



The Role of Animal Traction Technology in enhancing Production for Small Scale Farmers in Sierra Leone

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Abstract— This paper summarises the results of a base line survey conducted in 2019 and gives an overview of the current status of animal traction in the country. The study assessed the socio-economic characteristics of household heads utilizing the technology, the application of animal power and its associated opportunities and constraints. A total of 130 households were targeted and data were collected through the administration of structured questionnaires, key informant interviews, and focus group discussions. Majority (99.2%) of household heads using this technology were males. The ethnic groups mostly involved in animal traction were Madingos (18.6%), with the least being the Shebro tribe (1.6%). Farming was the main source of income for about (96.1%) of the respondents. The level of awareness of the technology was very high and most (71.3%) of the household heads became aware about traction from other farmers. Cattle was the sole draught animal used and was mainly sourced through purchase (69%). In the selection of oxen for traction, bulls of medium sizes and aged 2 years were the most preferred. Household heads possessed an average of 9.73 years of experience in animal traction and owned at least a farm site with mean sizes of 6.93 acres. Animal power was mostly preferred over traction due to ease of management, cost effectiveness and its potential to give higher crop yields. Traction services was estimated as readily available by (32.6%) of the farmers, with (10.1%) citing the service as not readily available. Animal traction was used solely for agricultural purposes and ploughing was the most common activity. A set of oxen was reported to plough about 1.4 acres within 5.1 hours with weekly and annual work cycles of 5.2 days and 5.3 months respectively. Operators of work oxen were mostly males with few adolescent boys and rarely women. (77.5%) of household heads owned implements with about (22.5%) not owning implements. Majority (80.6%) of the implements were imported with (19.4%) locally fabricated. In conclusion, the awareness and use of animal traction for agricultural purposes was quite high and due to its numerous advantages is highly recommended for small scale farmers.

Keywords— Agriculture, Household heads, Sierra Leone, Socio economic, Work oxen.

I. INTRODUCTION

Animal traction is the use of draught animals for tillage, seeding and other activities [3]. The most commonly used animals have been horses, mules, oxen, donkeys and buffalos [9]. In Sierra Leone, the use of animal power dates back to a period during the 18th century when horses were imported into Freetown for riding, racing and wheeled

transport [4]. However, a devastating outbreak of a disease thought to be trypanosomiasis between 1856 and 1858, spread by tsetse flies, severely restricted the subsequent use of horses [4].

The use of oxen for Agriculture was not introduced in Sierra Leone until the early 1900's. In 1927, the British

authorities banned a traditional form of domestic slavery practiced by the Mandinka people. The Mandinka elders then asked how they could cultivate their rice fields without their traditional labour supply [6]. The Sierra Leone Department of Agriculture, based at Njala, had already experienced problems with the first few tractors introduced, and so suggested the use of animal power. This was a new and innovative technology in the farming systems of Sierra Leone, where human labour was the major power source.

Information concerning the success of the animal traction scheme in Guinea reached Sierra Leone, and in 1928, three agricultural instructors were sent to Kankan in Guinea to learn how to work with N'dama oxen. They returned and were posted to Njala, Batkanu and Karina where they taught farmers how to train animals and plough. In 1930, "all operations in connection with ox ploughing succeeded almost beyond expectations" and animal power training centres were established in four locations [7, 8]. Though animal traction had been firmly established in the country since 1928, its adoption and spread was slow until there was further promotional schemes in the 1950s and again in the 1980s, which led to further adoption, encouraged by support services such as equipment provision, credit and training [7, 1, and 10].

The Sierra Leone Work Oxen Program (SLWOP) was established in the 1970's and was charged with the responsibility of developing animal traction in the country. It had a research and a development phase. The research phase lasted from 1979-1984 and included on-farm and on-station trials, surveys, testing and modification of animal traction equipment, all geared towards tailoring the technology to the agro-socio-economic circumstances of the users [1, 7, and 10]. The development phase commenced in 1985, and during this period the equipment production aspect at the Rolako Work Oxen Technical Centre was strengthened. The initial sets of 30 oxen and equipment in 1980 were increased to 2000 sets located in different parts of the country [2].

However, the outbreak of the civil war which spanned 1991-2002, had a devastating effect on the general economic life of the country, and in particular animal traction development [2]. During this period, work oxen farmers were forced to flee their farms with most of them leaving their oxen behind. Donor-funded projects that promoted traction stopped abruptly and the Work Oxen Programme was temporarily closed at one stage.

Currently, little information exists on the utilization of animal traction in the aftermath of the civil war.

Therefore, this survey aims at providing comprehensive information on the present state of animal traction in the country.

II. METHODOLOGY

The sampling frame of the survey was households utilizing animal traction. In conducting this baseline survey, multi stage sampling was used for the selection of individual households. The first stage was the selection of areas of interest, and this was achieved through purposive selection of two (2) regions based on the farming practices adopted by the farmers; which are the North and North-West regions. In the second stage, districts were also purposively selected from the selected regions based on the availability and rearing of livestock and also from the history of districts known for using animal traction technology. Hence after purposive selection of the districts, these five (5) districts were concluded; Kambia, Bombali, Koinadugu, Port Loko and Falaba districts.

In determining the sampling frame for the animal traction survey, data collection was triangulated in order to capture different dimensions of the animal traction technology. Questionnaires with both demographic and primary questions on animal traction were administered in all the five districts that were selected.

A total of one hundred and thirty (130) respondents were selected and these were equally distributed among the five selected districts, with each district having twenty six (26) respondents. Due to the difficulty of locating households using animal traction, the selection of the respondents to be interviewed in the selected districts was by snowball sampling method. In addition, key informant interviews (at least five per district) and a focus group discussion in each district were done.

Enumerators were trained in administering the questionnaires and on how to enter data directly onto the CSEntry software via tablets. Data collected during the survey was entered into CSEntry and later imported and stored in the Statistical Package for Social Science (SPSS version 21). Descriptive statistics of the explanatory and other variables examined in the study for the animal traction households at the national, regional and district levels were computed using SPSS v.21 and charts developed using the Microsoft excel 2010.

III. RESULTS

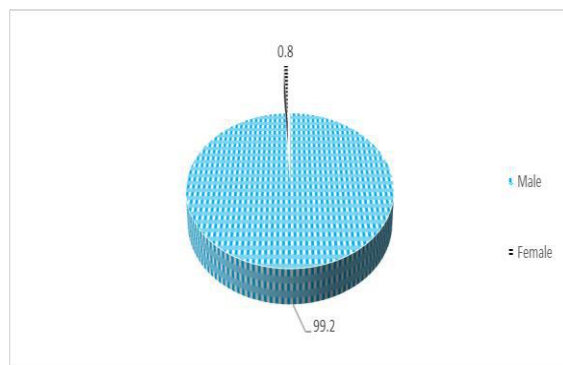


Fig.1. Gender of household heads

Gender of household heads (HH) is shown in (fig. 1). Majority (99.2%) of the HH engaged in animal traction were males with few (0.8%) females.

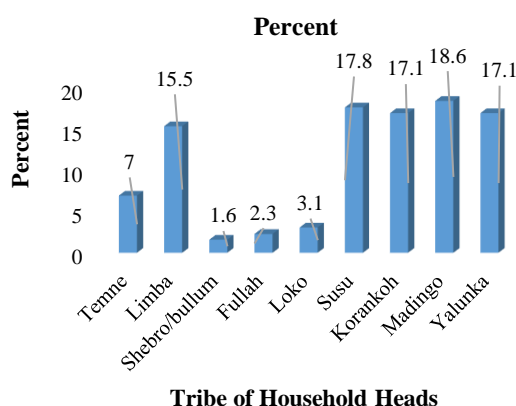


Fig.2. Ethnicity of household heads

The percentage distribution of the various ethnic groups engaged in animal traction is shown in Figure 2. The ranking of the most dominant tribes stood at (18.6%) for Madingo, (17.8%) for Susu, (17.1%) for both Koranko and Yalunka, and (15.5%) for Limba. The least dominant tribes were the Temne (7%) Loko (3.1%), Fullah (2.3%), and Shebro (1.6%).

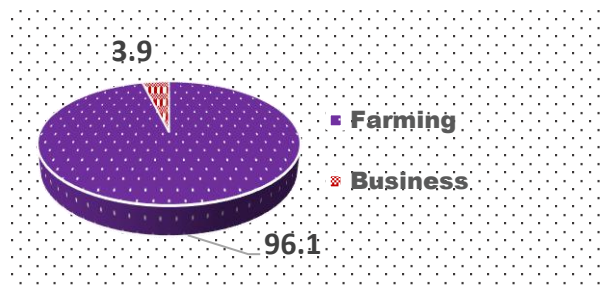


Fig.3. Main source of income for household heads

Figure 3 shows the main source of income for the household heads. Majority (96.1%) of the respondents reported farming as their main source of income with (3.9%) earning from business activities.

Table 1. Information on animal traction

Variables	Category	Frequency	Percent
Have you heard about animal traction?	Yes	129	100
	No	0	0
	Total	129	100
Source of Information	Other Farmers	92	71.3
	NGOs	13	10.1
	MAF	17	13.2
	Media	7	5.4
	Total	129	100

Information on animal traction is shown in (table 1). Data indicated that all (n=129) household heads interviewed had awareness about work oxen. Majority (71.3%) of the HH stated that they got information about animal traction from other farmers, while 13.2% cited the Ministry of Agriculture and Forestry (MAF), (10.1%) cited extension workers of Non-Governmental Organizations (NGO's) and (5.4%) stating media as their main source of information.

Table 2. Percentage of utilization, type and sources of work oxen

Variables	Category	Frequency	Percent
Do you use work oxen	Yes	129	100
	No	-	-
	Total	129	100
Animal used as work oxen	Cattle	129	100
	Buffalo	-	-
	Horse	-	-
	Donkey	-	-
	Total	129	100
Major source of work oxen	Inheritance	10	7.8
	Gift	13	10.1
	Purchase	89	69
	Hire	17	13.2
	Total	129	100

Table 2 shows the percentage of utilization, type and sources of work oxen. Data revealed that all the respondents interviewed use work oxen on their farms and solely used cattle as draught animals. Majority (69%) of the HH sourced animals through purchase, with (13.2%) sourcing through hire, (10.1%) deriving them as gifts and 7.8% stating inheritance as their major source.

Table 3. Factors considered in selecting cattle for work oxen purposes

Variables	Category	N	Percent
Sex	Yes	127.0	98.4
	No	2.0	1.6
	Total	129.0	100.0
Type of Sex	Bull	127.0	100.0
	Cow	0.0	0.0
	Total	127.0	100.0
Size	Small	12.0	9.3
	Medium	78.0	60.5
	Large	39.0	30.2
	Total	129.0	100.0
Age	Yes	125.0	96.9
	No	4.0	3.1
	Total	129.0	100.0

N= Number of respondents

Table 3 shows the factors considered in selection of cattle for work oxen purposes. Majority (98.4%) of the respondents cited sex as a major criterion in selecting animals for traction, with only a few (1.6%) who do not consider sex as a factor. However it was interesting to note that, all the respondents (N=127) interviewed prefer bulls rather than cows for the purpose of work oxen. In terms of size as a selection criterion, about (78%) of the respondents prefer oxen with medium body size, (30.2%) prefer large body sizes, with only a few (9.3%) having preference for smaller body sizes. Majority (96.6%) of the farmers considered age as crucial factor in the selection of animals for traction with few (3.4%) neglecting age as a criteria.

Table 4. Farming experience, number of work oxen and farm sites owned and total acreage of land size

Variables	N	Min	Max	Mean	S. D.
Farming experience (years) in using work oxen	129	1	30	9.73	6.173

Number of work oxen owned	127	1	3	1.08	0.61
Number of farm sites	129	1	15	2.52	1.682
Total farm size (acres)	129	1	20	6.93	4.610

N= Number, Min=Minimum, Max= Maximum,

S.D= Standard deviation

Table 4 summarises the level of farm experience in animal traction, number of oxen and farm sites owned and the acreage of farm sites. Most farmers had experience in traction spanning up to three decades with averages of 9.73 years, and a minimum of 12 months. The number of oxen among households were not more than 3 sets with an average of 1 set per household. As regards to the number of farm sites and size of land, all of the respondents had at least a farm site with land sizes not less than an acre or exceeding 20 acres, with a mean of 6.93 acres.

Table 5. Reason for using animal traction

Variable	Category	Frequency	Percent
Why do you prefer animal power over tractor power	Easy to manage	71	55
	Less expensive	40	31
	Higher crop yields	14	10.9
	Affordable & sustainable	4	3.1
	Total	129	100

Table 5 shows the main reasons why animal traction is preferred over tractor power. Majority (55%) of the household heads stated easy management of work oxen as the main reason why they are preferred over tractors. Most (31%) of the respondents stated that work oxen are less expensive compared to the hiring of tractors which requires the provision of fuel and lubricants. Some (10.9%) of the farmers stated higher crop yields as the major reason for using traction. Few (3.1%) cited affordability and sustainability of the technology as the main reason for using work oxen.

Table 6. Rate the level of availability of animal traction services

Variable	Category	Frequency	Percent
Level of availability of animal traction services	Readily available	42	32.6
	Somewhat available	74	57.4
	Not readily available	13	10.1
	Total	129	100

Table 6 shows the ratings of the level of availability of animal traction services. Majority (57.4%) of the respondents ranked the service as somewhat available. Most (32.6%) of the respondents ranked the service as readily available. Few (10.1%) of the respondents estimated the service as not readily available.

Table 7. Use of animal traction for agricultural activities

Variable	Category	Frequency	Percent
Use animal traction for Ploughing	Yes	129	100
	No	0	0
	Total	129	100
Use animal traction for Harrow	Yes	64	49.6
	No	65	50.4
	Total	129	100
Use animal traction for Ridge	Yes	9	7
	No	120	93
	Total	129	100

Table 7 shows the use of animal traction for agricultural activities. In this study, all respondents (N=129) interviewed stated that they use animal traction solely for agricultural purposes and not for transportation or generation of electricity. Most respondents (49.6%) use animal traction for harrowing with few (7%) of the respondents stated that they used traction to perform ridging.

Table 8. Number of acreage ploughed per day and the time taken

Variables	N	Min	Max	Mean	S.D
Acreage/day animals plough	129	1	8	1.4	0.8
Hours/day animals plough	128	2	8	5.1	1.4
Number of days/week animals plough	128	3	7	5.2	1.0
Number of months/annum animals plough	128	1	5	5.3	9.4

N= Number, Min=Minimum, Max= Maximum,

S.D= Standard deviation

Table 8 shows the time taken for a set of oxen to plough an acreage of farm land. Data revealed that a set of bulls can plough on average an area of 1.4 acres per day and a maximum of 8 acreage per day. According to this study, a set of work oxen ploughs on average 1.4 acres within 5.1 hours. The respondents stated that they use these animals for ploughing an average of 5.2 days per week and 5.3 months within a year.

Table 9. Number of acreage harrowed per day and the time taken

Variables	N	Min	Max	Mean	S. D
No. of acreage harrowed/day	64	1	8	2.2	1.5
No. of hours harrowed/day	64	1	8	4.1	1.8
No. of days/week animals harrow	64	1	6	3.9	1.5
No. of months/year animals harrow	64	1	3	3.7	3.9

N= Number, Min=Minimum, Max= Maximum,

S.D= Standard deviation

Acreage harrowed per day and time taken is illustrated in (Table 9). Results show that work oxen can harrow on

average of 2.2 acres per day within an average period of 4.1 hours a day. Most of the respondents (N=64) stated that their oxen harrow a maximum of 6 days per week with an average of 3.9 days per week. Data also indicated that work oxen operate on farms slightly below four months within the year. It was further observed that out of a total number (N=129) of respondents interviewed (as shown in table 10) only 64 of these farmers use animal traction for harrowing.

Table 10. Number of acreage ridged per day and the time taken

Variables	N	Min	Max	Mean	S.D
Acreage ridged/day by work oxen	9	0.5	2	1.3	0.6
No. of hours/day animals ridge	9	2	9	5.3	2.5
No. of days/week animals ridge	9	3	6	4.4	1.0
No. of months/year animals ridge	9	2	15	5.2	4.9

N= Number, Min=Minimum, Max= Maximum,

S.D= Standard deviation

Table 10 shows the acreage ridged per day and the length of time taken. Few (N=9) of the respondents stated that they utilize animal traction services for ridging.

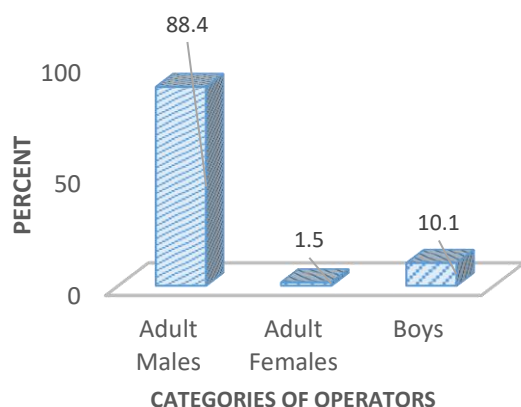


Fig.42. Category of operators

The categories of work oxen operators is depicted in (fig. 4). Majority (88.4%) of the operators comprised of adult males, with (10.1%) being adolescent boys, while only (1.5%) were adult females.

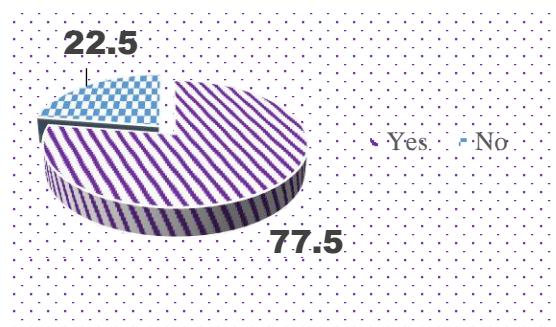


Fig.53. Ownership of implements by household heads

In figure 5, the ownership of implements by household heads is displayed. Majority (77.5%) of the household heads owned implements with those not owning implements accounting for (22.5%) of the respondents.

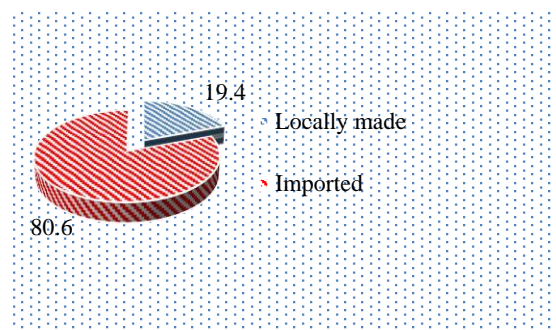


Fig.6. Source of implements

Source of implements is depicted in (fig. 6) Majority (80.6%) of the animal traction implements are imported while only (19.4%) are made locally.

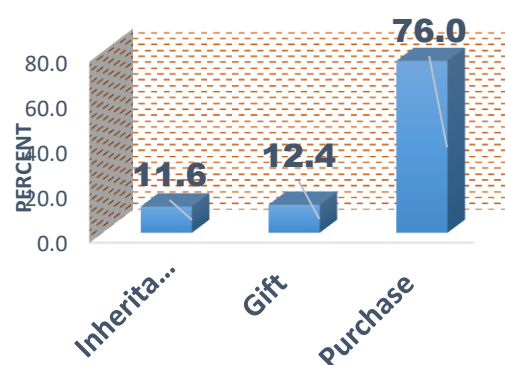


Fig.7. Means of acquisition of implements

The means by which household heads acquire implements is shown in (figure 7). Majority (76.0%) of the respondents stated purchase as a means of acquiring implements, (12.4%) acquiring implements as gifts and (11.6%) through inheritance.

IV. DISCUSSIONS

In this study, majority of the household heads were males. Involvement of women in animal traction will only appear to become comparatively prevalent if there is a higher number of female headed households. Also, barriers to women using work oxen exist and these include; lack of access to assets such as livestock and land which are owned by men and the misconception that animal traction is a male dominated activity.

Ethnicity of respondents engaged in animal traction is mainly dependent on their location, land topography and ecology. It was observed that the most dominant groups using the technology were much closer to Guinea, and this proximity gave them relative advantage through greater access to oxen, implements and operators.

Farming was the main source of income of household heads and this result is in consonance with [12] report which states that, farming is a major economic activity in the rural areas of the country due to the availability of arable land and cheap labour.

The level of awareness of a technology is likely to be higher in areas to which that technology is better suited. In this study, awareness of work oxen was very high among the respondents. The dominant source leading to awareness was farmer-farmer source with marginal contributions from MAF and NGO's. As expected, media was the least source as most household heads in the remote rural areas do not have access to radio, television and internet coverage.

Household heads used work oxen on their farms and cattle was the only draught animal used. This is the case because, during the period when animal power was introduced in the country, cattle was the sole animal used. Infestation of tsetse flies in rural areas hindered the use of other draught animals such as horses and donkeys which were susceptible to trypanosomiasis as opposed to the trypanotolerant N'dama cattle. Oxen was mostly sourced through purchase and this was due to the fact that since the work oxen program at Rolako came to an end, no promotional schemes now exist to provide farmers with sets of oxen.

Sex of cattle was a major criterion in the selection of draught animals, and respondents preferred bulls to cows. The preference of bulls as work oxen is mainly due to the fact that, they can be castrated, which reduces their temperament and eliminates their libido thus improving docility. This is in concurrence with [8] who observed that castrated bulls remain the dominant draft animals in West Africa. Medium sized animals were mostly preferred as farmers opined that they are easier to control. Age of animals was also a crucial factor, and farmers said they preferred animals aged 2 years as young animals can be

easily trained and will last longer as work oxen as opposed to older ones.

Household heads had a relatively long experience in using animal power and some of them most likely benefited from the traction schemes of the late 1980s or are descendants of the initial beneficiaries. During that time, implements and oxen were supplied to farmers to encourage them adopt the technology and as expected they might have transferred their knowledge and skills to the younger generation. Work oxen were owned by most household heads with few stating non-ownership. According to the study, majority of the farmers owned at least a set of oxen, however, they complained that at the start of the planting season a set of bulls might not be enough to plough their fields in time.

Household heads cited easy management of work oxen as a main reason why they are preferred over tractors. They further opined that ease of management are manifold; first, oxen can be handled by young boys. Second, animal traction can plough small farms sizes which are scattered and have irregular topography as opposed to tractors which normally operates on medium to large farms. Lastly, animal traction requires less technical operators compared to tractors which require specialized personnel for its operation.

The use of work oxen was considered cheaper than tractor power as the operational and maintenance costs of oxen is lower. Higher crop yield was cited as a reason for using animal traction as it has the potential to increase yields through timeliness of farm operations and deeper ploughing. Also, the use of work oxen improves soil fertility through the deposition of urine and manure on crop fields by the animals.

In terms of availability of animal traction services, most farmers who declared the service to be readily available, were those who own cattle and had easier access to implements and operators. Respondents who gauged animal traction services as somewhat available, attributed this to the fact that, the number of farmers that require the service per production season outweighs the number of traction service available. Farmers who said traction services were not readily available are those who do not own cattle and live far from Guinea thereby making it difficult for them to source the implements.

In this study, animal traction was majorly used for ploughing as it is the main activity in crop cultivation. This is in line with [7] who reported that majority of farmers utilize traction mainly for ploughing. Reasons for this is due to the fact that, the plough can be easily sourced and much cheaper compared to other implements such as the harrow and ridger. Furthermore, most of the operators of work oxen

were trained to operate the plough and not the other implements.

In this study, operators of work oxen were mainly adult males and this is consistent with the report of [5] which stated that operators of work oxen are predominantly male, with few adolescent boys and rarely women. The low occurrence of women as operators can be attributed to the fact that animal traction operations are labour intensive and are better suited to men. Also, due to the numerous roles women play in the household on a daily basis, not much time is left to engage in work oxen operations.

According to the study, most respondents had implements of their own with most sourcing these equipment through purchase and a few through inheritance or as gift token from the work oxen program at Rolako in the 1970's and 80's.

Implements used were mostly imported from guinea and comprised of ploughs, harrows and ox-carts. However, a type of locally made plough referred to as the pecotool was encountered and according to the respondents, these were fabricated at the Rolako centre in the 1980's. Implements such as chains, yokes and ropes, were made from locally available materials such as scrap metal, wood and fibre respectively. Farmers expressed need for a fabrication facility, as particularly, lack of spare parts and repair services were indicated as the main challenges.

V. CONCLUSION

Findings indicates that, the involvement of women in animal traction was very low. The dominant tribes utilizing work oxen were mostly cattle owners found in pastoralist societies close to Guinea. Their location gave them comparative advantage in using work oxen as they had access to draft animals, implements and repair services. The awareness of animal traction was very high and sources leading to awareness were mainly from other informed farmers with Government, NGO's and the media playing less roles in extension. Animal power was used only for agricultural purposes and not for packing or transport. Despite the devastation of the work oxen programme as a result of the decade-long civil war, draught power is still a viable means of assistance to farmers during and after the cropping season. Cattle was the sole animal used for traction as their trypano-tolerance made them ideal for use in tsetse infested areas. Bulls were preferred to cows as work oxen and this implies that they are more dispensable in herd multiplication programmes. Even though farmers had lots of experience in using work oxen on their crop fields, sufficient technical know-how on handling, nutrition and management of oxen was grossly lacking. Most households owned at least a set of work oxen and those that did not own

oxen complained that access to credit facility was a major constraint. According to the number and acreage of farm sites cultivated in these study areas it can be inferred that most were small to medium farm holdings. The adoption of traction technology was very high as it was reported to be easy to manage, cost effective, available and sustainable and also produced higher crop yields compared to human or tractor power. Work oxen was used mainly for ploughing and was reported to be more efficient on small acres of land. Implements such as ploughs and harrows were sourced from Guinea as presently no fabrication facility or blacksmiths trained in the manufacture of traction equipment exists.

The use of man and tractor power will continue to have a huge space in the agriculture sector in the country. However, results from this study suggests that animal traction is generally the best option for small-scale farmers as it is affordable, sustainable, and profitable. A major limitation of the study was that no gross margin analysis was conducted to comparatively determine the cost effectiveness and production levels of human, animal and tractor power.

VI. RECOMMENDATIONS

Based on the opportunities and constraints revealed in this study, it is recommended that;

- Women's livelihood be supported by improving their access to ownership and utilization of livestock and technologies for enhanced agricultural production.
- To aid in the level of adoption of animal traction technology, farmers should be supplied with animals and traction implements on a loan basis, possibly at a subsidized rate.
- Work oxen training centers be established and the local manufacture of animal traction equipments be further developed through reopening of the national blacksmith factory.
- Research programs be conducted on all aspects of the use of animal power in farm production.

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