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RESEARCH ARTICLE

ROLE OF ANIMAL TRACTION TECHNOLOGY ON PROFITABILITY AND INCOME OF SMALL SCALE FARMERS IN KEBBI STATE, NIGERIA

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ABSTRACT

The study examined the role of animal traction technology on profitability and income of small scale farmers in Kebbi State, Nigeria. Primary data were collected through the use of pre tested questionnaires in 2017. A multistage sampling procedure was used to collect data from two categories of respondents that is ATT Users and Non-users. Data were analyzed using descriptive statistics, Net Farm Income Analysis and Gini Co-efficient. The result showed that bull (100 %), camel (60.26 %) and donkey (32.05 %) are the various types of animals used as draught animals in the study area. The result further reveals that ploughing (100 %), ridging (98.72 %), tillage (97.44 %), weeding (88.46 %), transportation (65.38 %) and fetching of water (12.82 %) are the activities performed using draught animals. The result further reveals that farmers who are ATT users outperformed farmers who are non ATT users when using Net Farm Income analysis. Farmers who are ATT users achieved a Net Farm Income of N436,885.36 and non-users achieved about N150,365.38 which shows a significant difference of about N286,519.98. This suggests that ATT users achieved more profit than non-users. Furthermore the result also showed that for ATT users there was less income inequality having a Gini coefficient value of 0.4592 while for non-users there is wider income inequality with a Gini coefficient value of 0.7284. This suggests that ATT usage enhances the profitability and income of the farmers. It is recommended that farmers should key into the use of Animal Traction Technology as it increases income and profit of the users at a low cost in the absence of machines such as Tractors. Also farmers should be supported with incentives in kind with draught animals as credit at low interest rate.

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INTRODUCTION

The employment of domestic animals for tillage or transport is known as animal traction. The term is generally understood to include pack transport as well as the 'pulling' work of animals. The use of draught animal technology for agricultural production in Nigeria is therefore about 80 years old. In recent years, some international research institutes particularly the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) have tested and introduced more sophisticated animal drawn implements into the country (Alkali, 2001). However, despite the numerous advantages of draught animal technology on farm production, it has been argued that the technology could encounter difficulties. The predominant use of hand tools/implements (hoes and cutlasses) by the Nigerian farming community, which formed about 70 % of the Nation's population, contributes greatly to the country's inability to feed herself. The use of hand tools makes farm tasks arduous and unattractive and the yields are usually low. The slow growth in agricultural production in Nigeria and other sub-Saharan Africa countries is a serious problem challenging both local and international policy makers. To increase agricultural production however, certain forms of appropriate technologies are necessary. An appropriate technology in this context implies the use of the modern scientific and technological development that has been identified and adopted to suit the local conditions to the highest degree (FAO, 2004). Draught animal technology (DAT) can provide a cheap and effective power source to replace human labour in the agricultural sector. Despite the superiority of draught animal technology over the hoe technology, less than 15% of the total cultivated area in Sub-Saharan African countries including Nigeria is prepared with draught animal technology (Rajeev *et al.,* 2009)
Agricultural mechanization has been described as one of the great achievements of the 20th century among the technologies that have contributed significantly to agricultural production practices through the more efficient use of labor, the timeliness of operations, and more efficient input management (NAE, 2000). Animal Traction Technology (ATT), a branch of agricultural mechanization had for a long time been in use as a method of cultivation, plowing, harrowing, weeding and transportation in many developing countries including Nigeria (Musa, 1988). Although, there was often a tendency to regard

animal power as an archaic concept, to be replaced with fossil fuel-power device as soon as possible, this reflects disregard and lack of understanding of the role of animal traction in the rural setting of developing countries. The empirical studies by Musa (2004) show that research on mechanization of agricultural activities with animal-drawn implements shows that there is a significant savings in labour and time over hand weeding. According to (Simon *et al.,* 2010; Baba and Alhassan, 2000) in Nigeria, animal traction is widely used among smallholder farmers who accounted for over 90% of the country's agricultural outputs. However, the innovation of animal traction lacks policy and investment support from the stakeholders to make it more efficient (Paul, 2008). The use of animal traction has been advocated as one of the possible ways of increasing farm productivity. The current high cost of ownership of farm tractors in Nigeria, militates against the use of tractors by majority of the farmers who are poor and lives in rural areas. In developing countries, like Nigeria, the most viable alternative to the use of mechanical power is animal power. It has been reported that draught animal power utilization could be an alternative to the use of farm machinery and it is better in terms of return to land, labour and capital compared to both manual cultivation and tractor powered mechanization. (Abiye and Cirma, 1998; Havard *et al.,* 1998; Umar, 1997; Shittu, 1996). The technical aspects of animal traction are well documented (Sylwander, 1994). However, the user aspects of animal traction have received less attention (Kabutha and Kooijman, 1996; Sylwander, 1994). As noted by Starkey (1994), the overall low level of use of animal traction in sub-Saharan Africa raises doubts about its profitability and sustainability. Animal traction has the potential of bringing more land under cultivation compared to the use of the hand tools (Okalebo, 1996). Despite the various uses of animals for agricultural purposes in the form of animal traction, the use of animal traction technology among small scale farmers for improving income has not been well documented in the study area. Moreover, the study hopes to ascertain the role of animal traction technology in enhancing profitability, income and the prospects of its utilization as a sustainable means of alleviating poverty. It is against this backdrop that this study hopes to provide answers to the following research questions;

1. What are the different farming activities carried out by the animals among users of the technology in the study area?
2. How profitable is animal traction technology to the users and non-users in the study area?
3. What is the income inequality of animal traction technology among users and non-users in the study area?

MATERIALS AND METHODS

Study area: This research was carried out in four (4) selected local Government Areas (Aliero, Arewa, Dandi and Birnin Kebbi) of Kebbi State, Nigeria. The choice of the local government areas was based on large number of farmers who are using animal traction technology to carry out their farming activities. The State is located in the North Western Nigeria, it has a total land area of 36,800km^2, with a population projection from 2006 census figure, and the state is estimated to have a population of 4,629,880 million people (NPC, 2006; 2017). Kebbi State has latitude of 10^0 8' to $13^0$15' N and longitude of $3^0$30' to $6^0$02' E. The state has Sudan and Sahel Savannah Vegetation, the southern part of the state is rocky and the northern part is sandy. The state is bordered by Sokoto State to the North and East, Niger State to the south, Dosso Region in the Republic of Niger to the North-west and Republic of Benin to the West. Majority of the population in the area are into Agricultural activities which include crop cultivation, animal rearing and fish farming.

Sampling procedure and sample size

Based on reconnaissance survey, a multistage sampling technique was used for data collection. First, the purposive selection of four local Government Areas (Aliero, Arewa, Dandi and Birnin Kebbi) based on preponderance of animal traction technology users in the State. Secondly, purposive selection of two major district areas from each of the LGA (Aliero and Sabiyel districts from Aliero LGA, Kangiwa and Yeldu districts from Arewa LGA, Zauro and Ambursa districts from Birnin Kebbi LGA, Geza and Kyangakwai districts from Dandi LGA) giving a total of 8 districts. Third stage involves selection of two villages each from the selected districts giving a total of 16 villages. The last stage involves random selection of 5 animal traction technology users and non-users each, giving a total of 160 farmers as sample size.

Data Collection

Users and non-users of Animal traction technology were the primary source of data and were collected using pre-tested questionnaires. In addition, interview schedule was employed to obtain relevant information from the respondents. Data that were collected comprises of farm inputs (labour, fertilizer, seed, and insecticide/herbicide) crop output and the problems involved in the use of the technology were also employed in the research.

Analytical techniques

Three analytical techniques were used to ascertain the profitability and income between the technology user households and non-user households in the study area. These analytical procedures include Descriptive Statistics, Net Farm Income and Gini coefficient.

Model for Net Farm Income Analysis

Net Farm Income Analysis is given by;

$$NFI = TR - TC \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

NFI = Net Farm Income
TR = Total Revenue
TC = Total Cost
TC = TVC + TFC

$$NFI = TR - TVC - TFC \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Rate of return = Total Revenue / Total Cost

Gini coefficient Model

The Gini coefficient was employed to ascertain the pattern of income distribution amongst the users and non-users of ATT. The Gini coefficient is a measure of inequality among values of a frequency distribution, for example, levels of income,

wealth etc (Wikipedia, 2012). It has values between 0 and 1. A Gini coefficient of zero expresses perfect equality where all values are the same i.e. everyone has exactly equal income, while a Gini coefficient of one (100 on the percentiles scale) expresses maximal inequality among values, for example where only one person has all the income. Therefore a low Gini coefficient indicates a more equal distribution of income or wealth with 0 corresponding to complete equality while higher Gini coefficients indicates more unequal distribution with 1 corresponding to complete inequality.

The Gini coefficient (G) is given as

$$G = 1 - \sum xy \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where,
G = value of the Gini coefficient
X = percentage of farmers
Y = cumulative percentage of the farmers income
$\sum$ = summation sign

The G has a possibility of values ranging from 0 to 1

Expressing the extent to which the farmers' income is either evenly or unevenly distributed.

RESULTS AND DISCUSSION

Types of draught animals

Results in Table 1 outline the different types of draught animals used in the study area. Animals if well managed can improve household food security. Results in Table 1 shows that all the respondents (100%) of the ATT users use bull as one of the types of animals for traction purposes in the study area. Furthermore (60.26 %) use camel and (32.05 %) use donkey for traction purpose in the study area. This corroborates the findings of Belal *et al.,* (2015) who affirmed the use of bull, donkey, camel and horse for animal traction in their studies.

The various activities carried out using draught animals

Results in Table 2 shows the various activities performed by the ATT users in order of magnitude of importance. These include; ploughing as reported by (100 %) of the ATT users, ridging (98.72 %), tillage (97.44 %), weeding (88.46 %), transportation (65.38 %) and fetching water (12.82 %). This implies that draught animals in the study area have both agricultural and non-agricultural benefit. Some of the agricultural benefits include reduction of drudgery during ploughing, ridging, tillage and weeding operations, while for non-agricultural purposes activities such as fetching of water, transportation of water, firewood and farm inputs as well as farm products to the market are important. This is in line with a study by Abubakar *et al,* (2010) who found that small scale farmers in Hadejia used draught animals only for farm operations such as tillage, weeding and transportation. Other operations like planting and harvesting are still done manually using human labour.

Costs and Returns of ATT Users and Non-users

Results in Table 3 revealed that for ATT users, the average total variable cost per individual farmer in the study area is **N**262, 584.33 while the average total fixed cost per farmer is N87, 416.67. The revenue per farmer is **N**786, 086.36. It can be observed that variable cost has a dominant proportion of the total cost of animal traction technology usage, accounting for as much as 75.03 % variable cost while fixed cost accounted for 24.97 % of the total cost in the study area.

Table 1. Distribution of Animal Traction Technology users according to the various types of animals used for Animal Traction in Kebbi State

Types of animals	*frequency	Percentage
Bull	78	100.00
Camel	47	60.26
Donkey	25	32.05

*Multiple responses were recorded
Source: field survey, 2017

Table 2. Distribution of ATT users according to the various activities carried out in Kebbi State

Activities	Frequency	Percentage
Ploughing	78	100.00
Ridging	77	98.72
Tillage	76	97.44
Weeding	69	88.46
Transportation	51	65.38
Fetching water	10	12.82

*Multiple responses were recorded
Source: field survey, 2017

The average net farm income for ATT users per individual respondent was **N**436, 085.36. Similarly, results from the Table reveals that for non-users, the average total variable cost per individual farmer in the study area is **N**170, 906.62 while the average total fixed cost per farmer is **N**9100.00 and the revenue per farmer is **N**330, 372. It can be observed that variable cost has a dominant proportion of the total cost for non-users too, accounting for as much as 94.94 % while fixed cost accounted for 5.06% of the total cost in the study area. The average net farm income of non-users per individual respondent was **N**150, 365.38. Based on the findings, the net farm income analysis has shown that the use of animal traction technology for farming in the study area generates more revenue thus, more profitable. **N**436, 085.36 for users, than **N**150,365.38 for non-users, suggesting that ATT usage enhances more profit. This result is in line with studies by Simalenga *et al*., (1999) who found that the usage of ATT in their study area was profitable and also study by Sanni (2008) who found that Animal traction practice is capable of extending the per capita cultivation by almost double. It has also been observed that, it increases the yield and net income.

Income Inequality of ATT Users and Non-users

The Gini coefficient was used to ascertain the pattern of income distribution amongst the users and non-users of ATT. The Gini coefficient is a measure of inequality among values of a frequency distribution, for example, levels of income, wealth etc.(Wikipedia, 2012). It has values between 0 and 1. A Gini coefficient of zero express perfect equality where all values are the same i.e. everyone has exactly equal income, while a Gini coefficient of one(100 on the percentiles scale) expresses maximal inequality among values, for example where only one person has all the income. Therefore a low Gini coefficient indicates a more equal distribution of income or wealth with 0 corresponding to complete equality while higher Gini coefficients indicates more unequal distribution with 1 corresponding to complete inequality.

Table 3. Average costs and returns of ATT users and non-users in Kebbi State

	Users			Non-users		
Variable	Average amount (N)	Total amount (N)	Percentage	Average amount (N)	Total amount (N)	Percentage
Revenue						
Revenue from crop sales	656,936.36	51,241,036.08	83.57	330,372.00	25,108,272.00	100.00
Revenue from traction animal	55,000.00	4,290,000.00	07.00			
Revenue from manure sales	74,150.00	5,783,700.00	09.43			
Total revenue	786,086.36	61,314,736.08	100.00	330,372.00	25,108,272.00	100.00
Variable cost items						
Seed	26,600.00	2,074,800.00	07.60	13,969.00	1,061,644.00	07.76
Fertilizer	39,000.00	3,042,000.00	11.14	26,000.00	1,976,00.00	14.44
Chemical	11,500.00	900,900.00	03.29	9,900.00	752,400.00	05.50
Planting	13,688.00	1,067,664.00	03.91	101,290.63	782,087.88	05.72
Ridging	32,083.33	2,502,499.74	09.17	10,843.75	824,125.00	06.02
First weeding	34,490.00	2,690,220.00	09.85	20,365.45	1,547,774.88	11.31
Second weeding	28,890.00	2,253,420.00	08.25	19,800.00	1,504,800.00	11.00
Third weeding	17,333.00	1,351,974.00	04.95	15,000.00	1,140,000.00	08.33
Fertilizer application	5,500.00	429,000.00	01.57	3,385.71	257,313.96	01.88
Harvesting	17,700.00	1,380,600.00	05.06	12,852.08	976,758.08	07.14
Processing	35,750.00	2,788,500.00	10.21	20,500.00	1,558,000.00	11.39
Transportation				8,000.00	608,000.00	04.45
Total variable cost	262,584.33	20,481,577.74	75.03	170,906.62	12,988,903.12	94.94
Fixed cost items						
Land	4,000.00	12,000.00	01.14	2,000.00	152,000.00	01.11
Traction animals	60,000.00	4,680,000.00	17.14			
Plough/ridger	1,500.00	117,000.00	00.43			
Cart	11,666.67	910,000.26	03.33			
Hoe	333.32	25,998.96	00.10	833.33	63,333.08	04.46
Cutlass	466.68	36,401.04	00.13	1,166.67	88,666.92	00.65
Empty bags	9,450.00	737,100.00	02.70	5,100.00	387,600.00	02.83
Total fixed cost	87,416.67	6,818,500.26	24.97	9,100.00	691,600.00	05.06
Total cost	350,001.00	27,237,678.00	100.00	180,006.62	13,788,755.12	100.00
Profit	436,085.36			150,365.38		
Benefit cost ratio	2.25			1.84		

Source: field survey, 2017

Table 4. Income of ATT users in Kebbi State

Range of revenue for users	Midpoint	Frequency of farmers	Percentage of farmers (X)	Cumulative % of farmers	Percentage of income	Cumulative % of income (Y)	XY
< 50,000	46,780	01	01.28	01.28	01.11	01.11	0.0001
50,000-99,000	77,033.33	02	02.56	03.82	01.83	02.94	0.0008
100,000-199,000	157,933.36	04	05.13	08.97	03.75	06.69	0.0034
200,000-299,000	269,983.07	04	05.13	14.10	06.40	13.09	0.0067
300,000-399,000	353,883.33	06	07.69	21.79	08.39	21.48	0.0165
400,000-499,000	447,470.83	07	08.98	30.77	10.61	32.09	0.0288
500,000-599,000	565,558.35	09	11.54	42.31	13.42	45.51	0.0525
600,000-699,000	636,200	13	16.67	58.98	15.09	60.60	0.1010
700,000-799,000	792,385	30	38.46	97.44	18.80	79.40	0.3054
Above 800,000	868,449.99	02	02.56	100.00	20.60	100.00	0.0256
Total	4,215,677.3	78	100.00		100.00		0.5408

Source: field survey, 2017
G = 1 -∑xy; G = 1 – 0.5408; G = 0.4592

Table 5. Income of ATT Non-users in Kebbi State

Range of revenue for users	Midpoint	Frequency of farmers	Percentage of farmers (X)	Cumulative % of farmers	Percentage of income	Cumulative % of income (Y)	XY
<50,000	27,825	06	07.89	07.89	01.14	01.14	0.0009
50,000-99,000	72,606.25	10	13.16	21.05	02.99	04.13	0.0051
100,000-199,000	133,616.67	06	07.89	28.94	05.50	09.63	0.0076
200,000-299,000	246,150	18	23.68	52.62	10.13	19.76	0.0468
300,000-399,000	327,600	22	28.96	81.58	13.48	33.14	0.0963
400,000-499,000	466,250	10	13.16	94.74	19.18	52.42	0.0690
500,000-599,000	509,950	02	02.63	97.37	20.97	73.39	0.0193
Above 600,000	646,816.67	02	02.63	100.00	26.61	100.00	0.0263
Total	2,430,814.59	76	100.00		100.00		0.2716

G = 1 -∑xy; G = 1 – 0.2716; G = 0.7284

The result in Table 4 reveals that the Gini coefficient value for ATT users was 0.4592. This value indicates a less income inequality or more equality in the distribution of income among ATT users, implying that the income was evenly distributed. This indicates low disparity in income among the study population and that there was no wide variation in income among the ATT users i.e. small percentage are poor.

Similarly, results in Table 5 reveal that the Gini coefficient value for ATT non-users was 0.7284. This value indicates a wider income inequality among non-users, implying that the income was unevenly distributed. This indicates high disparity in income among the study population and that large percentage are poor. Based on the findings, the Gini coefficient has shown that income among ATT users was evenly

distributed than among non-users where income was unevenly distributed. This suggests that ATT usage enhances the income of the ATT users. This result is in line with studies by Charles (2003) and Simalenga *et.al* (1999) and Owolabi *et al.* (2016) who found out that animal traction technology usage enhances the income of farmers. This suggests that farmers who use animal traction received more income than those who did not use animal traction.

Conclusion

ATT is one major agricultural farming activity practiced in Kebbi State, Nigeria. Based on the findings of this research, it is concluded that ATT users realized a profit of **N**436, 885.36 than the non-users who realized a profit of **N**150, 365. 38. Results in the study revealed a Gini coefficient values of 0.4592 for ATT users and 0.7284 for non-users. It is concluded that income was evenly distributed among ATT users than non-users where income was unevenly distributed. This is due to the fact that there was less income inequality among ATT users than non-users. This suggests that the use of ATT enhances profitability and income of the users.

Recommendations: It is recommended that Farmers should be encouraged to procure drought animals for traction purposes in order to increase their income and profit. Farmers should also be supported with incentives in kind with draught animals as credit at a low interest rate.

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