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Determinants of Profitability Among Smallholder Cattle Farmers Under Animal African Trypanosomosis (AAT) Infestation in Edo State, Nigeria

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Abstract
This study on the determinants of profitability among smallholder cattle farmers under Animal African Trypanosomosis (AAT) infestation in Edo State, Nigeria examined the socioeconomic characteristics of smallholder cattle farmers and establish the determinants of profitability in cattle farming business. A multi stage and snowball sampling techniques were adopted in selecting a total of 270 pastoralists from 27 communities in 9 Local Government Areas across the three agricultural zones of the State. Data was obtained through the use of structured questionnaire and analyzed using descriptive statistics and multiple regression analysis. Results showed that all the pastoralists sampled were males (100%), and the modal age of respondents was between 26 and 30 years (39.9%). The mean farming experience was 15 years and 62.3% had some level of education with the mean years of schooling of 6.0 years. The regression result showed that herd size (β 500.60), depreciated total fixed cost (β 5.65), treatment cost (β -10.34), feed cost (β- 2.22), transport cost (β-10.89) and marketing cost (β -10.93) were significant socioeconomic variables that affected revenue of pastoralists in the study area. It was recommended that pastoralists should form cooperative society to pull resources and meet the financial requirements for cattle breeding.

Key words: Trypanosomosis, Disease, smallholder, Trypano-tolerant, Tryperno-susceptible

1.0 Introduction
Cattle play an important role as subsistence farming, for drought power and as an income earner in Northern-Nigeria. Livestock production especially cattle contributes significantly to the economy of Edo State as it is among the most significant sources of revenue from livestock production in EdoState. A field survey according to Winny Report (2019) show that the agricultural section supports 35% of Nigeria's Gross Domestic Product (GDP) of which 18% is supported by the cattle sub-sector.
However, the cattle production sector has been facing some challenges such as animal diseases and scarce pasture for their cattle. This is especially in Northern Nigeria, where majority of the Fulani cattle rearers originate from and migrate towards the South to Edo State in search of greener pasture, water, lush vegetation and lucrative market, especially during the dry season. Pastoralists move to Edo State in Extensive system of animal husbandry. This system of cattle production is practiced mainly by Fulani-pastoralists. These cattle are not indigenous to Edo State; they move to the area through hoof and through

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trucks. In this process they pass through tsetse fly infection zones, and they pick up parasites like trypanasomaisis. The major cattle productivity sub-sector constraint is animal diseases (Winny (2019). The most common disease among cattle in the study area is trypanosomiasis (Dede *et al.,* 2007). It is a parasitic disease that is transmitted by tsetse flies which are found in a large part of Nigeria. In region under challenge of trypanosomiasis, land cannot be exploited for cattle rearing.

In Nigeria, Animal African Trypanosomosis (AAT) disease commonly referred to as *nagana* in cattle has caused low cattle productivity and also livestock loss (Moulding, 2006). Trypanosomiasis is an illness caused by various species of *Trypanosoma*. The most significant zoonotic species include *Trypanosoma brucigambiense, Trypanosoma bruci rhodesiense*, which result in human African sleeping sickness, and *Trypanosoma cruzi*, responsible for human American Chagas disease.

According to WHO, 2023 the tsetse fly transmitted trypanosomosis is a very severe disease which is caused by fhlagellate protozoan parasites of the genus *Trypanosoma*. The disease affects both humans and animals in Nigeria and is primarily transmitted by infected *Glossina spp* (tsetse flies) (Britannica 2023). Generally, the African Animal Trypanosomosis (AAT) that affects cattle is mainly caused by *Trypanosoma vivax, T. congolense, and T. brucei spp*. while the *T. simiae* affects pigs. Desquesnes (2018) observed that infected animals experience symptoms such as fever, anemia, decreased appetite, weight loss, reduced milk production as well as fertility issues and increased mortality. Ahmed *et al.* (2016) earlier noted that AAT extends beyond tsetse-infested areas due to the mechanical transmission caused by other biting flies during animal movement. They further noted that AAT has significant economic impacts in Nigeria as it ranks as the second most important cattle disease in the country. Approximately 6 million cattle, out of a total population of 20 million, are estimated to be at risk of AAT in Nigeria (Cecchi and Mattioli**,** 2009). The disease leads to reduced cattle productivity and decreased efficiency in draught animals used for crop production (Karshima *et al*., 2016). Finding ways to treat AAT by cattle farmers with all manner of drugs contributes to the high use of veterinary drugs in Nigeria which raises concern about use of substandard medicines and drug resistance in the country (Kingsley 2015).

Franco *et al*. (2017) noted that while trypanosomosis can be mechanically transmitted by other biting flies, cyclical transmission occurs exclusively through tsetse flies. Tsetse fly control efforts in Nigeria have been undertaken in the past, including aerial and ground spraying as well as the sterile insect technique (SIT), bush clearing and trapping (Olandunmade *et al*., 1988). Some areas in northern Nigeria, where tsetse flies were previously eliminated, have experienced re-infestation due to discontinuation of control measures. Moreover, areas such as the Jos, Mambilla, and Obudu plateaus, previously known to be free of tsetse flies, have shown changes in the entomological situation with the detection of *G. palpalis palpalis and G. tachinoides* (Dede *et al*., 2005; Karshima *et al*., 2016).

Disease control measures for AAT in Nigeria include disease surveillance, chemoprophylaxis, and chemotherapy. However, several challenges exist, such as the use of outdated and expensive trypanocides, inadequate veterinary services support, and the improper use of treatments resulting in antimicrobial resistance. The adoption of trypanotolerant breeds, which can resist the severe effects of trypanosomal infection has been constrained due to the farmers' preference for more productive but susceptible breeds (Grace *et al.,*2009).

There is no doubt that the primary motive of the smallholder cattle farmers is to make profit from their cattle production activities. Some factors aside the effects of trypanosomal infection contribute positively or negatively to profitability in cattle production. The socioeconomic attributes of the farmer contributes in influencing the profitability. Hence finding answers to such questions as: What are the socioeconomic characteristics of pastoralists in the Edo State and which of the variables affect the income of the farmers are the crux of the study. The specific objectives of the study are to:

a) describe the socioeconomic characteristics of pastoralists in Edo State;
b) examine the variables that determine the profitability of Beef Cattle production in the study area

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2.0 Research Methodology

Study Area

The study was carried out in Edo State which is one of the six States in the Niger Delta region of Nigeria. The State was created out of the former Bendel State on August 27th, 1991. It has boundaries on the East by the river Niger, on the West by Ondo state, on the South by Delta state and in the North by Kogi state. The State occupies a land area of 19,639.7km^2 with a population of 4,777,000 people made up of 2,470,908 males and 2,306,092 females (NPC, 2022) projected figure).

Edo State lies between latitude 6^0.44'N and 6^0.21'N of the equator and Longitude 5^0.35'E and 5^0.44'E of the Prime Meridian Hemisphere. It has two distinct seasons of rainy and dry seasons with an annual rainfall of 2500mm in the southern parts and 1500mm in the Northern areas (Iyalomhe & Cirella, 2018). It has three (3) ecological zones with the mangrove swamp forest in the extreme South, the rain forest in the middle and the derived savannah in the North.

The State has 18 Local Government Areas (LGAs) divided into three Agricultural zones (Edo North, Edo Central and Edo South). Farming is the predominant occupation of the people and they grow cash crops such as rubber, oil palm produce, cocoa, cashew, timbers, and food crops such as yam, cassava, cocoyam, rice, melon, maize, plantain, vegetables and ground nut. Artisanal fishing is carried out by the riverine communities while fish farming and livestock rearing are growing agricultural investments in the State.

Sampling Procedure

The population of the Cattle Farmers in the study area comprised of 1300 registered members of Cattle Breeders Association of Nigeria in the study area. Multi stage sampling technique was employed to select respondents for the study. The first stage involved the selection of three (3) LGAs from each of the three Agricultural Zones in the State.

In the second stage, three (3) communities were randomly selected from each of the sampled LGAs making a total of 27 communities across the State while the third stage involved the selection of ten (10) pastoral farmers from each of the selected communities to give a total of 270 pastoral farmers sampled State wide. In the third stage snowball method was also applied in identifying and selection of pastoralists. Of the 270 questionnaire distributed for the study, a total of 263 returned were considered to be useful and therefore utilized for analysis.

Data Collection

Primary data were collected using structured questionnaire that was administered to the respondent cattle farmers using trained enumerators. The questionnaire contained questions on a number of variables including socioeconomic characteristics of the farmers and profitability variables in cattle production business.

Methods of Data Analysis

The socioeconomic characteristics of cattle farmers were achieved using descriptive statistics such as tables, percentages, frequencies and means while the effect of socioeconomic variables on profit was achieved using Ordinary Least Square (OLS) Regression analysis. The null hypothesis for the study tested was that the socioeconomic characteristics of cattle farmers have no significant effect on the profitability of cattle production.

Multiple regression analysis was done to estimate the relationship between socioeconomic characteristics of cattle farmers and the profitability in cattle production.

The basic function was expressed implicitly as:

$$REV = f(AGE, FAS, EDU, EXP, HES, TFC, COF, COM, TRC, MAC; e_i)$$

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Where:
REV = Profit (₦)
AGE = Age of the farmer in years
FAS = Family size (Number of persons feeding from the same pot)
EDU = Educational level of the respondents (years of schooling)
EXP = Farming experience (years so far spent in farming)
HES = Herdsize (Numbers of animals kept)
TFC = Total Fixed cost (₦)
COF = Cost of feeds (₦)
COM = Cost of medication (₦)
TRC = Transport cost (₦)
MAC = Marketing cost (₦)
β_0-β_{10} = Parameters to be estimated
e_i = Error term

The equation was specified explicitly and tried in four functional forms of linear, exponential, semi-log and double-logs. The profit in cattle farming business was the dependent variable against the socioeconomic variables of the respondents which formed the independent variables. Output of the form with best result according to econometric *apriori* criteria was adopted as the lead equation. The explicit versions of the functional forms are stated as:

Linear: $PRO = \beta_0 + \beta_1 AGE + \beta_2 FAS + \beta_3 EDU + \beta_4 EXP + \beta_5 HES + \beta_6 TFC + \beta_7 COF + \beta_8 COM + \beta_9 TRC + \beta_{10} MAC + e_i$

Exponential: $InPRO = \beta_0 + \beta_1 AGE + \beta_2 FAS + \beta_3 EDU + \beta_4 EXP + \beta_5 HES + \beta_6 TFC + \beta_7 COF + \beta_8 COM + \beta_9 TRC + \beta_{10} MAC + ei$

Semilog: $PRO = \beta_0 + \beta_1 InAGE + \beta_2 InFAS + \beta_3 InEDU + \beta_4 InEXP + \beta_5 InHES + \beta_6 InTFC + \beta_7 InCOF + \beta_8 InCOM + \beta_9 InTRC + \beta_{10} InMAC + ei$

Double-log: $InPRO = \beta_0 + \beta_1 InAGE + \beta_2 InFAS + \beta_3 InEDU + \beta_4 InEXP + \beta_5 InHES + \beta_6 InTFC + \beta_7 InCOF + \beta_8 InCOM + \beta_9 InTRC + \beta_{10} InMAC + ei.$

3.0 Results and Discussion

Socioeconomic Characteristics of the Respondents

The data presented in Table 1 showed that 39.9% of cattle farmers interviewed were aged between 26 and 30 years and this is followed by age range of 25 years and below (33.5%), while 19.4% were 31 – 35 years and 4.6% were 36 – 40 years and 2.6% were 41 years and above. The average age was 28 years and this the farmers were within the active age category. The works of Ibitoye (2012) and Ehiwario (2016) established similar trend in age of livestock farmers. Being young indicates that the farmers possess enough energy to engage in pastoral activities.

The result for the sex of respondents reveals that all the sampled respondents were all males indicating that cattle farming was male specific economic activity. This finding implies that male folks in the study area (Edo State) are the ones engaged in cattle farming. This could be due to energy requirement of the business or tasking nature associated with the business including the security risks of moving from one place to the other. This finding is in accordance with the work of Javon, Evans and Anakalo, (2015), who postulated in the work that cattle farmers business is gender or male specific. Conversely, this findings is at variance of a similer research study by Ikheloa, Ukpi, Akinyosoye and Oluwatago (2013) on 'understanding farmers response to climate change variability in Nigeria' and reported the involvement of more females in farming

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activities than the male. In cattle farming, females dominate in the processing and marketing of milk and milk products.

The marital Status revealed that most (71.1%) of the respondents were married while 28.5% were single. Being married connotes sense of responsibility in Africa as the society attach so much importance to the marriage institution. Married families harness family labour comprising of their children and wards to execute the day to day rearing of the livestock.

Table 1: Socioeconomic characteristics of the respondents

Variable	Frequency	Percentage
Age		
≤ 25	88	33.5
26-30	105	39.9
31-35	51	19.4
36-40	12	4.6
> 40	7	2.6
Total	263	100.00
Sex		
Males	263	100.0
Females	0	0.0
Total	263	100.00
Marital Status		
Single	75	28.5%
Married	187	71.1%
Widow(er)	1	0.4%
Total	263	100.00
Level of Education		
No formal Education	97	36.9
Primary Education	131	49.8
Secondary Education	33	12.5
Tertiary Education	2	0.8
Total	263	100.00
Household Size		
0 – 2	6	2.28
3 – 5	185	70.34
6 – 8	69	26.24
> 8	3	1.14
Total	263	100.00
Experience (years)		
< 10	46	7.49
11 – 15	126	47.19
16 – 20	62	23.57
> 20	29	11.52
Total	263	100.00

Source: Computed from Field Survey Data 2024

Most of the pastoralists (62.3%) had primary and secondary education while 36.9% had no formal education and 0.8% attempted one form of tertiary education or the other indicating that respondents literacy level

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was on the average (i.e intermediate level). This level of education improves the respondents' technology adoption in pastoral farming.
The distribution of respondents according to household size showed that 70.34% had between 3 and 5 members in the family while 26.24% had 6 to 8 members and 2.28% had less than 2 members. Only 1.14% of the respondents had above 8 family members. Ehiwario (2016) established that farmers with large household size were likely to be more productive than those with smaller household size since they employ household members in labour intensive farming activities.

Majority (47.19%) of the respondents had experience as pastoralists between 11 and 15 years. The average years of experience for the respondents was 15.5 years and this indicated that farmers in the area possessed the necessary and required experience in beef cattle production. They also had the necessary skills in adoption of new technologies/ innovations. This is in line with the findings of Adewuyi (2010) who reported a positive relationship between farming experience and technology adoption as well as profitability while Suliyat et al (2023) also reported that farmers with enough experience in terms of cattle breeding possess better skills in handlling compared to less experienced farmers.

Socioeconomic Determinants of Income of Respondents

The socioeconomic variables that affect the revenue of the pastoralists is as presented in table 2.
The linear regression model was selected as the lead model because it has the highest value of R^2 (0.917). This implies that the variables in the model accounted for about 92% of revenue realised by the farmers. The result revealed that five (5) of the independent or explanatory variables significantly influenced the revenue realised by the farmers. Variables such as herd-size, fixed cost have positive and significant impact on revenue at the 0.01 level.

Herd-size (β =50.60): The result of the analysis revealed that herd size significantly had positive influence on the profit realized by the pastorialist at the 1% level of significance. This implies that the more the herd size, the higher the profit as the number of animals in the herd determines the turn over which invariably determines the revenue generated. This supports the report of Ibitoye,

Table 2: Socioeconomic Determinants of Income of Pastoralists

Independent Variables	Linear Coeff.	Prob. level	Semi Log Coeff.	Prob. Level	Cob Douglass Coeff.	Prob. Level	Exponential Coeff.	Prob. Level
(Constant)	-2993.20*		-4512.52		-3458.56*		1521.33	
	(-1.74)	0.08	(-1.11)	0.27	(-1.84)	0.07	(0.065)	1.53
Age	-12.98		58.97**		12.03		34.87	
	(-0.47)	0.64	(1.95)	0.07	(1.37)	1.86	(1.65)	1.29
Family size	-15.69		34.66**		1.99		-37.21	
	(-0.07)	0.95	(2.21)	0.05	(1.02)	1.34	(0.96)	0.99
Education	27.32		46.86		-0.02		74.86	
	(1.02)	0.31	(1.50)	0.96	(-1.45)	0.98	(0.66)	1.34
Rearing experience	19.60		23.56		-30.03		-23.41	
	(0.73)	0.47	(0.88)	1.20	(1.32)	0.86	(1.02)	3.01
Herd size	50.60***		50.23*		11.15**		09.56**	
	(23.70)	0.00	(1.87)	0.08	(2.4)	0.06	(2.45)	0.06
TFC	5.65***		-37.66		32.11**		-4.44E-08	
	(6.29)	0.00	(0.34)	0.75	(2.09)	0.05	(0.89)	1.95
Cost of feed	-2.22***		-17.40**		51.45		2.63E-7	
	(-2.43)	0.02	(-2.39)	0.07	(1.39)	2.34	(1.34)	1.41
Cost of medication	-10.89***		25.14		22.43*		-1.06E-6	

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	(5.18)	0.00	(1.49)	0.76	(1.88)	0.09	(0.99)	9.60
Transport cost	-10.89***		-34.70**		20.10		-1.39E-6*	
	(-5.36)	0.00	(-2.71)	0.08	(0.25)	1.03	(1.89)	0.08
Marketing cost	-10.95***		-12.03		-10.29***		12.84E-6	
	(-5.48)	0.00	(0.13)	0.91	(-6.41)	0.00	(0.13)	1.17
Model statistics								
Adjusted R square	0.917		0.588		0.546		0.391	
Durbin Watson	2.1		2.2		2.02		1.96	
F value	263.5		34.9		29.6 (P<0.01)		16.3	
	(P<0.01)		(P<0.01)				(P<0.01)	

***Significant at 1%, **Significant at 5% and *Significant at 10%. Figures in parentheses are t-values

(2012) in Kogi State which established a relationship between herd-size and profitability in livestock management.

Total fixed cost (β =5.65): Similarly, TFC had statistically significant effect on the profit of the farmers at the 0.01 level. This can be explained on the basis that the more the farmers invested on fixed assets in the farm, the more it creats room for expansion to bring in more cattle to be reared. This eventually brings in more revenue for the farmers and more profit is realized.

Feed cost (β =-2.22): Feed is a major component in cattle production. This input cost negatively affects profit at the 0.05 level of significance. The more resources are expended on feed the more it's effect on the revenue generated and then a rduction effect on the profit made by the farmers.

Treatment cost (β = -10.89): This variable also negatively affects profit in cattle production at the 0.01 level. The more money a farmer spends on the treatment of his animals in the event of an outbreak of any disease or pest infestation, the more it's effect on the revenue generated. This invariably reduces the profit realized by the farmers.

Marketing cost (β =-10.95): Marketing costs are usually incurred during the course of transaction in cattle marketing. This affected profitability negatively at the 0.01 level. As marketing services are performed at every point of the marketing channel, cost is being incuured Among them are transportation costs. This finding supports the work of Obasi and Njokuoma (2008) which reported that transportation is the most critical factor affecting marketers and their performance in many developing economies.This cost has great effect on the revenue generated and therby reduces the profit made by the farmer.

4.0 Conclusion/Recommendation

The study investigated the determining factors of profitability among smallholder cattle farmers under the effects of Trypanosomosis disease infestation in Edo State, Nigeria. The issue of trypanosomosis with regards to cattle production forms a significant part of livestock policy making in both developed and developing world. Some of the socioeconomic variables of the pastoralists were identified to have significant effect on profitability of the business. Herd size and total depreciated fixed costs positively affected profit while feed cost, treatment cost and marketing costs have significant negative impact on revenue, hence profitability.

Pastoral farmers should form cooperatives so that they can pull resources together and be able to impact the financial requirements for their respective members in terms of cattle production.

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