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TECHNICAL EFFICIENCY OF *KILISHI* MEAT PROCESSING IN KEBBI STATE, NIGERIA

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Abstract

This study examined the technical efficiency of kilishi meat processing in Kebbi State, Nigeria. Data was collected from one hundred and twenty (120) kilishi meat processors using a well structured questionnaire. A multistage sampling technique was used for the study. A stochastic frontier production function model was used to analyze the data for the study. The results showed that labour, spices, fresh meat, equipment, fire wood and oil significantly affect the output of kilishi meat in the study area at 0.237, 0.213, 0.441, 0.119, 0.226 and 0.332, respectively. The mean technical efficiency index is 0.795 and none of the processors surveyed had technical efficiency of one (1) suggesting that the processors were technically inefficient in utilizing their resources. It is recommended that Kilishi meat processors should be supported with financial intervention in the form of credit in order to enhance their production capacity. Improved processing technology devices are also advocated in order to preserve meat during raining season.

Key words: *Kilishi,* meat, processors, technical efficiency.

INTRODUCTION

The importance of animal protein and its inadequacy in the dietary of most households in developing countries of Africa and South East Asia are variously documented (Okolo, 2011; Ume *et al*; 2016). For instance, Food Agriculture Organization, (FAO), (2008) reported that animal protein origin is capable of predisposing victims to low productivity, high infant mortality, malnutrition and related diseases. This animal protein origin could be acquired in Nigeria through mainly cattle, goat, Camel and sheep (Ajala *et al;* 2007). Kilishi processing is becoming very popular in the northern part of Nigeria, the kilishi is tender and nutritive in relation to high protein and B-vitamins (Adeschinwa *et al*; 2003; John, 2007; Ume, *et al*; 2018).

Kilishi is a traditionally processed sun dried ready to eat meat product, it's popular in northern Nigeria, Cameroon, Chad, Niger republic and other countries in the Sahelian region of Africa. It has been an important export commodity to the Saudi Arabia and other Asian countries where it is widely consumed. This ready-to eat meat is brownish in color, light in weight, rich in protein and other vital nutrients. Kilishi is mostly consumed as snacks food and a part of main dish. Its consumption seems to have no age, religious, or ethnic barrier (Omojola *et al.*, 2003).

Processing of *kilishi* comprises the use of fresh meat such as beef, Lamb, Camel, and Goat or other essential animal flesh or muscles in combination with *labu* (which is locally defatted groundnut paste), spices and condiments in the mixture. During the processing, fat is trimmed and removed before the meat is sliced or cut into flat thin sheets using a sharp knife. The sheets are spread on mat or wooden tray and sundried (First stage drying) to reduce the moisture content and condition the meat for ingredients infusion. The dried meat is then coated or infused with the ingredients mix powder (Tunkusa or Labu, spices and condiments). The Slurry are dried again (second stage drying) and finally roasted in a smokeless glowing fire. The resultants *kilishi* is often in a card board paper and sold along the streets, in filling station, retail shops, restaurants, hotels, markets and airports (Igene *et al.*, 1990)

Theoretical Framework

Efficiency is the ability to produce a given level of output at lowest cost (Farrell, 1957). The efficiency is the ease of transforming given inputs into outputs in a production process (Coelli, 1994; Ume, *et al;* 2016). Efficiency according to Farrel, (1957) and Heady and Olayide, (1982) could be in form of technical, allocative and economic efficiency. Economic efficiency is the ability of an enterprise to achieve the highest possible profit, given the prices and levels of resources of the enterprise (Bagi, 1982).

Technical efficiency refers to the ability of firms to achieve maximum output at minimal waste at given technology (Jondrow *et al.*, 1982; Coelli, 1994). The economic theory of production provides the analytical framework for most empirical research on productivity and efficiency. As a result of the pioneering, but independent, works by Aigner *et al.* (1977), Bagi and Huang (1983), Kalirajan and Flinn (1983) as well as Amaza and Olayemi (2001), consideration has been given to the possibility of estimating the stochastic frontier production function. In most of the studies, it was found that the Cobb–Douglas stochastic frontier does not provide an adequate representation for describing the data given the specification of a Translog model.

Considering a processor using inputs X_1, X_2….Xn to produce output Y, efficient transformation of inputs into output is characterized by the production function f(X), which shows the maximum output obtainable from various input vectors. The stochastic frontier production function is defined as:

Y_i = f (Xi; β) exp (V_i – U_i) (i = 1, 2………...n)……..…………… (1)

Where:

Y_i = Production of the i^{th} farm

X_i = Vector of input quantities of the i^{th} farm

β = Vector of unknown parameters of the i^{th} farm

V_i = random error associated with random factors not under the control of the farm e.g. weather and diseases

U_i = inefficiency effects (one –sided error with U≥0) i.e. Ui's are non – negative with technical inefficiency in production.

(V_i - U_i) = composite error term.

The symmetric component, V, accounts for factors outside the farmer's control such as weather and diseases. It is assumed to be independent and identically distributed as N~(0,δ2V). A one-sided component U >0 reflects technical inefficiency relative to the stochastic frontier, f(X_i; β) exp (V_i – U_i). Thus U = 0 for a farm output which lies on the frontier and U<0 for one whose output is below the frontier as N~(0, δ2 U), i.e. the distribution of V is half-normal. Thus, the stochastic production frontier model can be used to analyze cross- sectional data. The model simultaneously estimates the individual technical efficiency of the respondents as well as determinants of technical efficiency (Battesse and Coelli, 1995).

The estimation of stochastic frontier production makes it possible to find out whether the deviation in technical efficiencies from the frontier output is due to firm specific factors or due to external random factors. It provides estimates for the technical efficiency by specifying composite error formulations to the conventional production functions (Battesse and Coelli, 1995).

Technical efficiency of an individual farmer is defined as the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by the farmer. The technical efficiency of farmer (i) in the context of the stochastic production function in equation (1) is

TE = Y_i/Y_i*…………………..…………………………..…… (2)

= f(X_i; β) exp (V_i – U_i)/f(X_i; β) exp V_i……………………… (3)

= exp (-U_i)………………..………..……………..………….(4)

Where:

Yi = Observed value of output

Yi* = frontier output (or potential output)

Given the density function Ui and Vi, the frontier production function can be estimated by the maximum likelihood technique. The value of the technical efficiency lies between zero and one. The most efficient farmer will have value of one, whereas the least efficient farmer will have value lying between zero and one. The stochastic frontier of the Translog type was specified for this study. The maximum likelihood technique was used to estimate the parameters of the stochastic frontier and the predicted technical efficiency/inefficiency of the farmers. While, economic efficiency is the ability of a farm to maximize profit (Ume *et al*, 2012). It is imperative to state that information on measuring technical efficiency of kilishi processing using stochastic frontier method is limited in the study area; therefore, the need to abridge this research gap is mandatory. This could help in making available information for making sound management decision as relates to technical efficiency.

METHODOLOGY

Study area

STATE	Location	Latitude	Longitude	Area	Boundary	International boundary	Population	Occupation
Kebbi	north western part of Nigeria	latitude $10^{0}8N$ and $13^{0}15^{1}N$	longitude $3^{0}30$, $^{1}3^{0}E$ and $6^{0}2^{1}E$	36,800km^{2}	Sokoto state to the north east, Zamfara state on the eastern part, Niger state to the south	Benin republic to the west	3,256,541 million people	Agricultural activities

Source: NPC (2006)

Sampling procedure and sample size

Data collection

Primary and secondary data were collected for the study through the use of structured questionnaires and Stochastic Frontier Production Function Model

MODEL FOR STOCHASTIC FRONTIER PRODUCTION

Yij=β0+β1LnX1ij+ β2LnX2ij+ β3LnX3ij+ β4LnX4ij+ β5LnX5ij+Vi-Uj

Y=Output of *kilishi* (kg)

X1= Labour (man-hour)

X2=Fresh meat (kg)

X3=Spices (Naira)

X4=Equipments Depreciation (Naira)

X5= Fire wood (Naira)

X6=oil (Liters)

Vi= random error term accounting for output from the frontier caused by noise

Ui=non- negative random error accounting for technical for Technical inefficiency in processing

Ln= natural logarithm

β0, β1, β2, β3, β4, β5, β6-- βn= unknown parameters estimated

Technical inefficiency model

$Ui=d_0+d_1z+ d_2z_2+ d_3z_3+ d_4z_4+ d_5z_5+V_i-U_i$

Where

U_i=Technical inefficiency

Z_1=Age of processors (years)

Z_2=Educational level (number of years spent in school)

Z_3= Processing experience (years)

Z_4= Household size (number)

Z_5=Amount of credit accessed (naira)

RESULTS AND DISCUSSION

The Maximum Likelihood Estimates (MLE) of the stochastic frontier production parameters for *kilishi* processing is presented in Table 1. The table revealed that, labour input, fresh meat, spices, firewood and oil were positive and significant at different probability levels. These influence significantly the value of output of *kilishi* processing. The coefficient of labour, fresh meat and equipments input were positive and significant at 1% alpha level. This implies that *kilishi* processing venture is labour intensive and if properly enhanced, could reduce inefficiency in the animal production and also increase in labour, fresh meat and fire wood would increase the input of *kilishi* meat processing venture (Adesehinwa *et al*; 2003). The coefficient of spices as shown in Table 1 was inversely related to technical efficiency and statistically significant at 10% probability level. The implication is that as the spices increases, their technical efficiency decreases. The diagnostic statistic of the technical efficiency as contain in Table 1 indicates that the sigma and gamma of the variance were both positive and significantly different from 1% and 5% level of probability respectively. The sigma and gamma indicates that the model is good fit and assumes the correctness of the specified distribution assumption of the composite error term. Hence, the use of the stochastic frontier function estimated by the Maximum Likelihood Estimates procedure is suitable for the data. On the sigma value of 16.788, implies that 83.212% of the variations in output among the *kilishi* meat processing venture were as result of the disparities in technical efficiency.

Table1: Parameter estimate for technical efficiency in kilishi meat processing

Inputs	Parameter	Coefficient	Standard	T-ratio
Intercept	B_o	0.305	0.415	11.300***
Labour	β_1	0.237	0.663	5.122***
Fresh meat	β_2	0.441	0.318	2.843***
Spices	β_3	0.213	0.267	1.812*
Equipments	β_4	0.119	0.418	1.301
Firewood	β_5	0.226	0.543	2.707***
Oil	β_6	0.332	0.715	1.114
Diagnostic test				
Log likelihood		591.341		
Sigma square		16.788	0.315	2.012**
Gamma		0.819	0.315	16.118***
L.R test		27.325		

Source: Computed from Frontier 4.1 MLE/Field Survey, 2017

Note: ***, **, * indicate statistically significant at 1, 5, and 10 percent respectively.

The technical efficiency distribution of the respondents is presented in Table 2. The mean technical efficiency of *kilishi* meat processing venture is 0.795, and the minimum technical efficiency is 0.490, while the maximum technical efficiency is 0.96. It can also be observed that almost half of the respondents (46.66%) operated at a technical efficiency of below the mean technical efficiency, while 53.34% of the respondents operated within the technical efficiency above 0.795. This result shows a moderate level of technical efficiency among kilishi meat processing venture in the study area. This implies that technical efficiency in kilishi meat processing venture in the study area could be increased by 20.50% through better use of available resources given current state of technology. This could be achieved through processors specific factors like age, education and processing experience.

Table 2: Frequency Distribution of *Kilishi* meat processors according to technical efficiency indices

Technical efficiency index	Frequency	Percentage
0.41-0.50	6	5.00
0.51-0.60	23	19.16
0.61-0.70	16	13.33
0.71-0.80	11	9.17
0.81-0.90	38	31.67
0.90-1.00	26	21.67
Total	**129**	**100.00**
Mean technical efficiency	0.795	
Standard deviation	0.983	
Minimum technical efficiency	0.490	
Maximum technical efficiency	0.960	

Source: Computed from Field Survey, 2017

The coefficient of age as shown in Table 3 was inversely related to technical efficiency and statistically significant at 10% probability level. The implication is that as the age of the processors increases, their technical efficiency decreases. This could be ascribed to mental and physical strengths which correlate with advances in age (Aarnik, 2007; Ewuziem, *et al;* 2008). The coefficient of level of education had a positive way on technical efficiency at 1% level of significant. This indicates that household's level of technical efficiency increases with increase in his/ her level of education. This finding agrees with the work of Onyenweaku and Effiong (2000) and Ume, *et al* (2012). The coefficient for processing experience was positive and significant at 1% risk level, indicating a direct relationship between processing experience and technical efficiency. The implication is those processors who have more years in the *kilishi* processing venture are more technically efficient in the business compares with the less experienced ones. Empirical studies reveal that experienced business to be specific have technical know-how and could embrace easier innovations disseminated to them (Ewuziem *et al*., 2007). This assertion is in consistent with Onyenweaku, and Effiong, (2000) and Ume, *et al.* (2018*)*, who opined that experienced farmers have ability to overcome intricacies in their farming businesses for high technical efficiency to ensue.

Table 3: Maximum likelihood estimate of the determinant of technical efficiency in Kilishi meat

Variable	Parameter	Coefficient	Standard error	T-ratio
Intercept	Z_0	0.793	0.778	2.81***
Age	Z_1	0.315	0.613	1.70*
Level of education	Z_2	0.301	0.305	3.215***
Processing experience	Z_3	0.498	0.762	2.620***
Household size	Z_4	0.639	0.284	1.470
Amount of credit accessed	Z_5	0.702	0.314	1.113

Source: Computed from Frontier 4.1 MLE/Field Survey, 2017

Note: ***, **, * indicate statistically significant at 1 5 and 10 percent respectively

CONCLUSION

The study examined the technical efficiency of *Kilishi* meat processing in Kebbi State, Nigeria. Based on the findings of the study, it is concluded that *Kilishi* meat processors were not efficient in the use of existing resources. A mean technical efficiency value of 0.795 suggests that there is further scope for improvement. The determinants of technical efficiency for *Kilishi* processing include; age, level of education, and processing experience.

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