American-Eurasian J. Agric. & Environ. Sci., 8 (4): 460-467, 2010
ISSN 1818-6769


# Resource-use Efficiency and Constraints to Animal Traction Technology in Adamawa State, Nigeria

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**Abstract:** A comparative study of *Fasciola*-infested and non-infested draught animals was conducted in Adamawa State, Nigeria, with the aim of determining the most efficient resource-use among the two categories of farmers. Data were collected through a cost-route method for the period of one cropping season (2001). Results obtained from analysis using descriptive statistics, production function and computed Marginal Value Productivity (MVP) showed that all the explanatory variables in the lead equation (Double-log) were significant at $P<0.001$. Similarly, the MVP indicated that 66.67% of the inputs were used above economic optimum, with inputs in the non-infested drought animal farms as most efficiently utilized. Major constraints to the technology include expensive veterinary drugs (93.29%), inability to detect infestation early by farmers (76.12%) and inadequacy of feeds (63.44%). Authorities that intend to improve this source of farm power should improve the healthcare aspect of these animals tremendously.

**Key words:** Draught animals · Farmers · Fascioliasis · Infested · Non-infested

## INTRODUCTION

Farm power has been in substantial demand in the rural areas of the country, where the bulk of the small-scale farmers who produce the food requirements of the ever-growing population reside. Essien [1] noted that these set of farmers use human muscle to cultivate small farms supplying about 90 percent of energy to produce food crops for consumption in the country thus lowering production. Efforts by the Federal Government of Nigeria to improve this situation led to the massive importation of engine-drawn implements like tractor etc. in 1970s and 1980s as a result of the oil boom [2]. However, the use of these implements which is said to increase productivity is quite expensive and hard to access by the rural farmers in a depressed economy like Nigeria where these categories of farmers hardly get enough to feed themselves and their family and take care of other basic needs.

The above trend therefore, calls for an urgent alternative means of supply of farm power. This alternative technology must be cheap, affordable and be readily available to these farmers, which would also suit the changing situation in the country. Animal traction technology fits in this requirement. But, the use of this farm power has been constrained by inadequate animal healthcare. Draught animals are living things and therefore prone to infestation and infection by helminth parasites and microbes, respectively. These reduce the productivity of the affected animals.

Many eminent scholars have conducted studies to improve the technical aspect of the use of animal traction technology with success [3-10]. But very little has been done with regard to endoparasitism especially the liverfluke *(Fasciola)*. This parasite causes colossal economic loss not only in animals used for farm power but the susceptible livestock as a whole. This study therefore, focused at the economic effects of this parasite *(Fasciola)* on draught animals with regard to resource-use, investigated the cause and possible means of control generally and suggested some ways of improving the technology.

## METHODOLOGY

**The Area of Study:** The survey was conducted in Adamawa State, which is situated at the north-east part of Nigeria. It lies between Latitudes 7°and 11°N of the

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equator and between longitudes 11° and 14°E of the Greenwich Meridian. It has a landmass of 42,159 square kilometers with a population figure of 3,194,781 as at the 2006 National Population Commission (NPC) Census.

**Data Collection:** Data were collected from both primary and secondary sources. The former was from the farmers through a cost-route method using structured questionnaire supplemented by interviews; whereas the secondary data were from government agencies which include the State Ministry of Agriculture and the Local Government Department of Agriculture and Natural Resources.

**Sampling Procedure and Sample Size:** Of the 21 Local Government Areas (LGAs) in the state, 16 LGAs where animal traction technology was more dominant were selected purposively for the study. In each LGA, endemic (where *fascioliasis* was prevalent) and non-endemic areas were identified through the veterinary records and personnel. Five pairs each of infested draught animals and non-infested draught animals from five farmers of each category were randomly selected. Therefore, a total of 160 farmers (80 for each category of animals) with a total of 320 draught animals (160 in each category) were scheduled for the research. However, 60 farmers and owners of non-infested draught animals and 74 farmers and owners of infested draught animals responded positively. It was later discovered that among those farmers that responded, some either have two or three pairs supplying traction on a farmer's farmland. In the end, 148 non-infested and 204 infested draught animals were involved in the research.

The fact that *Fascioliasis* does not present apparent clinical signs on these sets of animals, a more reliable method reported by Hensen and Perry [11], the analysis of faecal samples of the selected draught animals using the sedimentation technique was adopted in confirming the status of draught animals. Further, Hensen and Perry [11], stated that this method is the ideal and qualitative way of detecting liverfiuke eggs in the faeces.

**Data Analysis Technique:** The use of descriptive statistics, computed MVP and Production function were used for analysis. The descriptive statistics used, include frequency distribution, Percentages and means. The implicit form of the production function is shown as:

$$Y=f(X_1, X_2, X_3, U)$$

Where:

Y = Gross value of output (in Naira = N)
$X_1$ = Land (in hectares)
$X_2$ = Animal traction (in hours)
$X_3$ = Capital services (in Naira = N)
U = Error term

The model was estimated in four functional forms (linear, semi-log, double-log and quadratic) and the lead equation was the double-log function because it gave the best fit in terms of the magnitude of $R^2$, standard error (S.E.) and the appropriate level of significance of the explanatory variables.
Thus:

(a) Double-log function

$$\log Y = \log b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + U \quad (1)$$

Where:

$B_1$-$b_3$ are also parameters interpreted directly as elasticities in this function.

The Marginal Value Productivities (MVP) of the inputs included were realised using the model below:

$$(b)\ MVPij = b_1 (y/xi).\ Py \quad (2)$$

Where:

$MVP_{ij}$ = Marginal Value Product of ith input
Y = Geometric mean of the output
X = Geometric mean of the ith input
Py = Price of the product
*bi* = Regression coefficients

## RESULTS AND DISCUSSION

**Selected Socio-economic Characteristics of the Animal Traction Users in the State:** The results in Table 1 show the selected socio-economic characteristics of the farmers in the study area. From the age distribution, it was discovered that the mean age was 35 years, indicating that majority of the respondents were relatively young and energetic persons. Furthermore, it could be seen that 41.79% of the farmers were between 30-39 years, 30.60% were between 40-49 years, whereas 15.67%, 10.45% and 1.49% fell within 50 and above years, 20-29 years and

Table 1: Distribution of selected socio-economic Characteristics of animal traction users in Adamawa State, Nigeria

| | Owners of non- infested animals | | Owners of infested animals | | |
|---|---|---|---|---|---|
| ITEM | Frequency | % | Frequency | % | Percentage of categories of farmers |
| Age range (years) | | | | | |
| 11-19 | 2 | 3.33 | 0 | 0.00 | 1.49 |
| 20-29 | 8 | 13.33 | 6 | 8.11 | 10.45 |
| 30-39 | 24 | 40.00 | 32 | 43.24 | 41.79 |
| 40-49 | 17 | 28.34 | 24 | 32.43 | 30.60 |
| 50 and above | 9 | 15.00 | 12 | 16.22 | 15.67 |
| Total | 60 | 100.00 | 74 | 100.00 | 100.00 |
| Gender | | | | | |
| Male | 60 | 100.00 | 73 | 98.65 | 99.25 |
| Female | 0 | 0.00 | 1 | 1.35 | 0.75 |
| Total | 60 | 100.00 | 74 | 100.00 | 100.00 |
| Marital Status | | | | | |
| Married | 56 | 93.33 | 68 | 91.89 | 92.54 |
| Single | 4 | 6.67 | 6 | 8.11 | 7.46 |
| Total | 60 | 100.00 | 74 | 100.00 | 100.00 |
| Household Size | | | | | |
| 1-4 | 16 | 26.67 | 18 | 24.32 | 25.37 |
| 5-9 | 28 | 46.66 | 28 | 37.84 | 41.79 |
| 10 and above | 16 | 26.67 | 28 | 57.84 | 32.84 |
| Total | 60 | 100.00 | 74 | 100.00 | 100.00 |
| Level of Education | | | | | |
| Tertiary | 6 | 10.00 | 8 | 10.81 | 10.45 |
| Secondary | 7 | 11.66 | 17 | 22.98 | 17.91 |
| Primary | 10 | 16.67 | 8 | 10.81 | 13.43 |
| Adult Education | 16 | 26.67 | 18 | 24.32 | 25.37 |
| Non formal Education | 21 | 35.00 | 28 | 31.08 | 32.84 |
| Total | 60 | 100.00 | 74 | 100.00 | 100.00 |

Source: Field Survey, (2001).

11-19 years, respectively. The nature of animal traction technology, which requires some kind of strength to operate effectively, may be the reason for having young people as participants in the majority group.

Regarding the gender of the farmers, the results revealed that 99.25% were males with only 0.75% representing the female counterpart. This showed that the males are dominant in the practice of this farming system. The lowest percentage of the female folks in the adoption of this technology may also be attributed greatly to biological factor, which by nature have females, weaker beings and therefore find it difficult to cope with the rigors required by this technology.

Of the whole farmers studied, 92.54% were married, while 7.46% were singles. Further investigation revealed that marriage is contracted at a very early age among the people in the study area. Males generally enter in to the institution as early as 20 years of age, while the females, as early as 12-15 years. The highest number of married respondents could therefore be said to be as a result of this factor. However, financial status and acquisition of stock (heads of cattle) also contribute to some extent. Because it was understood that only farmers who can afford to buy at least a pair of bulls at ₦15, 000:00 each (i.e. ₦15, 000:00 x 2 = ₦30, 000:00) and a ridger/plough at ₦9,500:00, giving a total of ₦39,500:00 can adopt the technology, whereas farmers with already existing herd of cattle can only train a pair or more of bulls from their stock and purchase a ridger/plough as mentioned earlier.

The total of 25.37% of the farmers had between 1 and 4 persons in a household, while 41.79% between 5 and 9 and 32.84% had more than 9 people in a home. Activities like third weeding of farms which are considered too delicate an exercise to employ the services of workbull (the latter may destroy plenty of grown crops), farm clearing, planting and harvesting require heavily the services of hired and/or family labour. In this regard, it was discovered from the study that household size also

Table 2: Animal traction time-use efficiency of non-infested and infested draught animals in Adamawa State, Nigeria

| | Category of Animals | |
|---|---|---|
| Criterion Non-infested animals | Infested animals | |
| Cumulative number of animals used in a cropping season | 148 | 204 |
| Cumulative number of hectares cultivated in a cropping season. | 227 | 287.3 |
| Cumulative number of hours used in a cropping season. | 2033 | 5023 |
| Total income realized in a cropping season (₦*) | 4374780 | 4984620 |
| Average hours worked by animals in a cropping season. | 13.7 | 24.6 |
| Average of equivalent yield per animal per cropping season (₦*) | 29559.3 | 24434.4 |

Note: Naira (₦140) = US$1 Source: Field Survey. (2001)

Table 3: Results of the four estimated production functions of animal traction in Adamawa State. Nigeria

| Functional forms | Constant | Land ($X_1$) | Animal Traction ($X_2$) | Capital Services ($X_3$) | $R^2$ | S.E. |
|---|---|---|---|---|---|---|
| Linear | -12978 | 1082.63** (12.33) | 2.1679*** (5.18) | 81.27*** (5.42) | . 975 | 23251 |
| Semi-log | -95233 | 3025 (0.07) | 16459 (0.45) | 40386*** (5.52) | . 617 | 90459 |
| Double-log | 2.1412 | 0.5234*** (11.11) | 0.1552*** (4.08) | 1.1922*** (6.53) | . 957 | 0.05328 |
| Quadratic | -1255 | 746.5*** (3.65) | 2.1070*** (2.89) | 66.93* (1.77) | . 977 | 21693 |

Note: Values in Parentheses are the t-ratios

***: Significant at P < 0.001 **: Significant at P < 0.01 *: Significant at P < 0.05 Source: Field Survey, (2001).

had influence on the farm size. The higher the number of active persons in a home, the more confident the farmer had on expanding the size of his farmland. Because the use of family labor is considered more economical i.e. labor provided without cost.

The educational background of people in any given society is said to have great positive influence on their adoption process of innovations. And animal traction technology is regarded as an improvement/innovation over the hand-tooled (cutlasses, hoes etc) implements used by the farmers. In this research, "No formal education" is regarded, as the respondents never attended western school at all. However, farmers in this category might have had either Qur'anic or Bible learning at home. It could be observed from Table 1 that 67.16% of the number of respondents have had some western education ranging from adult education to tertiary education and 32.84% are the ones with "no formal education at all". The high percentage of elite recorded in this study may have connection with their ability to adopt new innovation faster.

**Efficiency in Time-use of the Two Categories of Draught Animals:** The analysis of time-use of the non-infested and infested draught animals is presented in Table 2. While a non-infested draught animal put in an average of 13.7 hours to produce output equivalent of ₦29,559.3 in one season, the infected counterparts worked 24.6 hours on the average to realize output equivalent worth ₦24434.4 in the same period under consideration. This implied that time was more efficiently utilized by the former category of animals. These findings agreed with Pearson [12] who observed that the reduced output and inability to work by otherwise well-fed and apparently healthy draught animals was as a result of chronic *Fascioliasis*.

**The Productivity of Draught Animals in the Study Area:** The results of the four production functions (linear, semi-log, double-log and quadratic) are presented in Table 3. Parameters considered in the selection of the lead equation/function (Double-log) among the models were the significant level of coefficients of independent variables (land, animal traction and capital services) included in the models, the coefficient of determination ($R^2$ ) and the standard errors. The $R^2$ of the double-log is 0.957 implying that 95. 7% of variations in the gross value of output (crop yield) is explained by the explanatory variables (land, animal traction, capital services) included in the model. It could also be observed that the production elasticity of all inputs is signed positive. What this entail is that keeping other inputs constant, a percentage increase in any of the included inputs, would increase crop yield by a proportion corresponding to the value of the production elasticity of the input. In this regard, all the inputs significantly (P<0.001) contributed to the crop yields. However, their levels of contributions differ. Values of 0.5234, 0.1552 and 1.1922 were obtained for land, animal traction and capital services, respectively. Furthermore, the double-log function has the lowest standard error margin (0.05328) compared to the remaining models.

Table 4: The acquisition costs and marginal value products of inputs by category of draught animals in Adamawa State, Nigeria

| | Acquisition Cost (₦*/unit) | | MVP (Xi by draught animals (₦*/Unit) | |
|---|---|---|---|---|
| Input | Non-infested animals | Infested animals | Non-infested animals | Infested animals |
| Land ($X_1$) | 926.20/hectare | 1226.50/hectare | 484.77 | 641.95 |
| Animal traction ($X_2$) | 13.73/hour | 24.62/hour | 2.13 1 | 3.821 |
| Capital services ($X_3$) | 8800. l5 hectare | 8549.37/hectare | 10491.54 | 10192.56 |

Note: Naira (₦* 140) = US$1

Source: Field Survey, (2001)

Table 5: Healthcare constraints associated with the use of animal traction in Adamawa State, Nigeria

| | Vet drugs are expensive | | Lack of knowledge to detect disease early. | | Inadequate feeds | | No access to Vet. personnel | | Inadequate clean water | | Fake Vet. drugs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category of farmer | Freq. | % | Freq. | % | Freq. | % | Freq. | % | Freq. | % | Freq. | % |
| Owners of non-infested animals | 54 | 43.30 | 40 | 29.85 | 25 | 18.66 | 12 | 8.96 | 9 | 6.72 | 5 | 3.73 |
| Owners of infested animals | 71 | 52.99 | 62 | 46.27 | 60 | 44.78 | 31 | 23.13 | 37 | 27.61 | 20 | 14.93 |
| Total: | 125 | 93.29 | 102 | 76.12 | 85 | 63.44 | 43 | 32.09 | 46 | 34.33 | 25 | 18.66 |

Note: *Multiple responses were recorded

Source: Field Survey, (2001)

**The Resource-use Efficiency Between the Two Categories of Animal Traction Users:** The computed marginal value productivity and acquisition cost (prices) per unit of the inputs are presented for each category of draught animals in Table 4. According to Baba and Etuks [13], the decision criterion is that when the marginal value product of inputs are higher than the acquisition cost, the inputs are said to be used below the economic optimum. On the other hand, lower values in the former are an indication that the inputs are utilized above economic optimum.

It could therefore, be observed from Table 4 that the MVP for capital services ($X_3$) was higher than the acquisition cost of the input, implying that the input ($X_3$) was used below economic optimum level and profit could be increased through an increased use of the input. In the case of land ($X_1$) and animal traction ($X_2$) their MVP were lower than acquisition cost of the inputs, indicating that the inputs ($X_1$ and $X_2$) were used above economic optimum in crop production. Therefore, reducing these inputs in the farming could raise profit. On a general note, it could be stated that about 66.67% of the resources were utilized by the animal traction users above economic optimum, while about 33.33% were used below their economic optimum in the area surveyed. This is irrational for any producer and therefore, adjustments have to be made as suggested earlier.

**Constraints to the Use of Animal Traction in the Study Area:** The main problem expressed by the farmers had its base associated with the healthcare of the draught animals. The result is presented in Table 5. The research revealed that 93.29% of the total farmers studied had the problem of acquiring veterinary drugs at exorbitant rates. Of this figure, 43.30% were owners of non-infested animals and 52.99% were owners of infested animals. Farmers with inability for detection of disease early recorded 76.12% with 29.85% and 46.27% for owners of non-infested and infested animals, respectively, as shown in Table 5.

The inability of the farmers to identify the disease early had to do with the cause of the disease in large ruminants {bulls} as the study indicated. Hensen and Perry [11] stated that this class of animal mostly adopt sub-clinical condition and therefore the disease cannot be detected early enough even by a well trained veterinarian to commence therapy appropriately. Apparent clinical signs may take 1-3 months or even more depending on the plane of nutrition of the animal involved. This ultimately

brings about delayed medication. By the time signs start becoming vivid, the predilection site (liver) must have been partially injured and complications set in. Among, are secondary bacterial infections, weakness and less productivity.

Another serious aspect discovered was the inadequacy of feeds and clean water supply more especially in the dry season. A total of 63.44% farmers experienced feeds scarcity. Out of this percentage, 18.66% were non-infested draught animals owners and 44.78% owners of infested counterparts. The inadequacy of clean water supply recorded 34.3 3%, with 6.72% and 27.61% for non-infested and infested draught animals' owners, respectively.

Furthermore, the results in Table 5 show that 32.09% of the farmers studied had no access to Veterinary facilities. Farmers in this aspect recorded 8.96% and 23.13% for owners of non-infested and infested draught animals, respectively. This had a direct link with the number of veterinary officers in the local government areas. A very worrisome situation discovered, as at the time of this study, was that out of the 16 local government areas surveyed, there were only 14 qualified divisional veterinary officers taking charge of the whole state. By implication, this meant that Out of the 14 personnel, 2 were taking charge of 2 local government areas at a time. This could be considered as grossly inadequate for a state like Adamawa regarded as the leading in cattle production in the country.

Another problem revealed during the study was the issue of fake veterinary drugs. A total of 18.66% farmers reported this, with owners of non-infested and infested draught animals recording 3.73%s and 14.93%, respectively.

**The Cost-effective Method of Cure and Prevention of *Fascioliasis* in Draught Animal in the Study Area**

**Modern Method:**

- Number of infested draught animals treated with veterinary drugs = 130
- Cost of Veterinary drugs used for all animals = ₦72,680:00
- Output equivalent by all treated infested animals = ₦4,368,379:00
- Value of output equivalent by an average treated infested animal =

$$\frac{\text{Total output equivalent Produced}}{\text{Number of infested animals treated}} - \frac{\text{Cost of Veterinary drugs used}}{\text{Number of infested animals treated}}$$

$$\frac{₦4,368,379}{130} - \frac{₦72680}{130} = \frac{N\,4,295,699}{130} = ₦330433.84$$

**Indigenous Method:**

- Number of infested draught animals treated with indigenous drugs 74 =
- Cost of indigenous drugs used for all animals = ₦2,675:00
- Output equivalent produced in the study year ₦616,241:00
- Value of output equivalent by an average treated infested animal =

$$\frac{\text{Total output equivalent Produced}}{74} - \frac{\text{Cost of indigenous drugs used}}{74}$$

$$\frac{₦616,241}{74} - \frac{₦2675}{74} = ₦8291.43$$

$$₦616,241 - ₦2675 = ₦613,566$$

$$₦613,566 = ₦8291.43$$

$$₦82991.43$$

Aliyara [14] in his report on a study carried out in the research area, stated that in addition to disease treatment through veterinary services, a variety of local herbs are being used for various disease conditions with different success rate.

The indigenous treatment can take the form of preventive or curative methods. However, there is variation in the type of treatment used for the same condition across the state. The success rate also varies greatly. With regard to *Fascioliasis* in the specie of animals studied, prominent among the remedies used across the state both for curative and preventive measures are: *Nicotina tabacum* commonly referred to as the local Tabacco, *Khaya senegalensis* known as Mahogany, *Monodica balsamina* popularly called balsam pear and the *Leaceunea species*. While veterinary preparations used include Banminth-F® suspension, Rafoxanide suspension, Albendazole bolus and Oxytetracycline long acting (Against secondary bacterial infections). These are shown in Table 6.

The results in Table 6 further revealed that the application of veterinary drugs in the treatment of *Fascioliasis* in draught animals in the area accounted for 45.15%, 23.08%, 30.77% and 76.92% by Banminth-F®

Table 6: Cost components of modern and indigenous methods of cure and prevention of *Fascioliasis* in Adamawa State, Nigeria

| Item | Unit | Unit Cost (₦) | Qty | Total Cost (₦) | Frequency of user farmers | Percentage % |
|---|---|---|---|---|---|---|
| Modern method | | | | | | |
| Baminth-F® | | | | | | |
| Suspension | .9 litre | 1250 | 15 jars | 18750 | 60 | 46.15 |
| Rafoxanide Suspension | 1 litre | 1000 | 12 jars | 12000 | 30 | 23.08 |
| Albendazole bolus | 5 grams | 25 | 350 boluses | 8750 | 40 | 30.77 |
| Oxytetracycline L.A.* | 100 ml | 1659 | 12 vials | 33180 | 100 | 76.92 |
| Total: | | | | 72680 | | |
| Indigenous methods | | | | | | |
| Nicotina tabacum | 30kg | 50 | 30 kg | 1500 | 30 | 40.54 |
| Leaceunea Species | 3 kg | 65 | 3 kg | 195 | 20 | 27.03 |
| Khaya sene- galensis | 2.2kg | 200 | 2.2 kg | 440 | 14 | 18.92 |
| Monadica balsamina | 3 kg | 180 | 3 kg | 540 | 10 | 13.51 |
| Total | | | | 2675 | 74 | 100.00 |

Note: *'Multiple responses were recorded

Source: Field Survey, (2001)

suspension, Rafoxanide suspension, Albendazole bolus and Oxyretracycline Long acting, respectively. An average treated draught animal under this category put in output equivalent of ₦33043.84 in the cropping season under consideration. While the indigenous herbs used include *Nicotina tabacurn, Leaceunea species, Khaya senegalensis* and *Monodica balsamina*, accounting for 40.54%, 27.03%, 18.92% and 13.51%, respectively. The yield equivalent of an average treated animal in this category was ₦8291.43.

## CONCLUSION

Although all the explanatory variables (land, animal traction, capital services) were found to significantly influence the gross output (yield) in both the two categories of farmers, resources have been discovered to be used irrationally in the study area. This was more valid among the farmers with infested draught animals. The major constraints experienced by the users of animal traction stem from the healthcare of the draught animals in general. Inspite of the fact that both modern and indigenous methods of control of *Fascioliasis* were used in the infested animals, the former method was found to be cost-effective.

Based on the above, the government and non-governmental organizations should intensify their extension services to educate the animal traction users on rational use of their resources at economic optimum. Furthermore, adequate veterinary facilities (drugs, feeds, equipment, personnel, etc) should be made available in the rural areas and also be easily accessible by the farmers using draught animals at a subsidizing rates.

## ACKNOWLEDGEMENT

I wish to sincerely thank late Dr. Muhammad Pate, the former Divisional Veterinary Officer of Fufore LGA, for his immense efforts in sample collection and analysis and all the 14 livestock superintendents in-charged of the respective LGAs surveyed for painstakingly collecting the data used for this study and the farmers for their patience and absolute cooperation.

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