live-weight, Body Condition and Field Performance of Draught Horses when Ploughing

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Abstract – The present study examined the effect of some work horses husbandry practices on their live weight, body condition and field performance when ploughing. The research adopted the cross-sectional design on a sample of 90 farmers randomly selected from 10 villages. Field data were collected using formal survey questionnaire and direct field measurements. Dependency between husbandry practices and field performance was tested using the chi square test. The results showed that husbandry practices were less than optimal which reflected on horses' live weight. The only significant relationship was established between regularity of veterinary care and live weight ($p \leq 0.05$). Horses mostly worked at moderately low to low forward speed and field capacity. Field efficiency was rather on the high side. The low performance is partly a result of poor husbandry practices and work practices that shadowed the effect of good animal management.

Keywords – Body condition, Draught horses, Field capacity and efficiency, Farming in Sudan, Harness, Live weight.

I. INTRODUCTION

Draught animal technology (DAT) or as sometimes referred to animal traction plays an important role in traditional farming in many developing countries. The technology continues to be a relevant technology in small scale agriculture. This is on farms where it is not economic or practical to use mechanical forms of power [1]. The power remains persistent where there are many small holder farmers with access to animals and fodder and where most people do not have access to affordable motor-powered transport or tractors [2]. Reference [3] regarded animal power as a sustainable form of power which can greatly reduce the enormous problems being encountered by the rural farmers. Most small scale farmers cannot afford the use of tractors; therefore, animal drawn equipment can provide power and take drudgery out of land preparation. Reference [4] went farther and suggested that within the foreseeable future there is unlikely to be a viable alternative to draught animal power and therefore, it becomes an important consideration in sustainable rainfed agriculture. On this ground [5] concluded that the use of animal traction is very important and so more scientific attention is needed. Further, [1] suggested that continued investigation on the management of working animals in the different agro-ecological zones in which they are found would seem to be justified by researchers; stressing on the importance of translating the knowledge into practical use by farmers in enabling them to improve the effectiveness with which they use animal power for crop production and transport.

In Sudan draught animal technology had been used in agriculture and transport for centuries along the Nile Valley. In the past few decades the technology was introduced to the traditional rainfed farming system as a strategic alternative to manual labour to assist farmers achieving food security through horizontal expansion. The main focus was on reducing work drudgery and providing power alternatives to a very fragile system with low or no access to motorized power; not to mention the environmental threats imposed by the latter. Despite the success of the technology, it did not receive considerable attention from academic and research institutions and its application and adoption remained limited. Information on work animals performance in relation to husbandry practices in Sudan is scanty or absent; at least in the published form. Therefore, this study was carried out to achieve the following objectives:

- To explore the variations in workhorses body condition and live weight.
- To identify the effect of some husbandry practices on horse body condition and live weight.
- To evaluate the effect of these husbandry practices on filed performance (field capacity and work speed).

II. MATERIALS AND METHODS

Study area

Field data for this study was collected in EN-Nhoud locality, Western Kordofan State, Sudan to investigate the effect of work horses' husbandry practices on its body condition, live weight and field performance when ploughing. EN-Nhoud locality is located in the semi-arid savannah zone. The locality consists of five rural councils. Different tribes live in the area with the *Hamar* being dominant. Most of the population depends on crop production beside other activities like animal breeding and poultry production. The average land holding of the family is about 4.5 feddans (1 feddan = 0.42 ha), but only 60% of that area is annually cultivated [6].

The dominant system of agriculture in EN-Nhoud area is the traditional rainfed farming system which is known as a small holding farming system that is mainly characterized by being subsistence oriented. No systematic agricultural rotation is followed, and farmers always tend to the horizontal expansion to increase crop production [7]. The land is flat to undulating and there are only a few seasonal water streams (*Khors*). However, the soil is mostly sandy to sandy loam, while clay soil (*Gardood*) covers the southern parts of the area. Groundnuts, hibiscus "*Karkade*", sorghum, sesame and water melon are

the main crops in the area. The area is famous for production of groundnuts as the main cash crop [6]. The agricultural production of both food and cash crops depends mainly on family labour mostly in an agricultural sharing system. The area is well known for livestock production for milk and meat. All the farmers use the same size of animal drawn mouldboard plough (15 kg in weight, 25 cm wide and 20 cm maximum depth)

Sampling

This study was based on the cross-sectional survey design. A sample of 90 farmers was selected from 10 villages (clusters) following the systematic random sampling technique based on geographical location. The first of every four farmers was chosen along a survey line drawn across the farming area in each cluster starting at the upper end until 9 farmers had been selected.

Data collection and analysis

The main husbandry parameters considered in this study were:

- Animal health (veterinary care)
- Animal feeding practices.

Further, field capacity and efficiency were determined as direct assessments of the field performance.

Data were collected using a formal survey questionnaire in a face to face interview for literacy reasons and by direct field measurements during land preparation. Some information was recorded as observations to avoid farmers' bias on issues they can consider "sensitive". Direct field measurements were concerned with determining field capacity and field efficiency in accordance with [8] and [9]. Two stop watches and a tape measure were used to record the total and net times of operation and the land dimensions, respectively.

Other parameters computed from the field performance data were; working speed (km/h), effective field capacity (ha/h) and field efficiency (%), expressed as:

Working speed = distance of run (km) / overall time taken (h)

Then the effective field capacity (ha/h) was taken as the product of dividing the area worked (ha) by the total time (h) as follows:

Effective field capacity (F.C) = Area (ha)/Total time (h)

Field efficiency = Net productive time/Total time of operation

Body condition was determined following the horses body condition scoring system, while animal live weight was determined from the measurements of heart girth and animal length applied in a nomogram following[10].

Survey data were entered as individual readings into an SPSS computer programme (SPSS 14.0), then some of the variables were regrouped into new variables to test the dependency. Data were analysed to produce frequency and percentage tables and the different parameters were assessed using the *chi* square test. Further some relationships were assessed using Pearson coefficient of correlation (SPSS14).

III. RESULTS AND DISCUSSION

Table 1 shows animal health care parameters, feeding practices, body condition and live weight of the work horses. The majority of the farmers (60%) do not take their animals to veterinary care regularly. This is not unusual in an area where veterinary service is unavailable, inaccessible (geographically and/or financially) and unaffordable. Reference[11]reported that farmers mostly rely on local/traditional remedies because of difficulty in transportation or lack of financial resources. A considerable portion of the latter buy medicines from the veterinary pharmacies in the locality center and give it to the animals without inspection. Farmers lack experience and awareness in this regard and the inefficiency of veterinary extension and service is highly questioned particularly for those who live in comparatively far villages from the locality center where the service is stationed. The latter argument appears clearly in farmers' response regarding the suitable measures to keep the animals in a good health condition as they all focused on feeding measures and none of them mentioned vaccination and veterinary care for example. To them, stocky/fat animals are healthy regardless of other health indicators.

All the farmers except for one rely on dry feed as the basic type of feed throughout the year. This is common in the traditional rainfed farming system in Sudan, where the rainy season is short and open grazing is not common or a choice especially with equids. Dry feed is supplemented with cereals and oil seed cakes (referred to as concentrated feed) given in a mix of two types (66.7%); but cereals are offered uncrushed; a practice that [10]considered improper as it affects the digestibility of these seeds.

Farmers mostly (71.1%) tend to feed their animals three meals where all the ration is divided equally between the meals, while slightly more than one fourth (27.8%) of them feed their animals in two meals i.e. in the morning and the afternoon. Further, most (93.3%) of them feed their animals differently before the season starts by increasing the amount of feed in each ration/meal so the animal will be in a good shape when they are required to do most of the work. This practice is in accordance with the presentation made by [10]who suggested changing the feeding program before the season starts.

Almost three quarters (74.4%) of the farmers do not offer water to their animals during work. They justify this by the claim that water during work causes gases to the horses and make them slower and lazy. They completely ignore the fact that water during work reduces the heat stress effect on the animal as mentioned by [1].

Most (90%) of the surveyed horses were in a good body condition, while those in moderate and poor condition were almost similar (5.6 and 4.4%, respectively). Body condition cannot be attributed to the feeding program only; but to age, health status and species as well. However, it can still indicate to the live weight and to some extent the capacity to work.

Live weight from its side is the main indicator of animals' draught ability which is usually defined by the weight of animals as mentioned by [4]. The majority

(51%) of the horses were 200 kg and less, followed by almost one fourth (24.5%) weighing 201 – 225 kg. A considerable portion (14.4%) weighed 241 – 275 kg; and marginal portions weighed more than 275 kg. Live weight is expected to reflect on animals work output. The relationship between body conditionscore and live weight as given by Pearson's coefficient of correlation was weak ($r=0.2$) and insignificant. This suggests that animals are small in size which makes them look in better body conditions, while in fact they are light in weight.

Effect of some husbandry practices on live weight and body condition

Horses live weight is significantly ($p \leq 0.05$) affected by regular veterinary care. Reference [12] reported that donkeys with access to veterinary service in the neighbouring Ethiopia were significantly healthier and more productive compared to the ones with less frequent access to health service. Within horses taken regularly to veterinary care one half (50%) were 200 kg and less in weight (Table 2). These are followed by horses of 201 – 225 kg in weight (33.4%), while horses of 240 – 275 kg are 11.2% of the total number. Heavier horses are represented by marginal portions. The same trend is witnessed in the horses that did not receive regular veterinary care. This suggests that other factors interact with horse body weight like age and species.

Although the measures followed by farmers to keep their animals in a good health were all about feeding, they did not have a significant effect on horses live weight (Table 2). This is probably because most of the farmers (95%) followed the same feeding practices (Table 1) (giving dry feed and cereals in fixed meals); within this group the highest percentage (50.7%) were 200 kg and less, followed by horses 201 – 225 kg (26.1%) and 240 – 275 kg (14.2%). In this regard its the quality and quantity of feed that affects body weight rather than the mere focus on feeding the animal. The same trend of the effect of health measures on horses' weight is noted with times of different feeding (Table 2). One half of the horses that are fed differently before the season starts (50.6%) were 200 kg and less compared to 50.1% of the horses that are fed differently at the beginning of the season (6 in total). This, again, suggests that horses live weight is affected more by the quantity and quality rather than by the feeding practices and programs. This is supported by and is evident from the effect of frequency of animal feeding and on live weight. Almost half (48.7%) of the horses that are given three meals/day (feed 3 times/day) are 200 kg and less in contrast to 15 horses (60%) that are fed twice a day; and the same comparative trend is observed in heavier weights suggesting that the number of meals does not have much effect on horses live weight as much as feed quality and quantity does. This is because the same amount of feed is divided between different numbers of meals, hence more meals does not mean more feed offered to the animal.

Further, the effect of number of concentrated feed given to the horse on its live weight followed/had the same trend as that of the frequency of feeding and health measures. In both groups, the highest percentage of the horses were 200

kg and less (48.4% in the two types group and 56.7% in the one type group). In all the rest of the live weight groups the recorded percentages are comparable. This confirms the aforementioned argument that it's the feed quality and quantity that affects horses live weight rather than feeding practices in a farming system where all the farmers do not have access to diversified quality of feed. However, except for regular veterinary care, all the parameters considered did not have a significant effect on horses' live weight.

Body condition was as well not significantly affected by all the parameters considered (Table 3). All the horses in the good body condition category recorded consistently higher percentages when compared to the other body condition categories.

Field capacity and efficiency/work output

Table 4 shows work output data. Work speeds are on the moderately low to low side (less than 2.5 km/h) for the majority of the farmers (57.7%), while one fifth (20%) worked at moderate speed (2.5 km/h and less than 3.0 km/h). Moderately high to high speed (3.0 km/h to 5.0 km/h) was recorded by slightly more than one fifth (22.1%) of the farmers. In general the different ranges are in accordance with [11] and [13] who worked in the same study area.

Most of the farmers (83.3%) worked at relatively low field capacities (0.1 ha/h and less), while those who worked at moderately high to high capacities were 12.2% and 4%, respectively. These ranges are comparable to those reported by [11].

Almost equal numbers of the farmers worked at efficiencies of 70 – 79% and more than 90%, while those who worked at moderate efficiencies were 12.2%. Low efficiencies were recorded by 17.8% of the farmers. These ranges are slightly different than those recorded by [11] and [13] in the same farming system. Obviously field efficiency is decided by the time lost during field operations as determined by the operator's experience rather than by husbandry practices of the animal.

Horse body condition did not have a significant effect on work speed with horses in good body condition recording comparatively higher work speeds (Table 5).

In all the live weight ranges the highest percentage of horses worked at moderately low to low forward speed. In the moderately high speed categories (2.5 km/h and less than 4.0 km/h) heavier horses recorded comparatively higher percentages. Altogether the results did not establish any significant relationship.

Distribution of work speed within each live weight category did not follow a particular pattern. This suggests that work speed is not solely affected by live weight and other factors can have greater influence on it. Further, the same trend is observed with field capacities in all the live weight ranges. The highest percentages recorded moderately low to low field capacities, while within each live weight category a general trend could not be established. Both results are in accordance with [1] who mentioned that "although it has been suggested that draught animals should be in good condition, with adequate fat reserves to work efficiently, there is little

conclusive evidence to show that animals in good body condition work faster and/or longer than those in poor condition at the start of the working season”.

Contrary to farmers’ belief, giving horses water during work did not significantly affect their work speed (Table 5). In all the speed ranges the results of both groups are comparative; and in this case it is better to give the horse water to reduce the heat stress and supplement any losses through sweating.

Veterinary care did not affect horses’ capacity to work and in all the field capacity ranges results of the horses not receiving regular veterinary care are comparable to those taken regularly to the veterinary center. This is further confirmed by the fact that time of different feeding did not have significant effect on field capacity as well. Horses that received extra feed before the season starts mostly (84.4%) worked at moderately low to low field capacities (0.06 – 0.1 ha/h) and 0.05 ha/h and less, respectively). This is in accordance with the same statement of [1].

Horse body condition did not significantly affect its work output. In the moderately low to low field capacity ranges comparable results are observed/witnessed/recorded. Further, animals in good body condition were the only ones recording moderate to high field capacity ranges (0.11 – 0.14 ha/h and 0.15 – 0.20 ha/h, respectively).

IV. CONCLUSION

Husbandry practices of work horses are rather on the weak side in the study area. This is a direct result of lack of capacity and information on the proper practices for profitable and sustainable application of draught animal technology. Horses live weight is on the low side and this reflected on work speed and field capacity which were both on the moderately low to low range. All the husbandry practices did not have a significant effect on live weight, work speed and field capacity. Field efficiency was on the high range probably as a result of the operators’ skills in adjusting/adapting to work situations.

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Table 1: Frequency Distribution and Percentage of Work Horses by Husbandry Parameters

	Frequency	Percentage
Regularity of animal veterinary		
Regular	36	40
Irregular	54	60
Measures followed to keep the animal in a good health		
Adequate supply fodder	1	1.1
Adequate supply fodder, supplements and concentrates	85	94.4
Adding food supplement and concentrates	1	1.1
Adequate fodder and feed supplement	3	3.3
Number of concentrated feed given to the animal		
Two types	60	66.7
One type	30	33.3
Basic type of feed during the year		
Concentrated feed	1	1.1
Dry feed	89	98.9
Frequency of animal feeding		
3 time	64	71.1
2 times	25	27.8
4 times	1	1.1
Times when animals are fed differently		
At the beginning of season	6	6.7
Before the beginning of the season	84	93.3
Giving animals water during work		
Yes	23	25.6
No	67	74.4
General status of animal (Body Condition)		
Good	81	90
Moderate	5	5.6
Poor	4	4.4
Live Weight (Kg)		
200 kg and less	46	51.1
201 - 225	22	24.4
240 - 275	13	14.5
276 - 300	7	7.7
301 - 350	2	2.2

Table 2 : Frequency Distribution and (Percentage) of Work Horses by Live Weight and Husbandry Parameters

	Live weight (kg)				
	200 kg or less	201 - 225	240 - 275	276 - 300	301 - 350
Regularity of Animal veterinary care					
Regular	18 (50.1)	12 (33.4)	4 (11.2)	5 (14.0)	1 (2.8)
Irregular	28 (52.1)	10 (18.7)	9 (16.7)	15 (28.0)	1 (1.9)
Measures followed to keep the animal in a good health					
Adequate supply fodder	0 (0.0)	0 (0.0)	1 (100.0)	1 (100.0)	0 (0.0)
Adequate supply fodder, supplements and concentrates	43 (50.7)	22 (26.1)	12 (14.2)	19 (22.5)	1 (1.2)
food supplement, concentrated feed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)
Adequate fodder, feed supplement	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Times in the year when animals are fed differently					
At the beginning of season	3 (50.1)	4 (66.8)	1 (16.7)	2 (33.4)	0 (0.0)
before the beginning of the season	42 (50.6)	62 (74.6)	12 (14.4)	18 (21.6)	2 (2.4)
Frequency of animal feeding/day					
3 times	31 (48.7)	17 (26.7)	9 (14.2)	14 (22.1)	2 (3.2)
2 times	15 (60.0)	5 (20.0)	3 (12.0)	5 (20.0)	0 (0.0)
4 times	0 (0.0)	0 (0.0)	1 (100.0)	1 (100.0)	0 (0.0)
Number of concentrated feed given to the animal					
Two types	29 (48.4)	14 (23.4)	9 (15.0)	15 (25.1)	2 (3.4)
One type	17 (56.7)	8 (26.6)	4 (13.3)	5 (16.6)	0 (0.0)

Table 3 : Frequency Distribution and (Percentage) of Work Horses by Body Condition and Husbandry Practices

	good	poor	moderate
Regularity of Animal veterinary care			
Regular	34 (94.4)	0 (0.0)	2 (5.6)
Irregular	47 (87.0)	4 (7.4)	3 (5.6)
Measures followed to keep the animal in a good health			
Adequate supply fodder	1 (100.0)	0 (0.0)	0 (0.0)
Adequate supply fodder, supplements and concentrates	76 (89.4)	4 (4.7)	5 (5.9)
Adding feed supplement to concentrated feed	1 (100.0)	0 (0.0)	0 (0.0)
Adequate fodder and feed supplement	3 (100.0)	0 (0.0)	0 (0.0)
Times in the year when animals are fed differently			
At the beginning of season	5 (83.3)	1 (16.7)	0 (0.0)
Before the beginning of the season	75 (90.4)	3 (3.6)	5 (6.0)
Frequency of animal feeding/day			
3 times	56 (87.5)	3 (4.7)	5 (7.8)
2 times	24 (96.0)	1 (4.0)	0 (0.0)
4 times	1 (100.0)	0 (0.0)	0 (0.0)

Table 4: Frequency Distribution and Percentage of Work Horses by Field Performance

	Frequency	Percentage
Work Speed Categories (km/h)		
less than 1 km/h	3	3.30
1 and less than 1.5 km/h	11	12.20
1.5 and less than 2 km/h	18	20.00
2 and less than 2.5 km/h	20	22.20
2.5 and less than 3.0 km/h	18	20.00
3.0 and less than 4 km/h	8	8.90
4.0 - 5.0 km/h	12	13.30
Field Capacity Categories (ha/h)		
0.05 ha/h and less	38	42.20
0.06 - 0.10 ha/h	37	41.10
0.11 - 0.14 ha/h	11	12.20
0.15 - 0.20 ha/h	4	4.40
Field Efficiency Categories (%)		
less than 50%	10	11.10
50 and less than 60%	6	6.70
60 and less than 70%	11	12.20
70 and less than 80%	19	21.10
80 and less than 90%	23	25.60
90% and more	21	23.30

Table 5 : Frequency Distribution and (Percentage) of Work Horses by Working Speed and Husbandry Parameters

	Work Speed Categories (km/h)						
	less than 1 km/h	1 and less than 1.5 km/h	1.5 and less than 2 km/h	2 and less than 2.5 km/h	2.5 and less than 3.0 km/h	3.0 and less than 4 km/h	4.0 - 5.0 km/h
Body condition							
Good	3 (3.7)	10 (12.3)	16 (19.8)	18 (22.2)	16 (19.8)	7 (8.6)	11 (13.6)
Poor	0 (0.0)	1 (25.0)	0 (0.0)	1 (25.0)	1 (25.0)	0 (0.0)	1 (25.0)
Moderate	0 (0.0)	0 (0.0)	2 (40.0)	1 (20.0)	1 (20.0)	1 (20.0)	0 (0.0)
Live weight (kg)							
200 kg and less	1 (2.2)	5 (10.9)	10 (21.7)	12 (26.1)	9 (19.6)	5 (10.9)	4 (8.7)
201 – 225 kg	1 (4.5)	4 (18.2)	5 (22.7)	3 (13.6)	3 (13.6)	1 (4.5)	5 (22.7)
250 – 275 kg	1 (9.1)	0 (0.0)	1 (9.1)	4 (36.4)	4 (27.3)	2 (9.1)	1 (9.1)
301 – 350 kg	0 (0.0)	0 (2.5)	1 (12.5)	0 (0.0)	0 (37.5)	0 (12.5)	1 (12.5)
Giving horses water during work							
Yes	1 (4.3)	2 (8.7)	4 (17.4)	6 (26.1)	4 (17.4)	2 (8.7)	4 (17.4)
No	2 (3.0)	9 (13.4)	14 (20.9)	14 (20.9)	14 (20.9)	6 (9.0)	8 (11.9)



Table 6 : Frequency Distribution and (Percentage)of Work Horses by Field capacityand Husbandry Parameters

	Field capacity (ha/h)			
	0.05 ha/h and less	0.06 - 0.10 ha/h	0.11 - 0.14 ha/h	0.15 - 0.20 ha/h
	Regularity of veterinary care of work horses			
Regular	15 (41.7)	11 (30.6)	7 (19.4)	3 (8.3)
Irregular	23 (42.6)	26 (48.1)	4 (7.4)	1 (1.9)
	Times in the year when horses are fed differently			
At the beginning of season	2 (33.3)	2 (33.3)	1 (16.7)	1 (16.7)
Before the beginning of the season	35 (42.2)	35 (42.2)	10 (12.0)	3 (3.6)
	Giving horses water during work			
Yes	10 (43.5)	9 (39.1)	3 (13.0)	1 (4.3)
No	28 (41.8)	28 (41.8)	8 (11.9)	3 (4.5)
	Body condition			
Good	34 (42.0)	32 (39.5)	11 (13.6)	4 (4.9)
Poor	2 (50.0)	2 (50.0)	0 (0.0)	0 (0.0)
Moderate	2 (40.0)	3 (60.0)	0 (0.0)	0 (0.0)