Journal of Agricultural Economics, Environment and Social Sciences 1(1):124–129 September,2015

Department of Agricultural Economics, University of Maiduguri, Nigeria
Available on line: http://www.unimaid.edu.ng/jaeess
ISSN: 2476 – 8423

Allocative Efficiency and its Sources among Cattle Fattening Farms of Borno State, Nigeria: Stochastic Frontier Approach

[1*]Umar, A.S.S., [2]Zakari, A. and [3]Oseni, Y.

[1]: Department of Agricultural Economics, University of Maiduguri, Borno State, P.M.B.1069, Maiduguri, Borno State, Nigeria
[2 & 3]Department of Agricultural Economics and Rural Sociology Ahmadu Bello University, P.M.B.1044 Zaria, Nigeria

ABSTRACT
This research was carried out to estimate the allocative efficiency and its sources among of cattle fattening farms in Borno state, Nigeria. Multi-stage sampling was used to select the sampled cattle fatteners. Primary data were used which were collected using the interview method. Stochastic frontier cost function was used to analyse the data collected. The result revealed mean allocative efficiency score of 0.431. The major sources of inefficiency identified were age, experience, herd size, management record, and access to credit. In order to further improve efficiency, is was recommends that the cattle fatteners should be provide with a cheap formal credit, they should be encouraged to form cooperative societies and be trained on the alternative ways of least cost feed formulation and mixing in order to reduce their cost of production.

Key words: Cattle Fattening, Farms, Allocative Efficiency, Stochastic Frontier

INTRODUCTION
Cattle play a very important role to the socio-economic life of many sub-Saharan Africans. It contributes about 4.8 % of the total (39%) agricultural Gross Domestic Product (GDP) in 2012 (CBN, 2012). It is the most predominant and the most valued livestock in Nigeria. Cattle also serve as symbol of status and prestige in many rural societies (Tukur and Maigandi, 1999). The possession of cattle serves same or similar functions that holding money provides. Apart from proving extra revenue to the farmers, it serves as a form of interest accruing equity (Ouma *et al.*, 2007).

In spite of the numerous human and natural resources, Nigerian Agricultural sector failed to provide adequate animal protein in the diets of the larger proportion of the population (Damisa and Hassan, 2009). Nigeria still remains among the least consumers of animal protein in Africa (Emaikwu *et al.*, 2011). While in North America, Western and Eastern countries consume 66. 3g and 33g respectively of animal protein per head/day, an average Nigerian consumes 7.5g which is below the 27g/head/day recommended by FAO (Emaikwu *et al*., 2011). The domestic supply of animal protein grows at 1.8 per cent per annum, while demand is rising at 5.1 per cent annually resulting in an acute scarcity of the product (FAO, 2009). This imposed serious constraints on the ability of the people to take the product for healthy living (FAO, 2009).

The shortage of animal protein in the nation was attributed to high cost of feed which constitutes about 80% of the total cost of production. This increases the price of the beef to a level beyoung the reach of the average Nigerian. The shortage of animal protein necessitated research into various alternative means of meeting the ever-increasing demand of the product (Emokoro and Amadusun, 2012). Cattle

*Corresponding Author email: sidiumar@yahoo.com Tel: 08065728871, 08029112728

fattening has been recommended as one of the fastest means of improving animal protein supply in the nation. Beef is the most commonly consumed animal protein in Nigeria. Cattle fattening is a management strategy employed to control and regulate the feed intake of the animals in order to obtain a faster weight gain. It is a strategic feeding schedule designed to achieve quick results in terms of faster improvement in the quality and quantity of meat (Umar, 2007). Beef which is the end product of cattle fattening is the most commonly consumed animal protein in Nigeria (Oni, 2006).

There is the need to improve the allocative efficiency, in order to reduce the cost of production as a result of rising cost of inputs and hence, improve the supply of the product in the nation. The quantitative determination of allocative efficiency of cattle farms has not been the focussed in recent studies. Most studies conducted on cattle fattening farms in Nigeria focused mainly on the profitability (Okoruwa *et al*., 2005; Omolehin *et al.,* 2009); economic (Umar, 2007 and Umar *et al.*, 2008) and productivity and resource-use efficiency (Gabdo *et al.*, 2005, Ibrahim, 2007). However, none of such studies estimates the allocative efficiency of cattle fattening farms in Borno State. Hence, this study was undertaken to determine the allocative efficiency of cattle fattening farms in Borno State, Nigeria. It is believed that study on efficiency of fattening will facilitate decisions to invest in the cattle fattening farms in Borno state in particular and Nigeria in general. It was against this background that this study determined the allocative efficiency and identifies sources of inefficiency in cattle fattening enterprise of Borno State in order to recommend appropriate policy measures that will improve beef supply in the state in particular and the nation in general.

METHODOLOGY

This study was conducted in Borno state which is located on the dry savannah and Sahel belt in the North-eastern part of the country. It lies between latitudes 10^0 30'N and 14^0'00'N and longitudes 11^0'03E and $14^0$45'E. The state has land mass of about 69,436sq km with population density of approximately 60 inhabitants per square kilometres (Borno State Official Diary, 2012). The state has a population of 4,151,193 people (NPC, 2006), which is projected to 4,708,599 for 2010 based on the 3.2 per cent annual growth rate. The temperature ranges between 24^o C and 44^o C. The rainy season lasts mainly for four months from June to September in the north and May to October in the south with a mean annual rainfall of 650mm. The relative humidity is about 49% and evaporation of 203mm per year (Ibrahim, 2012). The main occupation of the people in the study area is farming. The major crops grown in the state include millet, maize, sorghum, rice, wheat, groundnut, cowpea, onion, pepper, tomato and green vegetables like spinach, lettuce, carrot, garden egg, cucumber, okra, cabbage and water melon (Ibrahim, 2012).

Multi-stage sampling was used to select the respondents. In the first stage, four LGAs (Bama, Konduga Ngala and Maiduguri Metropolitan Area) were purposively selected based on concentration of fattening enterprise. In the second stage two villages were selected from each LGA based on the intensity of fattening enterprises which include Bama and Banki from Bama, Gamboru and Ngala from Ngala, Konduga and Kawuri from Konduga and Maiduguri metropolitan area council. The third stage involved a random sampling of 10% of the cattle fattening enterprises from each of the villages to get a sample size of 98 cattle fattening enterprise. Primary data were used for this study. The data were collected using the interview method. The data gathered include those on socio-economic characteristics of the cattle fatteners, cost of inputs used (Naira) and prices of the output (revenue) obtained (Naira).

Stochastic Cobb Douglas Cost Frontier Function was used to analyse the allocative efficiency of the cattle fattening farms. It is specified as follows:

$C_i = g (P_i; \&) \exp (V_i + U_i)$, 1, 2…. N… …….……..... …… (1)

Where:

C_i = represent the total input cost of the ith fattening farm (₦)

g = is the suitable functional form (Cobb Douglass)

P_i = prices of inputs employed by the ith fattening farm (₦)

& = Unknown parameter to be estimated
V_i and U_i = are random errors.
j = 1, 2, 3 … n

The allocative efficiency of the individual fattening farm is defined in terms of the ratio of the predicted minimum cost (C_1^*) to the observed cost (C_i) is, $AE_i = C_i^*/C_i$

$AE = g(P_j; \alpha)\ ex\ (V_i+U_i)/g\ (P_j, \alpha)\ exp\ V_i + exp\ (U)$ … ……..... (2)

$AE_i = exp\ (U_i)$…… ……..... (3)

The allocative efficiency also ranges between 0 and 1.

The Cobb-Douglas Cost frontier function for the cattle fatteners was specified as follows;

$$In\ C = \alpha_0 + \sigma_1 InP_1 + \sigma_2 InP_2 + \sigma_3 InP_3 + \sigma_4 InP_4 + \sigma_5 InP_5 + \sigma_6 InP_6\ \sigma_7 InP_7 + V_i + U_i \text{ …..……} \quad (4)$$

Where: C = Total cost of fattening farm of the i-th farm (₦)
α_0 = Intercept
σ_1- σ_7 = Unknown scalar parameters estimated
P_1 = Cost of feeder cattle (₦)
P_2 = Cost of feed (₦)
P_3 = Cost of labour (₦)
P_4 = Cost of water (₦)
P_5 = Cost of Veterinary services (₦)
P_6 = Cost of potash/salt (₦)
P_7 = Cost of Equipment (₦)

Allocative Inefficiency Model

It is assumed that the allocative inefficiency effects are independently distributed and U_{ij} arises by truncation (at zero) of the normal distribution with mean U_{ij} and variance, $ð^2$. The allocative inefficiency effects (U_{ij}) is defined by:

$$U_{ij} = \delta_0 + \delta_1 In\ Z_{ij} + \delta_2 Z_{2ij} + \delta_3 Z_{3ij} + \delta_4 Z_{4ij} + \delta_5 Z_{5j} + \delta_6 Z_{6j} + \delta_7 Z_{7j} \text{ ……} \quad (5)$$

Where:

U_{ij}	=	Represents the Allocative Inefficiency of the i-th fattening farm
Z_1	=	Age of the Fattener (years)
Z_2	=	Fattening Experience (years)
Z_3	=	Level of Education (Years of schooling)
Z_4	=	Herd Size (Number of Cattle Fattened)
Z_5	=	Management Record (Yes = 1, otherwise 0)
Z_6	=	Access to Extension Services (Number of Contact)
Z_7	=	Access to Formal Credit Facilities (₦)

These variables were included in the model to indicate their possible influence on the allocative efficiencies of the fattening enterprise. The δ_1- δ_7 are parameters estimated.

The variances of the random errors, $\delta^2 v$ and that of the allocative inefficiency effects $\delta^2 u$ and overall variance of the model δ^2 are related thus; $\delta^2 = \delta^2 v + \delta^2 u$ and the ratio $\alpha = \delta^2 v/\ \delta^2$, measures the total variation of output from the frontier which can be attributed to allocative inefficiency (Battesse and Corra, 1977). The parameters of the frontier model are estimated such that the variance parameters are defined as: $\delta^2 = \delta^2_{vi} + \delta^2_{Ui}$ and $Y - \delta^2/\ \delta x$

Where, the x has a value between 0 and 1. The maximum likelihood estimates of the σ and δ coefficients were estimated simultaneously using the computer programme FRONTIER 4.1 (Coelli, 1996).

RESULTS AND DISCUSSION

Allocative efficiency of cattle fattening farms in Borno State

The maximum likelihood estimates of the stochastic frontier cost function of cattle fattening farms are presented in Table 1. The variance parameter sigma (δ^2) was 3.521 and statistically significant at 1%

level which indicates good fit and correctness of the specified composite error term distribution. The gamma estimate was 0.763 and was statistically significant at 1% level meaning that 76% variation in total cost of production was due to allocative inefficiency.

The result revealed that the coefficient for feeder cattle (0.572) was positive and statistically significant at 1%. This implies that 1% increase in the cost of feeder cattle will lead to 0.572% increase in cost of production. A plausible explanation to this is that in cattle fattening, feeder cattle is the most important input used. The initial cost of the feeder cattle greatly influence the total cost of the production of the farms. The coefficient of feed (0.326) was positive and significant at 1% level. The cost of feed influences the cost of the fattening and hence the profitability of the farms.

The coefficient of labour (0.146) was positive and statistically significant at 5%. This implies that 1% increase in labour use will result in 0.146 % increase in cost of cattle fattening. Similarly, the coefficient of veterinary services and vaccine (0.272) was positive and statistically significant at 5%, implying that 1 per cent increase in the cost of veterinary services and vaccine leads to 0.2 per cent increase in the cost of cattle fattening. The quality of veterinary services not only improves the efficiency of the animal in terms of feed conversion, but also reduces rate of mortality in the farm. However, the coefficient of water (0.025), potash/salt lick (0.0163) and equipment were positive, but significant at 10%, implying that these variables had little influence on the cost of fattening. These findings also agree those of Ceyhan and Karem (2010).

Table 1: MLE of the Stochastic Frontier Cost Function for Cattle Fattening Farms

Variables	Parameters	Coefficient	t-ratio
Constant	P_0	5.104	5.105***
Cost of Feeder cattle	$\mathbf{P_1}$	0.572	3.054***
Cost of Feed	P_2	0.326	5.216***
Cost of labour	P_3	0.146	2.023**
Cost of water	P_4	0.025	1.743*
Cost of potash/Salt lick	P_5	0.016	1.854*
Cost of vet. Services	P_6	0.272	2.342**
Cost of equipment	P_7	0.032	1.951*
Variance parameters			
Sigma	δ^2	3.521	2.323**
Gamma	$\boldsymbol{\gamma}$	0.763	5.262***
Log likelihood		-128.523	
Mean efficiency		0.543	

***P<0.01, **P<0.05,*P<0.10

Frequency Distribution of Allocative Efficiency of Cattle Fatteners

The mean allocative efficiency of the fatteners was 0.541. This implies that on average, the cattle fatteners were about 46% allocative inefficient. They can reduce cost of production by 46% and still produce same level of output. There exist the scope of reducing cost by about 46%, by adopting the practices and techniques of the most efficient counterpart in the sample. Also for the average fattener in the sample to achieve the efficiency level of his most efficient counterpart, he could decrease his cost level by about 33% (1 – 43/64) x 100) and produce same quantity of output. Likewise, for the least efficient fattener in the sample to achieve the efficiency level of his efficient counterpart, he could reduce his cost by about 67% (1 – 21/64) x 100) and produce same quantity of outputs. The result also revealed that greater proportion (93%) of cattle fatteners had efficiency scores of less than 0.6, while 100% of the cattle fatteners in the sample had efficiency score of less than 0.7. This shows that cattle fatteners in the study area exhibit high level of allocative inefficiency.

Table 2: Frequency Distribution of Allocative Efficiency of Cattle Fattening Farms

Efficiency	Frequency	Percentage
0.10 – 0.49	68	78.6
0.50 – 0.59	14	14.3
0.60 – 0.69	07	7.14
0.70 – 0.79	–	–
0.80 – 0.89	–	–
0.90 – 0.99	–	–
Total	98	100
Mean	0.541	
Minimum	0.214	
Maximum	0.681	

Allocative inefficiency in cattle fattening farms

The result of MLE estimates of sources of efficiency revealed that coefficients of age, years of experience, farm size, management record and access to credit were negative and significant at 1% level. This implies that these variables reduce allocative inefficiency of the cattle fatteners in the study area. However, the coefficient of educational qualification and extension contact were also negative but significant at 10 % and 5% respectively implying that they have little influence on the efficiency of the farmers. Similar findings were reported by Ceyhan and Karem (2010) for cattle-fattening farms in Turkey.

Table 3: Determinants of Allocative Inefficiency in Cattle Fattening Farms

Variables	Parameter	Coefficient	t-ratio
Inefficient Model			
Constant	δ_0	0.012	3.623***
Age	δ_1	-0.012	5.312***
Experience	δ_2	-0.021	2.361**
Educational qualification	δ_3	-0.032	1.923*
Farm size	δ_4	-0.126	4.217***
Management record	δ_5	-0.241	2.250**
Extension service	δ_6	-0.012	2.413**
Access to credit	δ_7	-0.231	3.456***

***P<0.01, **P<0.05,*P<0.10

CONCLUSION AND RECOMMENDATIONS

The cattle-fattening farms in the study area showed high allocative inefficiency scores, however, there is scope for improving the level of efficiency by reducing the cost without decreasing the quantity of outputs. However, to obtain this, there is the need for the government to provide the cattle fatteners with formal credit to enable them purchase inputs especially feed at a time when they are cheap. Also, there is the need to encourage the cattle fatteners to form cooperative societies to enable them procure inputs for their members at a cheaper rates. Similarly, there need to train the cattle fatteners on the alternative ways of least cost feed formulation and mixing in order to reduce their cost of production.

REFERENCES

Battese, G. E. and Coelli, T. J. (1995). A Model for Technical Inefficiency Effects in a Stochastic Frontier Function for Panel Data. *Empirical Economics*, **20**: 325 – 332.

CBN (2012). Statistical Bulletin, Vol. 21: *Annual Reports and Statement of Accounts*, Abuja, Nigeria. CBN Publications.

Ceyhan, V. and Karem, H. (2010). Economic Efficiency of Cattle Fattening Farms in Amarya Province, Turkey. *Journal of Animal and Veterinary Advances*, 9(1):60-69.

Coelli, T. J. (1996). A Guide to FRONTIER version 4.1 Computer Programme for Stochastic Frontier Production and Cost Function Estimation, CEPA Working paper 96/67 Centre for Efficiency and Production Analysis, University of New England, Armidole, Australia.

Coelli, T. J., Rao, D. S. P. and Battesse, G. E. (2005). *An Introduction to Efficiency and Productivity Analysis*. Kluwer Academic Publishers; USA.

Damisa, M.A. and Hassan, M. B. (2009). Analysis of Factors Influencing the Consumption of Poultry Meat in the Zaria Emirates of Kaduna, Nigeria. *European Journal of Educational Studies*, 1(1):

Emaikwu, K. K., Chikwendu, D. O. and Sanni, A. S. (2011). Determinants of Flock Size in Broiler Production in Kaduna State of Nigeria. *Journal of Agricultural Extension and Rural Development*, 3 (11): 202-211.

Emokoro, C.C. and Amadasun, O.J. (2012). Analsis of Beef Marketing in Benin City, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, 8 (3): 26-31.

FAO (2009). FAO FAOSTAT http://faostata.fao.org/default.htm

Ibrahim, B. (2007). Analysis of Resource-use Efficiency in Cattle Fattening Enterprise in Birnin Kebbi Local Government Area of Kebbi State. *M. Sc. Thesis*,Usmanu Dan Fodio University, Sokoto, Nigeria.

Ibrahim, U. W. (2012) Analysis of Production Efficiency and Profitability of Watermelon in Kaga and Kukawa Local Government Areas of Borno State, Nigeria. *M.Sc. Thesis*, Department of Agricultural Economics and Rural Sociology, Faculty of Agriculture, Ahmadu Bello University Zaria.

NPC (2006). NPC Population Census of the Federal Republic of Nigeria. Census Report. National Population Commission, Abuja.

Ouma, E. Awudu, A. and Drucker, A. (2007). Measuring Heterogeneous Preference for Cattle Traits among Cattle-keeping Households in East Africa. *American Journal of Agricultural Economics*, 21(3): 1 – 15.

Okoruwa, V.O. Obadaki, F.O. and Ibrahim, G. (2005). Profitability of Beef Cattle Fattening in the Cosmopolitan City of Ibadan, Oyo State. *Moor Journal of Agricultural Research*, 6(4): 45 – 51.

Omolehin, R.A. Adeniji, O.B. Umar, A.S.S. and Ahmed, B. (2009). Profitability Analysis of Small Scale Beef Fattening Enterprise in Bama Local Government Area of Borno State. *Nigerian Veterinary Journal*, 30(3): 8-18

Oni, O. (2006). Investing in Cattle Fattening. An Article Presented on the Internet by Business Day Media Ltd. Hppt//www.business.dayonline/5089-5140. 37 July, 2006

Tukur, H.M. and Maigandi, S. A. (1999). Characterization and Management of Animals Used for *Draught. Tropical Journal of Animal Science*, 1 (1): 10-27.

Ugwumba, C.O.A. and Effiong, J.A.L. (2013). Analysis of Household Demand for Beef in Owerri Metropolis of Imo State, Nigeria. *Nigerian Journal of Chemical Biological and Physical Science*, 3 (2): 1201-1205.

Yakaka, B.M. and Bashir, A. B. (2012). Determinants of Ruminants Meat Demand in Maiduguri, Borno State, Nigeria. *Greener journal of Agricultural Science*, 2 (8):381-385

Umar, A.S.S. (2007).Financial Analysis of Small-Scale Cattle Fattening Enterprise in Bama Local Government Area of Borno State. Unpublished *M.Sc. Thesis*, Ahmadu Bello University, Zaria, Nigeria.

Umar, A.S.S., Alamu, J. F. and Adeniji, O.B. (2008). Economic Analysis of Small Scale Cow Fattening Enterprise in Bama Local Government Area of Borno State, Nigeria. *Production Agriculture Journal*, 4(1):1-10.