# Technical efficiency of rural women farmers in Borno State, Nigeria.

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**Abstract**

This study was designed to examine the technical efficiency among women farmers in Borno State, Nigeria. The data for the study were generated by the use of structured questionnaire which was administered to 266 respondents obtained by the use of multistage sampling technique. The techniques used to analyze the data generated for this study were descriptive statistics and the maximum likelihood estimates of the stochastic frontier production function. The major findings of the study showed that respondent's socioeconomic characteristics indicated high levels of illiteracy (59.4%), non-membership of cooperatives (89.8%), no extension contact (72%) and low access to credit (89.4%). The determinants of technical inefficiency were education, off farm income, time on farm, age, credit and land ownership which all contributed to reducing technical inefficiency as the variable was increased. Mean technical efficiency of respondents was 0.5754 while that of the ''best'' farmer was 0.9994. A boost in both girl child education and adult women education were recommended for girls/women in the study area to enhance technical efficiency of production.

**Key Words:** Women, Productivity, Technical Efficiency, Resources

## 1. Introduction

The challenge that is currently confronting Nigeria's agriculture is related to the problem of low productivity in production resulting from inefficient use of resources Although about 70% of her population is engaged in agriculture, the country is yet not self sufficient in food production (Obasi & Agu, 2000). The constraints to the rapid growth of food production seem to be mainly that of low crop yields and resource productivity (Udoh, 2005).This may not be unconnected with the role that women play in agricultural production in Nigeria.

A review of the various studies on the contributions of Nigerian women to agriculture shows that rural women have made considerable contribution to production. They have been found in the production of crops such as yam, maize, cassava, rice and other food crops (Adekanye, 1984; Adeyeye, 1988). Saito et al. (1994) noted that women now constitute the majority of smallholder farmers, providing most of the labour and managing many farms on a daily basis. The report noted that little difference exists between food and cash crops in terms of female labour input in their production. However, despite their contributions, women farmers still face daunting constraints to their productivity, arising from limited access to extension, capital markets and new technologies (FAO, 1985; Quisumbing, 1994). These constraints among others in Boserup's (1970) submission brought about an unprecedented attention to women's issues. She argued that development policies were biased against women's issues; hence women's contributions were unrecognized and unaccounted for.

Technical efficiency implies the ability to produce maximum output from a given set of inputs, given the available technology. It is a measure of agricultural productivity. Having access to a certain minimum set of resources, given the prevailing level of technology determines the level of technical efficiency of farmers. Considering the tendency for women farmers to be challenged by problems of limited access to resources, the objective of this paper was to examine the level of technical efficiency of rural women farmers in order to provide information that may be useful in designing effective policies towards improved agricultural productivity.

## 2. Theoretical frame work

The modern theory of efficiency dates back to the pioneering work of Farrel (1957). Farrel (1957) identified two components of firm efficiency- technical and allocative and the combination of these two components provides a measure of economic efficiency. Noting the three components of efficiency, Farrel (1957) referred to technical efficiency as the ability to produce the highest level of output given a bundle of resources. On the other hand, technical inefficiency depicts a situation in which actual and observed output from a given input mix is less than the maximum possible (Kumbhakar, 1989). Technical efficiency, the main issue in this study can be measured either as input conserving oriented technical efficiency or output expanding oriented technical efficiency. Output expanding oriented technical efficiency is the ratio of observed to maximum feasible output, conditional on technical and observed input usage (Jondraw *et al*., 1982; Ali, 1996; Udoh, 2005). Efficiency measurement has given rise to specification of various estimation methods. The stochastic frontier production function is a parametric method. The specification of stochastic parametric frontier recognizes component error term as major source of deviation from the production frontier. Stochastic frontier production function is given as:

$Yi = F(Xi; \beta) \exp(Vi - Ui)$ i = 1, 2… N (1)

Where

Yi is the output of ith farm;

Xi, is the corresponding (Mx2) vector of inputs;

β is a vector of un-known parameter to be estimated;

F denotes an appropriate functional form,

Vi, is the symmetric error component that accounts for random effects and exogenous shock, while

Ui, ≤ 0 is a one sided error component that measures technical inefficiency.

The major interest in efficiency study that specifies stochastic frontier is the decomposition of the component error terms (Vi - Ui) into mutually exclusive events. This is normally accomplished by estimating the mean of conditional distribution of U given V expressed as:

$E(V/ei) = \mu i = \sigma^* \{f^*(-\mu i/\sigma^*)[1-F(Ui/\sigma^*)]-1\}$ (2)

Where

$\sigma^* = (\sigma v2\ \sigma u2/\sigma 2)½$; $\mu = (-\sigma u2ei)/\sigma 2$,

f is the standard density function and

F is the standard distributional assumptions.

The values of unknown coefficients in (1) and(2) can be obtained jointly using the maximum likelihood(ML) method. This involves estimation of population parameters such that the probability density for obtaining the actual sample observations that have been obtained from the population is greater than the probability density obtainable with any other assumed estimates of the population parameters (Stevenson, 1980; Coelli, 1995; Draper & Smith, 1966; Olayemi, 1998; Udoh, 2005). The ML method provides estimators that are asymptotically consistent and efficient. This study uses a production approach to estimate technical inefficiency effects at farm levels by assuming a stochastic nature of production.

## 3. Methodology

The study was carried out in Borno State, Nigeria. The state is divided broadly into three agro ecological zones (AEZs) namely the Sahel, Sudan Savannah ang Guinea Savannah. The state comprises 27 local Government Areas (LGAs). Five LGAs were randomly selected to represent the three broad AEZs in the state. The number of LGAs selected were two LGAs each from the Guinea Savannah and Sudan Savannah, and one from the Sahel Savannah in proportion to the number of LGAs in each AEZ. Three villages were randomly selected from each of the selected LGAs in the second stage making a total of 15 villages. In the third stage, a total of 266 respondents were selected using purposive sampling procedure to allow for the
Of only female farmers.

## 4. Results and discussion

### 4.1 Socioeconomic Characteristics of respondents

The socioeconomic characteristics of respondents showing marital status, highest level of schooling, extension contact, farming experience, age and family size is presented in Table 1. The result shows that majority of the respondents (80.8%) were married and only a very few (1.5%) were single indicating that most women farmers in the study area were married. This observation is probably because most farm lands belong to men, and marriage is the commonest source of farm land among women in such societies. The result also showed that almost 60% of the respondents lacked formal education and about 70% had no extension contact. Despite limited formal and extension education, the respondents were on the whole quite experienced farmers with mean farming experience of 17.2 ≠ 8.7 years implying that respondents to a large extent relied more on their traditional farming information more than modern farming technology.

Over 80% of the respondents were young (less than 50 years). Mean age was 39. 5≠ 10.2 years. The women in the study were therefore expected to be strong and agile enough to carry out their farm labour which usually involves a lot of drudgery. Mean household size of respondents was 9.6 ≠ 4.5 people with about 70% of respondents having family size between 6-15 people indicating that households of respondents were fairly large. Rural women usually farm food crop to enhance household food security (Ogunlela and Muktar, 2009).

 

### 4.2 Technical inefficiency determinants

Table 2 also presented results of determinants of technical inefficiency of respondents in the study area. The results showed a gamma of 0.7865 implying that 78.65% of the variations in productivity of respondents were determined by technical inefficiency variables. This indicated that reducing technical inefficiency among respondents will result in substantial productivity increases. The Sigma squared ($\delta^2$) of 0.122 was significant at 1% indicating a good fit, thus showing the correctness of the specified distribution assumption of the composite error term.

The statistically significant determinants of technical inefficiency among the specified variables were education, off farm income; time spent on farming, age, credit, and ownership of land. These variables also carried the expected signs. Iheke (2008) and Omonona *et al*. (2010) had similar findings. These variables were significant at 1% and 5% levels of significance as shown on Table 2. The variables negatively influenced technical inefficiency (they reduced technical inefficiency). This meant that these variables increased technical efficiency among the respondents, thus increasing productivity. As age of farmers increased, inefficiency in resource use decreased. Farming experience is also expected to increase with age. The findings of Ogbimi *et al*. (2006) in a related study on women's accessibility to credit and inputs in Osun state indicated that as women increased in age, they tended to have more access to inputs and credit, resulting in higher efficiency as age of farmer increased. The low level of women's exposure to education, extension, and cooperatives suggested that women in the study may not make efficient farm management decisions. The large proportion of respondents who had relatively low farm incomes with no off farm income suggests that such farm incomes were likely to be used to meet other demands without investing in the farm enterprise, resulting in lower productivity.

This result showed that increasing the years of education of women can help to improve the efficiency with which women produce crop in the study area. This is because education stimulates farmers' adoption of agricultural technologies as observed by Ani *et al*. (2004). Similarly, as off farm income increased, there were more resources to help women to better access and allocate farm inputs. Farmers' input allocation was also enhanced when farmers had access to loans (credit). This is because credit enhanced farmers' enablement to purchase inputs they could not ordinarily afford. In addition, access to farming time significantly increased the technical efficiency of women farmers. This implied that as women were enabled to make time to give attention to their farms, farm efficiency was increased. Land ownership was shown to significantly reduce technical inefficiency. This is because when women owned their own land, they were enabled to invest on such land without the limitations they contend with when they hold land temporarily. This land use limitation of women was observed by Woldetensaye (2007), who noted that at the household level, women in Ethiopia had less influence on decisions on land and land related matters like what crop to grow on the land. This poses a challenge on women's ability to make investment decisions that will improve their technical efficiency as farmers. This limitation is however overcome when women acquire their own land.

Extension contact, farm income, farm management decision making powers and membership of cooperatives were not statistically significant. Extension contact and membership of cooperatives carried the expected negative sign, implying that they decreased inefficiency as they were increased. The decrease in inefficiency was however not significant. This was probably because of the generally low number of extension visits to farmers and low membership of cooperatives among respondents in the study. Farm income and women's decision making powers increased inefficiency as indicated by the positive signs they carried. This resulted in decreased productivity among the women. These two variables were also insignificant. Farm decision making powers of respondents probably increased inefficiency because of women's low access to resources like extension, education and membership of cooperatives resulting in limited management decision making powers.

### 4.3 Distribution of farm specific technical efficiency

Summarily, technical efficiency of the respondent farmers showed that minimum efficiency was 0.002 and maximum efficiency was 0.9994, while the mean technical efficiency was 0.5754. The maximum efficiency score of 99.94% was the frontier score which was obtained by twp farmers considered the 'best' farmers. The observed mean technical efficiency suggested that over 40% of the marketable output were wasted due to inefficient use of farm resources. The mean efficiency value of about 57.5% in the analysis showed that production among the respondents had not reached the frontier threshold. To reach this frontier however, determinants of technical efficiency among the farmers must be taken into cognizance. The inefficiency determinants had been observed to be responsible for about 78.65% of the variations in farm output among respondents (Table 2), thus, depressing the effectiveness with which respondents applied the existing technology in the study area. Addressing these inefficiency factors will enhance technical efficiency among individual farmers to the level of the ''best'' farmer which will in turn enhance the productivity of farmers. The '' best'' farmer efficiency appears to be significantly affected by years of schooling which was in both cases above the mean years of schooling among respondents in the study. This finding implies that education as a resource helps farmers to utilize the resources available to them more efficiently in the production process. Other factors were off farm income; time spent on farming, age of respondent, access to credit, and ownership of land.

The results of the study indicated technical inefficiency of women was on the average, low. This is similar to the findings of Njuki *et al.* (2006) who in a study in Kenya, using the Cobb-Douglas production function, found that Women in that study had a mean technical efficiency of 56%. The study also showed that 50% of the female managed farms had less than 50% efficiency. This situation was attributable to women's limited access to resource of technical efficiency. On the other hand, Oladeebo and Fajuyigbe (2007) in a study among rice farmers in Osun State, found that technical efficiency ranged between 0.543 and 0.987 with a mean of 0.904 for women farmers, indicating that women could be more technically efficient when they had better access to technical efficiency resources.

## References

Adeyeye, V. A. (1988). Women's Involvement in Agriculture and Rural development process in Nigeria. *African Notes* special issue, 3, 17-21.

Adekanye, 1 Udoh, E.J. (2005). Technical Inefficiency in Vegetable Farms of Humid Region; An Analysis of Dry Season by Urban Women in South-South Zone, Nigeria. *J. Agric. Soc. Sci.,* 1, 80–85

Ali, M. (1996). Quantifying the socio–economic determinants of sustainable crop production. *Agric. Eco.* 14, 45–6

Ani, A.O., Ogunnika, O. and Ifah, S. S. (2004). Relationship between socioeconomic characteristics of rural women farmers and their adoption of farm technologies in Southern Ebonyi State, Nigeria. *International Journal of Agriculture and Biology, 5,* (4), 802 – 805

Boserup, E. (1970). *Women's role in economic development*. New York St. Martin's Press.

Coelli,T.J. (1995). Recent development in Frontier Modeling and efficiency measurement. *Australian J. Agric. Eco,* 39, 219–44

Draper, N.R. and H. Smith, 1966. *Applied regression analysis,* New York, John Wiley and Sons, Inc

Farrell, M.J. (1957). Measurement of Production Efficiency. *J. Royal Stat. Soc., 120, 253–81*

Iheke, O. R. (2008). Gender, migration and agricultural productivity. *Pakistan journal of social sciences,* 5(7), 676 – 680.

Jondraw, J., lovel, C.A., Materov, I.S. and Schmidt, P. (1982). On the estimation of technical inefficiency in the stochastic frontier production function model, *J. Eco*., 19, 233–8

Kumbhakar, S. c., B. Biswas, and D. V Bailey. (1989). A Study of Economic Efficiency of Utah Dairy Farmers: A System Approach. *The Review of Economics and Statistics 71, 595-604.*

Njuki, J. M., Kihijo, V. B. M., O'Ktingati, A. and Place, F. (2006). *Productivity differences between male and femae managed farms in Eastern and Central highlands of Kenya*. Contribution Paper prepared for presentation at the International Association of Agricultural Economics Conference. Gold coast, Australia. August 12-18

Obasi, F.C. and Agu, S.E. (2000). Economics of small scale rice farming under different production systems in South Eastern Nigeria. *J.Agric. Business Rural Develop.* 1. 2

Ogbimi, G. E., Soyebo, K. O. and Alabi, D. L. (2006). Minimizing financial management problems among rural women for sustainable economic empowerment: case of Osun State, Nigeria. *Research Journal of social science, 1 (1), 51 – 55.*

Ogunlela, Y.I. and Mukhtar, A.A. (2009). Gender isues in Agriculture and Rural Development in Nigeria: The role of women. *Humanity & social sciences Journal* 4(1), 19 – 30.

Oladeebo, J.O. and Fajuyigbe, A. A. (2007). Technical efficiency of men and women upland Rice Farmersin Osun State, Nigeria. *J. Hum. Ecol., 22(2), 93-100*

Olayemi, J.K. (1998). *Food Security in Nigeria.* Research Report, No. 2. Development Policy Centre, Ibadan, Nigeria

Omonona, B.T., Egbetokun,O.A. and Akanbi, A.T. (2010). Farmers resource use and technical efficiency in cowpea production in Nigeria. *Economic Analysis and Policy, 40 (1), 102 - 110*

Quisumbing, A. R. and Pandolfelli, L. (2010). Promising Approaches to Address the Needs of Poor Female Farmers: Resources, Constraints, and Interventions, *World Development, Elsevier*, vol. 38(4), pages 581-592.

Saito, A. K.; Mekonnen, H. and Spurling, D. (1994). *Raising the productivity of women farmers in sub-Saharan Africa.* World Bank Discussion Papers. Africa Technical Department Series, No 230. Washington DC.

Stevenson, R.E., (1980). Likelihood fuction for generalized stochastic frontier estimation, *J. Eco.*, 13, 57–66

 

Woldetensaye, A. (2007). *Women's access to and control over land in the current land administration system in two Rural kebeles in Ada'a woreda of Oromia Region.* A Thesis submitted to the Institute of Gender Studies,

Addis Ababa University in partial fulfillment of the requirement of Master of Arts in Gender Studies.

| Factors | Percentage | Mean ±SD | minimum | maximum | mode |
|---|---|---|---|---|---|
| **Marital status** | | | | | |
| married | 80.8 | | | | |
| single | 1.5 | | | | |
| widowed | 15.1 | | | | |
| divorced | 2.6 | | | | |
| **Highest level of schooling completed** | | | | | |
| No formal schooling | 59.4 | | | | |
| Primary | 19.9 | | | | |
| secondary | 12.0 | | | | |
| Tertiary | 8.7 | | | | |
| **Extension contact** | | | | | |
| 1-4 | 12.0 | | | | |
| 5-8 | 6.8 | | | | |
| 9-12 | 7.9 | | | | |
| >12 | 0.8 | | | | |
| **Farming experience** | | | | | |
| 1-10 | 22.6 | 17.2 ≠ 8.7 | 1 | 70 | 15 |
| 11-20 | 59.5 | | | | |
| 21-30 | 17.7 | | | | |
| 31-40 | 3.7 | | | | |
| >40 | 1.5 | | | | |
| **Age** | | | | | |
| <25 | 3.4 | 39.5≠10.2 | 16 | 80 | 35 |
| 25-36 | 38.0 | | | | |
| 37-48 | 41.7 | | | | |
| 49-60 | 13.9 | | | | |
| >60 | 3.0 | | | | |
| **Family size** | | | | | |
| 1-5 | 16.5 | 9.6 ≠ 4.5 | 1 | 21 | 6 |
| 6-10 | 42.5 | | | | |
| 11-15 | 27.8 | | | | |
| 16-20 | 11.3 | | | | |

**Table 1: Socioeconomic characteristics of respondents** **( n – 266)**

**Source: Field survey, 2010**

**Table 2: ML estimates of Stochastic Frontier production Function of respondents (n=266)**

| Variable | | Coefficient | Std. error | t – ratio |
|---|---|---|---|---|
| Production function | | | | |
| land | $\beta_1$ | -0.0289 | 0.003 | -10.345*** |
| improved seed | $\beta_2$ | 0.0136 | 0.000 | 22.533*** |
| insecticide | $\beta_3$ | --0.0128 | 0.000 | --13.745*** |
| herbicide | $\beta_4$ | 0.0987 | 0.002 | 64.279*** |
| hired labour | $\beta_5$ | 0.0122 | 0.000 | 66.822*** |
| family labour | $\beta_6$ | 0.0419 | 0.000 | 76.090*** |
| fertilizer | $\beta_7$ | 0.0696 | 0.000 | 189.489*** |
| Mechanization | $\beta_8$ | -0.0242 | 0.000 | -95.005*** |
| diagnostic statistics | | | | |
| Sigma$^2$ | | 0.1218 | 0.909 | 13.3890*** |
| gamma | | | | 423.4404*** |
| | | 0.7865 | 0.212 | |
| technical inefficiency model | | | | |
| education | $\delta_1$ | -0.3854 | 0.190 | -2.074** |
| extension | $\delta_2$ | -0.0241 | 0.253 | -0.095 ns |
| farm income | $\delta_3$ | 0.2654 | 0.125 | .1.178ns |
| off-farm income | $\delta_4$ | -0.0254 | 0.100 | -10.584*** |
| Time | $\delta_5$ | -4.2361 | 0.406 | -10.429*** |
| age | $\delta_6$ | -0.5427 | 0.231 | -2.132** |
| credit | $\delta_7$ | -4.0145 | 1.420 | -2.614** |
| land owner | $\delta_8$ | -0.3762 | 0.173 | -3.356 *** |
| decision making | $\delta_9$ | 0.0053 | 0.156 | 0.0345 ns |
| cooperatives | $\delta_{10}$ | -0.2199 | 0.412 | -5.335ns |

Source: Field Survey, 2010.
*** = significant at 1%   ** = significant at 5%   ns = not significant
Log likelihood function = 239.4681

**Table 3: Frequency distribution of technical efficiency among respondents (n = 266)**

| Technical efficiency estimates | Frequency | Percentage (%) |
|---|---|---|
| 0 – 9 | 21 | 11.7 |
| 10 - 19 | 5 | 1.9 |
| 20 - 29 | 18 | 6.8 |
| 30 -39 | 29 | 10.9 |
| 40 - 49 | 38 | 14.2 |
| 50 - 59 | 44 | 16.5 |
| 60 - 69 | 45 | 16.9 |
| 70 - 79 | 25 | 9.4 |
| 80 - 89 | 17 | 6.4 |
| 90 - 100 | 14 | 5.3 |

Source: Field survey, 2010
Mean efficiency = 0.5754   Minimum efficiency = 0.002   Maximum efficiency = 0.9994