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Technical Efficiency among Small and Medium Scale Entrepreneurs in High Quality Cassava Flour In Four Geo-Political Zones of Nigeria

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Abstract

Purpose: Inadequate empirical data on value addition to cassava processed might be the bane of the inability of the enterprise to attract the necessary attention of private entrepreneurs in the sector. Therefore this study was carried out to analyze technical efficiency among small and medium scale entrepreneurs (SMEs) in high quality cassava flour (HQCF) processing in Nigeria. **Methodology:** Multi-staged purposive and random sampling techniques were used in selecting 104 SMEs from four out of six existing geopolitical zones. Data collected using structured questionnaires and interview schedule were analyzed using descriptive statistics and stochastic frontier production function.

Results: The results revealed that the coefficients for cassava tuber and capital were significant and positively influence HQCF processing at 5 percent level of probability. Household size and access to credit were negatively and significantly related to technical efficiency at 5 percent level of probability; while gender and processing experience were positively related to technical efficiency at 5 percent and 1 percent levels of probability respectively. The average technical efficiency of 79 percent implies that HQCF processors could further increase the efficiency of resource utilization by 21 percent.

Recommendation: It was therefore recommended that policy measures should aim at delivery of supervised credit to processors, skill development especially for women, expanded production of raw cassava and enhanced capital base in form of appropriate machineries for processing HQCF.

Keywords: *Efficiency, SMEs, HQCF processors, capital, credit, Nigeria.*

1.0 INTRODUCTION

Nigeria has been consistently ranked as the world's largest producers of cassava, producing about 54 million tonnes; being almost 19 percent of total world production, a third more than Brazil and almost double the production capacity of Thailand and Indonesia (Food and Agriculture Organization, FAO, 2011). Cassava is produced predominantly (99%) by small farmers with 1-5 ha of land intercropped with yams, maize, or legumes in the rainforest and savannah agro-ecologies of Southern, Central FAO Corporate Statistical Database FAOSTAT, 2012). It is however, majorly processed into food products such as fufu, akpu, garri, and flour while its potential for industrial utilization is yet to be adequately realized; with 84 percent of cassava production reportedly consumed as food and 16 percent utilized as industrial materials (United Nations Industrial Development Organization and Federal Government of Nigeria, UNIDO/FGN, 2006). As a result of low domestic utilization of cassava for industrial products, Nigeria still spends a lot of foreign exchange on importing starch and wheat flour, and income to farmers and small processors remains low due to poor value addition to cassava.

Nigerian government, since the early 1980s has consistently put in place policies to rapidly increase production and marketing, to transform the crop from a rural subsistence crop to urban food staple and a foreign exchange earner (Nweke et al. 2001). The Presidential Initiative on Cassava, which started in 2003 and the Cassava Transformation Agenda in 2011, specifically embarked on projects to build flour processing factories and increase productivity of cassava by small scale farmers and supply of raw materials for high quality cassava flour processing in Nigeria. Policy interventions included mandatory substitution of 10 percent wheat flour with high quality cassava flour in the baking industry (United State Development Agency, USDA, 2012). In addition to this, there is a policy on blending of 10 percent ethanol in fuel, which will boost the production of ethanol from cassava (Awoyinka, 2009). Subsequently, private sector players set up over 500 micro-processing centers and 100 small and medium enterprises for the manufacturing of cassava intermediate products, including high quality cassava flour (Federal Ministry of Agriculture and Rural development, FMARD, 2011). These initiatives on cassava are yet to yield the expected results, therefore portends negative consequences for the food security and employment situations in the country. Inadequate empirical data on high quality cassava flour value chain might be the bane of the inability of the enterprise to attract appropriate attention of private entrepreneurs and government to the sector. Muhammad-Lawal *et al.* (2013) found that socio-economic characteristics and some other variables can affect the amount of value added to cassava products. Consideration on productivity gains arising from a more efficient use of existing technology is necessary (Bravo-Ureta & Pinheiro, 1997). Therefore, the question of how efficient HQCF enterprises use resources is of considerable importance to the growth of the sector and development of the value chain. The firm-level efficiency of smallholder resources has important implications for agricultural development of a nation in the sense that efficient firms make better use of existing resources and produce their output at the lowest cost. If small-medium scale processors are to meet the export and domestic demand for HQCF, an analysis of the firm level efficiency of the processors in the use of their limited production resources is very germane in providing necessary information to guide policy implementation.

Thus, the main objective of this paper is to assess the technical efficiency of small-medium entrepreneurs in the processing of high quality cassava flour in four geo-political zones of Nigeria. Specifically, the paper describes the socio-economic characteristics of the entrepreneurs, estimates the coefficients of efficiency parameters for the production resources, describes the distribution of technical efficiency among HQCF processors, and assesses the factors that are privy to observed inefficiency of the processors. The paper layout consists the conceptual and analytical framework; followed by the description of data collection and analysis methods, and an highlight of the results; then a discussion of the findings; and summary and conclusions.

2.0 CONCEPTUAL FRAMEWORK

The conceptual framework for the study is premised on the microeconomics theory of the firm and production frontier, which indicates the minimum inputs required to produce any given level of output for a firm operating with full efficiency (Pascoe, Kirkley, Greboval & Morrison-Paul, 2003). The concept of technical efficiency entails a comparison between observed and optimal values of output and inputs of a production unit. It is concerned with how closely the production unit operates to the frontier of production possibility set (Sadoulet & Janvry, 1995). A HQCF firm is technically efficient when it combines the optimal combination of inputs (raw cassava tubers, labour, capital/ machinery, energy) to produce a given quantity of HQCF. On the other hand, the firm may be technically inefficient if it fails to produce maximum output of HQCF from a given bundle of inputs; in which case, it operates beneath the stochastic production function frontier. Using the stochastic frontier production function, we are able 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. TE is the amount by which all inputs used could proportionally reduce without a decline in output; expressed in percentage with the value ranging between 0 and 1. If TE is equal to 1, it implies the firm produces with full technical efficiency.

Model Specifications

Technical Efficiency Model

The stochastic production frontier model is specified as follows:

$$L_n Y_i = \beta_0 + \beta_1 L_n X_{1i} + \beta_2 L_n X_{2i} + \beta_3 L_n X_{3i} + (V_i - U_i) \text{-----} (1)$$

Where;

L_n = natural logarithm to base 10

Y_i = Output of HQCF plant/annum (tons)

β_i = the unknown parameter associated with the explanatory variables to be estimated.

X_1 = quantity of raw cassava processed per annum (ton)

X_2 = labour used (mandays) per annum

X_3 = capital (cost of machinery in naira)

X_4 = Source of machine power {diesel, fuel or electricity otherwise}

β_0 = Constant term

β_1, β_2 ----- β_3 = Regression coefficient

V_i = random errors which account for random variations in output due to factors beyond the control of the processor.

The inefficiency of production U_i is modeled in terms of the factors that are assumed to affect the efficiency of the processor as follows:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \dots \quad (2)$$

δ = a vector of unknown parameters to be estimated

Z_1 = gender (male =1, female =2)

Z_2 = age of managers (years)

Z_3 = educational level (number of years spent in obtaining highest qualification in years)

Z_4 = processing experience in years

Z_5 = marital status (married =1, otherwise =0)

Z_6 = number of associations

Z_7 = access to credit

Z_8 = ownership structure

The technical efficiency for individual firm is computed as an index. The index used is Gamma (γ) such that;

$$\delta^2_u / \delta \text{ or } \lambda^2 / (1 + \lambda^2) \text{ or } \delta^2_u / \delta^2_v \text{-----} \quad (3)$$

For $0 < \gamma < 1$

γ = total output attained on the frontier which is attributed to technical efficiency; hence it is a measure of technical efficiency.

3.0 DATA COLLECTION, ANALYSIS AND RESULTS

3.1 Study area and data collection

The data were obtained from a study carried out in eight states across four geopolitical zones of Nigeria including; Ogun, and Osun states in South West zone, Abia and Imo states in South East zone, Delta and Edo states in South-South zone, and Kwara and Benue states in North-Central zone (figure 1). The study area is bordered by the Republic of Cameroun (1690 km) to the east, Republic of Benin (773km) to the west and the Atlantic Ocean to the south (Ekanade, 2006). Nigeria lies between Latitude 4^0 to 14^0 North and between Longitude $2^0 2'$ and $14^0 30'$ East. The agroecologies include rain forest in the south west and south east, mangrove swamp forest in the south south and guinea savannah in the north central.

The study employed purposive and multistage random sampling techniques in selecting a sample of 104 HQCF processors from a population of 157 high quality cassava processing plants in Nigeria. The first stage employed purposive selection of four (4) Geopolitical zones in Nigeria namely; South West, South East, South-South and North Central based on the availability of

HQCF processing plants. The second stage employed a purposive selection of four (4) states from each zones to include; Ogun, Lagos, Oyo and Osun states in South West; Abia, Enugu, Anambra and Imo in South East; Delta, Edo, Akwa-Ibom and Cross Rivers in South-South region; and Kwara, Kogi, Benue and Nasarawa States in North Central. Consistent with Yaro Yamani (1964), a proportional sample of 80 percent was used to determine the sample size of 104 medium scale processors.

3.2 Data analysis and results

The data was analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequencies, percentages, and mean were employed to analyze and achieve objectives one and three; while stochastic frontier model was used to analyze objectives two and four. The gamma index was used to test the hypothesis of no technical efficiency among small-medium scale processors of HQCF in Nigeria. The results obtained are presented as follows:

3.2.1 Socioeconomic characteristics of small and medium scale processors of HQCF

The results indicate that majority of the respondents (82.7 percent) were male whereas 17.3 percent were female (table 1); which implies that there is dominant involvement of males in HQCF processing, probably due to the fact that male processors are more able to withstand the rigorous demands of HQCF processing such as machine operation, repairs and staff management compared to their female counterparts. This result agrees with the findings of Eneche, *et al.* (2014). The mean age was 52.8 years with 6.7 percent, 45.2 percent, 30.8 percent and 17.3 percent of the respondents being within the ages of 30-40 years, 51 - 60 years, 41 - 50 years, and above 61 years respectively. This result in agreement with Mgbakor *et al.* (2014) implies that most of the HQCF processors are old and no longer in their productive stage, and that there is need for the younger generation to embark on high quality cassava flour processing in order to boost the trade as the older ones will soon phase out as a result of old age.

Furthermore, majority of the respondents (96.2 percent) were married, with mean household size of 6 and 58.6 percent of the respondents having a household size of at least 6 people (table 1). The high percentage of the married processors with large families indicates tendency for processors to be stable and responsible in line with Femi and Shitu (2014), and the likelihood that family labour will be available for HQCF processing activities and consequently reducing the amount spent on hired labour (Haji *et al.*, 2015).

The mean educational years was 17, and 97.1 percent of the processors had at least 13 years of schooling; which implies that HQCF processors were educated. Education is likely to influence the ability of processors to adopt improved technology used for processing and consequently improve productivity and efficiency (Oluyele & Usman, 2006). The average processing experience was about 7 years; majority of the processors (83.7 percent) had about 6 to 10 years of experience in HQCF processing and 2.9 percent had above 10 years of experience. This has implication for expertise and efficiency with which the managers carry out their processing activities (Igbekele, 2002).

Majority of the processors engaged in other income earning activities, with an average income of N1, 014,800 from off-processing activities, about 66 percent earning below N1, 000,000 and about 34 percent earning between N1, 000,00 - 3,000,000. This may have a positive effect on the

rate of adoption of improved cassava processing technologies in agreement with the findings of Lawal *et al.* (2013) for Kwara state, while in contrast may also affect the length of time they devote to cassava processing.

Table 1: Distribution of Respondents According to their Socio-Economic Characteristics

Variables	Frequency (n=104)	Percentage (%)	Mean
Sex:			
Male	86	82.7	
Female	18	17.3	
Age (years)			52.84
30-40	7	6.7	
41-50	32	30.8	
51-60	47	45.2	
> 60	18	17.3	
Marital Status			
Single	4	3.8	
Married	100	96.2	
Divorced	0	0	
Widowed	0	0	
Household Size			6.12
< 5	43	41.3	
06-Oct	57	54.8	
Nov-15	4	3.8	
Educational Status (years)			16.61
07-Dec	3	2.9	
13 - 18	90	86.5	
> 19	11	10.6	
Processing Experience (years)			7.39
01-May	14	13.4	
06-Oct	87	83.7	
Nov-15	3	2.9	
Income (Naira)			1,014,800
1,000 - 1,000,000	69	66.3	
1,000,001 - 2,000,000	23	22.1	
2,000,001 - 3,000,000	11	10.6	
> 3,000,000	1	1	

Source: Data Analysis, 2016.

3.2.2 Technical Efficiency in High Quality Cassava Flour Processing

The stochastic frontier regression model was estimated to determine the influence of variable inputs on output of High Quality Cassava Flour firms as well as assessing factors influencing their technical efficiency (table 2).

Table 2: Maximum Likelihood Estimates of Stochastic Production Frontier Function

Variables	Coefficients	T-Ratio
Constant	-0.029	-0.028
Cassava tubers	0.16	1.97**
Labour	0.17	0.13
Capital	0.16	2.23**
Diesel	-0.85	1.38
Inefficiency Model		
Constant	7.91	1.57
Sex	-1.13	-2.48**
Age	-1.32	1
Household size	2.39	2.29**
Education	-0.71	-0.73
Processing experience	-2.91	-4.12***
Number of associations	-0.17	-0.42
Access to credit	1.04	2.05**
Ownership Structure	0.49	1.27
Sigma Squared (σ^2)	0.48	3.5***
Gamma (γ)	0.63	6.18***
Log Likelihood function	72.92	

Source: Data Analysis, 2016. *** and ** = t-ratio significant at 1% and 5% levels respectively

3.3.3 Determinants of Technical Efficiency/Inefficiency of HQCF processing

On the relationship between the inputs and HQCF output, the result indicates that cassava tuber and capital inputs significantly affect HQCF output. The estimated elasticity parameters of cassava tubers and capital inputs (0.16 in each case) were positive and significant at 5 percent level of probability, indicating that increasing the quantities of cassava tuber and capital inputs by 1 percent each would increase the HQCF output by 0.16 percent in each case. This result is close to the research findings by Onubuogu *et al.* (2014), Adeniyi (2015), Eze *et al.* (2012) and Girei *et al.* (2014) who found that capital, cassava tuber and labour have positive and significant effects on cassava output. However, the estimated coefficients for labour (0.17) and Diesel (-0.85) were found not to be significant at all conventional levels of significance. The return to scale (RTS) was 0.32 and positive, indicating that high quality cassava flour processors are in stage II (rational stage) of their production cycle as output is increasing at decreasing rate relative to the level of quantity input use. This also implies that 1 unit increase in the significant inputs will lead to 0.32 percent increase of HQCF output. Hence, processors are encouraged to increase the use of inputs, including labour and diesel for a better output.

The role of sex, age, household size, education, processing experience, numbers of association, access to credit and ownership structures on technical efficiency of HQCF processors was examined and also presented in table 2. Results showed that the coefficients on household size, access to credit, sex and processing experience were significant and positively influencing technical inefficiency of HQCF processors. The coefficients on household size (2.39) and access to credit (1.04) were positive and significant at 5 percent level of probability respectively; implying that technical inefficiency of HQCF processing in Nigeria will increase with increase in household size. In other words, HQCF processors with large household size will achieve lower level of technical efficiency compared to those with smaller household size. This is because large household size may constitute a drain on resources of the processors. Similarly large household size increases household consumption and expenditure thereby making little money available for the purchase of necessary input used for processing. This result concurs with the findings of Adeniyi (2015) and Kaine (2011) that marital status and large household size reduced the efficiency of the processors. Similarly, increase in access to credit will increase technical inefficiency of HQCF processors in Nigeria. This implies that HQCF processors with access to credit tend to achieve a lower level of technical efficiency than those without access to credit. Being contrary to a priori expectation, the result suggests that credit obtained by HQCF processors are not appropriately used in procurement of inputs. This result concurs with the findings of Djomo (2015) that access to credit decline technical efficiency and profitability of small scale rice farmers in west region of Cameroun. The results also contradict the findings of Abdulai & Eberlin (2001), which shows positive association between credit and input use and farm productivity in Nicaragua.

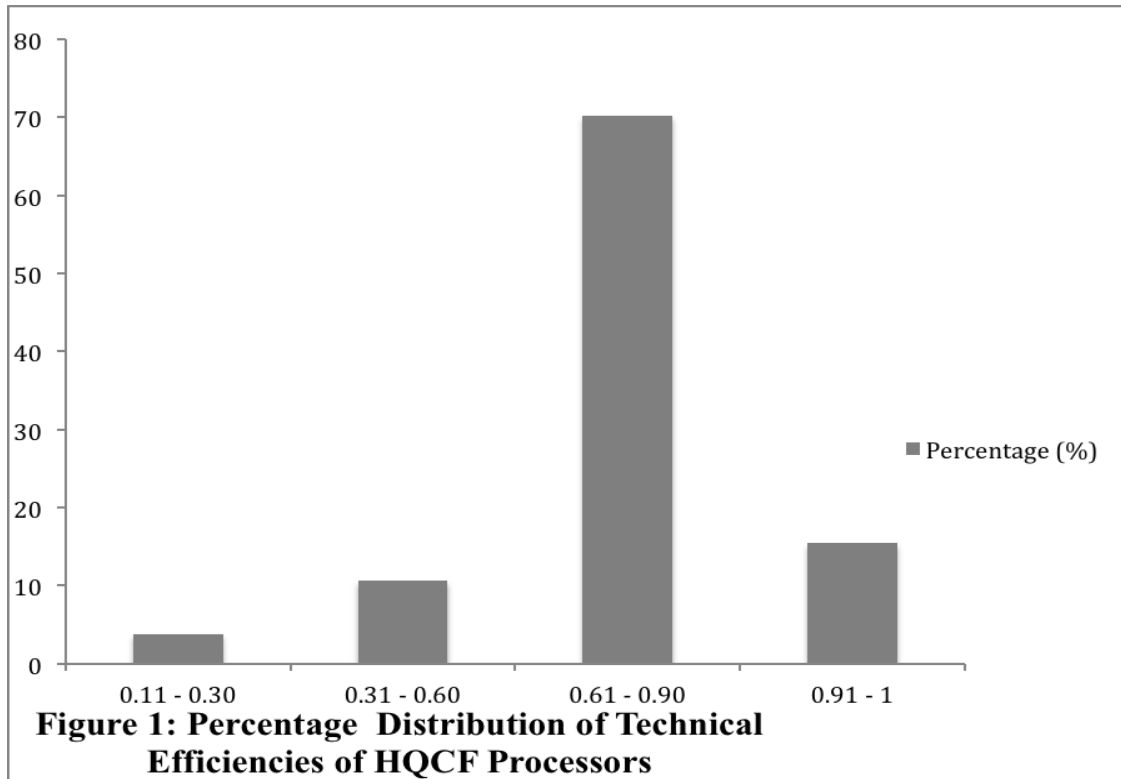
The coefficients of sex (-1.13) and processing experience (-2.91) were negative and significant at 5 percent and 1 percent respectively. The result on gender shows that being a male processor decrease the technical inefficiency effects in HQCF processing relative to being a female processor. This result suggests that HQCF processing calls for appropriate gender sensitivity by fabricating machines and equipment that can easily be operated by females. This finding

supports Adeniyi and Olufumilola (2015) who found coefficient of sex to be negative and statistically significant at 5 percent for gari and fufu processing in Ogun state, Nigeria.

Also the coefficient of processing experience is negatively related to technical inefficiency. This result suggests that increase in years of processing experience will decrease technical inefficiency in HQCF processing, and that processors with more processing experience are more efficient than their counterparts with less experience. This also implies that processors with more years of experience will have better knowledge on machine operation, better knowledge of efficient allocation of resources and are expected to run a more efficient and profitable enterprise than those with little or no years of processing experience. This result conforms to the *a priori* expectation and agrees with Ater and Umeh (2003), Banta (2008), Ewaonicha (2005) and Amao *et al.* (2011), which found that small-holder cassava farmers with higher years of experience are in better position to be more technically efficient than their counterparts. This is because farmers with more years of experience have better knowledge in allocating resources and are expected to run a more profitable enterprise. On the other hand, the coefficient of age, educational status, number of association and the type of ownership structure were found not to have significant influence on the efficiency level of HQCF processors in Nigeria.

The estimated sigma squared parameter indicates the goodness of fit test ($\sigma^2 = 0.48$, $t = 3.50$) and was significantly different from zero at 1 percent; implying that the stochastic frontier production is an adequate representation of the data. The magnitude of the gamma parameter (γ) was 0.63 and significant at 1 percent suggesting that, about 63 percent variation in the maximum output of High Quality Cassava Flour processing was due to inefficiencies on the part of the processors rather than random variability.

The result on figure 1 indicates that HQCF processors in Nigeria had technical efficiency varying from 13 to 95 percent with a mean of 79 percent. This implies that technical efficiency in HQCF processing in Nigeria could be increased by 21 percent through a more efficient use of available resources given the current state of technology and this could be achieved through efficient use of inputs and allocation of resources.



This result however, slightly differs from the findings of Ehinmowo and Ojo (2014) who found the average technical efficiency of cassava processors to be 82 percent and 73 percent respectively for local and modern methods of cassava processing in Southwest Nigeria. Specifically, 3.8 percent of HQCF processors had technical efficiency of 0.11 to 0.30; 10.6 percent of HQCF processors had technical efficiency of 0.31 to 0.60; 70.2 percent of HQCF processors had technical efficiency of 0.61 to 0.90 and finally, 15.4 percent of HQCF processors had technical efficiency of 0.91 to 1.

4. 0 THE ROLE OF POLICY IN TRANSFORMING HQCF PROCESSING IN NIGERIA

Findings from this study revealed that HQCF processors are technically efficient in the range of 13 to 95 percent with a mean of 79 percent (figure 1); indicating that technical efficiency in HQCF processing in Nigeria could be increased by 21 percent through a more efficient use of available resources given the current state of technology. Thus, in transforming the HQCF industry in Nigeria, policy efforts may target the critical factor inputs influencing HQCF output as well as the socio-economic factors influencing the efficiency of processors, as revealed by this study. In the case of fresh cassava tubers, which were found to increase the output of HQCF significantly; policies for expanded production of fresh cassava tubers should be encouraged. However, cassava production in Nigeria has been characterized by burst-boom cycle due to unstable price and low productivity (FMARD, 2011; Oludiran, 2012). Moreover, access of processors to fresh tubers is hindered by poor road and transportation infrastructure. Hence policy intervention that would guarantee sustained access of processors to fresh cassava tubers may include- formation of clusters of farmers around small and large scale processing factories,

dissemination of improved production packages (improved cuttings, fertilizers) to farmers to increase productivity and output of cassava, creation of effective supply chains to existing cassava processing factories, and establishment of a guaranteed minimum price scheme with government as buyers of last resort.

Similarly, the significance of capital input in the HQCF industry suggests the need for policy interventions to create incentives for investment in appropriate processing facilities (Oluwemimo, 2010). Although diesel was not significant, but the negative coefficient suggests policy measures that will improve access of processors to electricity and save expenditure on diesel for powering machines may have positive effect on productivity of HQCF processors (Falade *et al.* 2013). Hence, specific policies may include incentives for investment such as tax holidays for investors in processing plants; designation and development of staple crop processing zones for cassava to support processors with basic amenities like reliable power and water, and building a network of growers around the processors.

Contrary to apriori expectation, access to credit tends to reduce efficiency of processors significantly; which may be an indication of discouragement or disenfranchisement on the part of the processors due to policy inconsistencies such as failure of government to enforce the policy of 10% inclusion of HQCF in bread flour which has left several small processors with unsold inventories and farmers with nowhere to sell their cassava harvest (FMARD, 2011; Oluwawemimo, 2010). Policies that would create reliable demand and strengthen cassava value-added chains may include: provision of incentives for users of cassava products, cash back incentives to exporters, and a levy on imports of competing products.

The result on gender shows being a male processors decrease the technical inefficiency affects in HQCF processing in Nigeria relative to being a female processor. – policy implications - This result suggests that HQCF processing calls for appropriate gender sensitivity by fabricating machines and equipment that can easily be operated by females.

This result suggests that increase in years of processing experience will decrease technical inefficiency in HQCF processing. In order words, processors with more years of processing experience are more efficient than their counterparts with lesser years of processing experience. – policy implications - This also implies that processors with more years of experience will have better knowledge on machine operation, better knowledge of efficient allocation of resources and are expected to run a more efficient and profitable enterprise than those with little or no years of processing experience.

Although age was found not to have significant influence on the efficiency level of HQCF processors, the mean age and distribution of processors' age suggest that the population of processors are fast getting old and exiting their productive ages; hence policy that will encourage and empower the youths to participate should be promoted. This may include training and provision of supervised credit.

5.0 CONCLUSION AND RECOMMENDATIONS

This study was carried out to analyze technical efficiency of SMEs in High Quality Cassava Flour processing in four geo-political zones of Nigeria; with specific objectives of describing their socio-economic characteristics, estimating the coefficients of efficiency parameters for the production resources, describing the distribution of technical efficiency among HQCF processors, and assessing the factors that determine the efficiency of the processors. Results showed that raw cassava tubers and capital inputs positively and significantly affect HQCF output, while diesel was significantly negative. Similarly, gender and processing experience were factors that significantly promote technical efficiency of processors, while access to credit increases their technical inefficiency.

Based on these results, this paper concludes that policies that would promote access of HQCF processors to cassava tubers, appropriate capital/machineries, electricity/power sources at reasonable prices, supervised credit, appropriate skills and entrepreneurship development especially for females and youths; are appropriate for transforming the HQCF industry in Nigeria.

It was therefore recommended that:

- i) Policy measures should aim at facilitating access to credit; since it negatively affects technical efficiency of high quality cassava flour processors, such measures should include monitoring on use of credit.
- ii) Government should implement entrepreneurship programme that will combine training in HQCF processing with supervised credit especially for women as this may empower them to become more efficient and promote HQCF processing in Nigeria.
- iii) Similarly, training of women and youths on HQCF processing and utilization will also expand market for HQCF and provide a driving force for increased HQCF production in Nigeria.
- iv) Incentives must be created for investments in processing plants such as zero tariff
- v) Government should establish staple crop processing zones for cassava including necessary infrastructures especially, road, water and electricity.
- vi) Network and communication link between farmers, processors, users, financiers, and other actors along the value chain would aid for long term beneficial relationships such as reliable supply of raw materials and stable market for HQCF at competitive prices, access to supervised credit, among others
- vii) Farmers should be encouraged to form clusters around processing plants, with adequate support through dissemination of improved cassava cuttings and other inputs especially fertilizers to enhance productivity and output of raw cassava.
- viii) Creation of functional marketing institutions to support cassava farmers and processors.

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