

Technical efficiency of local dairy milk processing in Kwara State, North Central, Nigeria

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Abstract

This study examined the profitability and technical efficiency of local dairy milk processing in Kwara State using budgetary analysis and stochastic frontier model. Data set for the study was obtained through a randomly selected one hundred nomadic households in the state. The results of the budgetary analysis showed that local dairy milk processing was profitable in the study area with a net farm income of ₦683.25 per day. Results of the stochastic frontier efficiency model revealed the percentage efficiency to be 50-95 per cent with a mean of 76 per cent. The level of education of the nomadic household heads, the household size, as well as the years of experience in milk processing significantly reduced the inefficiency of local dairy milk processing in the study area. Improvement in the level of education of the milk processors will have positive implication on their technical efficiency.

Keywords: Technical efficiency, costs and returns, local milk processing, nomadic households, stochastic frontier model.

Introduction

Though food takes an integral position in human existence, its present crisis is however an increasing global phenomenon. Among the major causes of global food crisis are: climate change, increasing demand for food grains for bio-fuel and peculiar to Nigeria is the continuing decline in farmers' population without technological know-how to make up for the shortfall (FAO, 2010a and Heady and Fan, 2010). Deficiency in protein consumption is another dimension of Nigeria's food problem (FAO, 2002). The per capita milk consumption in Nigeria in 2007 was 8 kilogrammes per annum as against 50 kilogrammes for Niger and 22.79 kilogrammes for Chad for the same period (FAO, 2007). The United State of America for the period under review consumed a staggering 253.8 kilogrammes per capita per year. Thus the per capita milk consumption in Nigeria falls short of the

minimum recommended 62.5 kilogrammes per capita per annum suggested by the Food and Agricultural Organisation of the United Nations (FAO, 1974). The bulk of Nigerians protein consumption also comes from plant protein, which is lower in quality than animal protein (Osotimehin, Tijani and Olukomogbon, 2006). The local dairy farmers in Nigeria also face production and marketing challenges such as lack of modern basic infrastructure for milk processing, poor access to artificial insemination and veterinary services and disorganised market structure for marketing their products (Uddin et al. (2010). It has been reported however that smallholder milk production is an avenue for global food security for the milk producing households and could also help to create enormous job opportunities throughout the dairy chain (FAO, 2010a). Most studies on small scale dairy production in Nigeria have however

focused mainly on the problems militating against the ability of the industry to produce good quality milk and milk products to meet the demand of the Nigerian teeming population (Adesokan et al., 2011; Okpalugo et al., 2008 and Tona et al. 2002). This study was carried out to verify the profitability and efficiency of local milk processing in Kwara State to inform policy for meaningful amelioration. The peasant farmers have been described as small producers characterized by small resource base. They are squeezed between high production costs and relative low returns (Olorunsanya and Omotesho, 2012). Various studies have adopted the costs and returns as analytical tools for determining the profitability of farm production (Olorunsanya, 2004; Osotimehin, 2006; Udin, 2010 and Alemdar et al., 2010). Uddin et al. (2010) examined the profitability to dairy milk production among small, medium and large scale farmers in Bangladesh. The study opined that the net income from livestock production was a function of total output of products, the price of the inputs, the total level of feeds and labour employed and their prices. Osotimehin et al., (2006) examined the profitability and efficiency of dairy milk processing in Kogi State. The result showed that milk processing enterprise was profitable and flexible in the State with a net farm income of N18.011.20 per month per average processor and the fixed costs accounted for about 1% of the total costs of processing milk into different products. Singh and Sharma (2011) assessed the technical efficiency of dairy farmers in India using stochastic frontier model. The study found the mean of the dairy farmers to be two third of the total. It was further observed that the technical efficiency of the milk producers was influenced positively by the

innovativeness, economic status and schooling of the farmers and negatively by the age of the milk producers. The study suggests the need to promote young farmers as well as raise the level of education of milk producers for higher level of efficiency.

Alemdar et al. (2010) measured the technical efficiencies of small dairy growing farms in Turkey using stochastic frontier model. The results obtained showed the mean efficiency of the smallholder farmers to be 78 per cent indicating a significant scope for increasing their level of efficiency under current technology. Results of the inefficiency analysis indicated that 96 per cent of the variation in milk production was due to inefficiency in production. It was also found that only cow quality significantly affected production efficiency among the fitted variables. It was suggested that efficiency could be improved upon through adequate training of the milk farmers without increasing the cost of production in the short run. Nganga et al. (2010) measured the production efficiency of smallholder milk producers in Kenya using stochastic profit frontier and inefficiency model. The study found out that the profit efficiencies of the representative farmers varied widely between 26 and 73 per cent with a mean of 60 per cent suggesting that an estimated 40 per cent of the profit was lost due to a combination of both technical and allocative inefficiencies in smallholder milk production. Level of education of the farmers, their experience in milk production and herd size influenced profit efficiency positively while age of farmers had a reducing effect on farmers' profit efficiency. It was suggested that, improvement in the level of education of the dairy farmers could reduce their level of profit inefficiency. Wubeneh and Ehui

(2006) analysed the inefficiency of smallholder dairy producers in Ethiopia with the stochastic production frontier technique. The results of the study show system inefficiency in milk production in Ethiopia. Average efficiency of the farmers was 79 per cent giving room for increase in milk output by 21 per cent with the existing technology by training the dairy farmers better production techniques.

Methodology

This study was carried out in Kwara State, North Central Nigeria. The State is located between latitudes 7° 45'N and 9°30'N and longitude 2°30'E and 6°25'E with a topography that is mainly plain lands to slightly gentle rolling. The State is stratified into four agricultural zones by the Kwara State Agricultural Development Project (KWADP). The zones are: Zone A: Baruten and Kaiama LGAs; Zone B: Edu and Patigi LGAs; Zone C: Asa, Ilorin East, Ilorin South, Ilorin West and Moro LGAs and Zone D: Ekiti, Ifelodun, Irepodun,Offa, Oyun, Isin and Oke–Ero LGAs. The target population for the study was the nomadic local milk processors in Kwara State. Data for the study were obtained through a multi-stage sampling technique. The first stage involved a random selection of two zones out of the four ADP zones in the state. The second stage was a random selection of five LGAs from the two zones. At the third stage, two villages were randomly chosen from each of the selected LGAS. The fourth stage was a random selection of five nomadic settlements ('Gaas') from each of the chosen villages. The final stage was a random selection of two nomadic families from each nomadic settlement. In all, a total of 100 nomadic families were interviewed. The information used for the study was obtained through structured questionnaire. Both descriptive and inferential statistics were used to analyse the data obtained from

the survey. The descriptive statistics included frequency counts, means and percentages while the inferential statistics were budgetary analysis and stochastic frontier model. The formula for the budgetary analysis following Olorunsanya, (2004) is given as follows:

$$NI=GI-TVC-TFC$$

Where NI= Net Income

GI=Gross Income

TVC= Total Variable Cost

TFC=Total Fixed Cost

“Technical efficiency is defined as the ability of the farms to produce the maximum possible output with a given set of resources” (Farrell, 1957). Some studies investigating the influence of some hypothesised factors affecting farm level inefficiency have used a two stage approach. The first stage involves the estimation of a stochastic frontier production function and the determination of farm level technical inefficiency. The second stage entails relating the estimated technical inefficiencies to some farm specific factors using Ordinary Least Square (OLS) (Bravo-Ureata and Pinherio (1993) and Kumbhakar, Ghosh and McGuckin (1991). Battese and Coelli, (1995) have however specified the use of stochastic frontiers which is capable of simultaneously measuring technical inefficiency effects as well as estimating the parameters involved. The technical inefficiency of the individual milk processor for this study was estimated using the stochastic frontier production function. The Cobb-Douglas production function is specified as follows:

$$Y_i = f(X_i, V_i - U_i) \dots\dots\dots(2)$$

Where

Y_i = Output of cheese in Kilogramme

X_1 = Quantity of milk used in litres
 X_2 = Labour in Mandays
 X_3 = Quantity of wood used in kilogramme
 β_0 = intercept
 β_i = (i=1, 2, 3)
 U_i = Error term under the control of the processor, the technical inefficiency
 V_i = Error term not under the control of the processors
 To determine the factors that contributed directly to technical efficiency, the following model was formulated and estimated with stochastic frontier model in a single stage maximum likelihood estimation procedure using the computer software frontier version 4.1 (Coelli, 1996):

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5$$
(3)
 Where:
 Z_1 = Age of the processors
 Z_2 = Educational status of the processors
 Z_3 = Household size
 Z_4 = Dairy experience
 Z_5 = Credit

The variables Z_1 to Z_5 represent measurement of technical inefficiency effects to indicate possible effects of processor specific characteristics on the inefficiency of milk processing. The β_i and δ_i were expressed in terms of Coelli and Battese, (1996).

Results and Discussion
Descriptive Statistics of Key Variables in Local Milk Processing in Kwara State

The descriptive statistics of key socio-economic and explanatory variables for local milk processing enterprise in Kwara State is presented in Table 1. The division of labour in the nomadic family assigned the men to cattle rearing while the women and children engaged in milk collection, processing and marketing. This is in

Table 1: Descriptive Statistics of Key Variables in Local Milk Processing in Kwara State

Variable	Percentage
Educational Status	
No western Education	86
Quranic	8
Primary	4
Secondary	2
Household Size	
1-5	20
6-10	62
11-15	14
16-20	4
Herd Size	
1-40	30
>40	70
Dairy Experience	
1-5	7
6-10	35
>10	58
Labour Use in Mandays	
Family labour	75
Hired labour	11
Family and hired labour	14

Source: Field survey, 2009

consonance with FAO, (2010b) which reported a gender gap in involvement in agricultural production between male and female-headed households in developing countries. The nomadic households in the study area were still without western education. Eighty-six per cent of the household heads had no western education while only eight per cent had Arabic education. This goes on to show the low literacy level of the local milk processors in the study area. This finding is in agreement with the studies carried out by Olorunsanya and Omotesho, (2012) and NBS, (2006). The two studies recorded low level of educational attainment among rural farming households in Kwara State. Low level of educational attainment could however result in poor hygiene and could hinder adoption of modern method of processing.

As it is common with rural dwellers in Nigeria, the nomadic local milk processors in the study area had large household size,

Table 2: Average Net Income from Milk Processing Per Cow per Day

Item	Costs and Returns(₦)
Gross Income from Cheese	1624.00
Variable Cost	
Raw milk	280.00
Labour	600.00
Wood	22.00
Coagulating Leaf	10.00
Total Variable Costs	912.00 (96.94)
Fixed Cost	
Pots	6.67
Buckets	5.00
Plates	2.05
Calabashes	7.78
Spoons	1.20
Baskets	6.11
Total Fixed Costs	28.81(3.06)
Total Costs	940.81
Net Income	683.23

Source: Field Survey, 2009. The figures in parentheses are percentage of total costs.

62 per cent of the processors had more than five members per household. Large household size provided ample family labour for herd tending and milk processing for the nomads. This is evident in the high percentage of family labour used for milk processing 75 per cent compared to 11 per cent for hired labour.

Costs and Returns

The cost structure consists of variable and fixed costs. The fixed cost consists of depreciated values of the cost of calabash, spoons, plates, pots and buckets. The variable inputs in milk processing are raw milk, coagulant leaves and fuel wood. An average of five litres of milk was produced per cow per day in the study area and the imputed cost of raw milk per litres was 70 naira. The cost of family labour although not directly incurred by the processors, was imputed on the assumption that if the processors and his family were not working on the cattle/ dairy farm, they could have hired out their labour to something else. A sum of N1624.00 was realized as the

average gross income per production cycle.

The total cost per production cycle was N940.76 which consists of variable cost of N912.00 and total depreciated value of fixed costs of N28.81. Thus, the net processing income for local dairy milk in the study area was N683.23 per cycle. Mumba et al. (2011) reported similar finding in Zambia. Though the returns to milk processing was encouraging this was however not evident in the standard of living of the nomads or in the acquisition of better technology for milk processing.

Results of the Stochastic Frontier and Inefficiency Model for Local Dairy Milk Processing in Kwara State

Table 3 and 4 present the maximum likelihood estimates of the stochastic frontier and inefficiency model for the local milk processors in Kwara State. All the parameter estimates for labour, fuel wood and quantity of milk were statistically significant at 1 and 5 per cent levels of significance respectively. The quantity of milk used in processing, labour in man-

Table 3: Maximum Likelihood Parameter Estimates of the Stochastic Frontier Production Function of Local Dairy Milk Processing in Kwara State

Variables	Parameters	Coefficient	z-ratio
Stochastic Frontier			
Constant	β_0	5.4**	2.152
Raw milk (X1)	β_1	0.76**	3.561
Wood (X2)	β_2	0.65**	2.732
Labour (X3)	β_3	2.54*	5.180
Variance Parameters			
Sigma-Squared	δ^2	0.24*	
Gamma	Y	0.85	
Log Likelihood	μ	170	
Sample Size	n	100	

Source: Field Survey, 2009 **, *

days and quantity of fuel wood used were all significant and important in production of milk products in the study area. Increase in any of these variables would increase the quantity of milk products produced by the magnitude of the coefficients of these variables. Ojo et al., (2009) obtained similar result. Table 4 shows the coefficients of the explanatory variables that influence inefficiency in milk production in the study area. The level of education of the processors and their years of experience in milk processing as well as their household size significantly affected their inefficiency in milk processing negatively. The negative sign for the coefficient of level of education of the processors agrees with *a priori* expectation that educated processors would be apt to use modern method of processing that could enhance efficiency in production. Age of the milk processors though not statistically significant was found to have positive association with inefficiency in

milk production. Older processors would naturally be risk averse and might be slow in adopting modern method of processing which could bring about efficiency in production. Access to credit facility also had negative association with inefficiency in milk processing in the study area. The significant variables should be the focus for more efficient local milk processing in the study area. Olorunsanya, (2004) found the level of educational attainment of egg farmers in Kwara State to significantly affect egg production in the state. Results of the stochastic frontier efficiency model further revealed the percentage efficiency to be 50-95 per cent with a mean of 76 per cent. This suggests there is an avenue for improvement in technical efficiency in the study area.

Conclusion

This study used 100 representative nomadic households to examine the profitability and technical efficiency of local dairy milk processing in Kwara State. Descriptive statistics, budgetary analysis and stochastic

Table 4: Estimated Determinants of Technical Inefficiency

Variables	Parameters	Coefficient	t-ratio
Inefficiency Model			
Constant	δ_0	0.62**	5.234
Age	δ_1	0.206	1.462
Education	δ_2	-0.005**	-2.156
Household size	δ_3	-0.160**	-4.620
Dairy experience	δ_4	-0.006*	-2.212
Credit	δ_5	-0.062	-1.660

** , * significant at 1% and 5% respectively; Source: Data analysis 2009

frontier model were used as analytical tools. The results of the descriptive statistics showed that 86 per cent of the heads of the nomadic households had no formal education with 80 per cent having more than five members per household. The results of the budgetary analysis showed that local dairy milk processing was a profitable enterprise in the study area with a net farm income of N683.25 per day. Results of the stochastic frontier efficiency model revealed the percentage efficiency to be 50-95 per cent with a mean of 76 per cent suggesting an avenue for drastic improvement on the technical efficiency level of the processors. The level of education of the household heads, their household size, as well as their years of experience in local milk processing significantly affected their efficiency in local dairy milk processing in the study area. Among the recommendations made to improve efficiency of local milk processing in the study area were: (1) that the nomads should endeavour to improve on their level of education for better efficiency. (2) That the nomads should increase the level of use of the significant inputs such as labour and

quantity of milk for increased output.

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Received: 4th May, 2011

Accepted: 18th October, 2012