Journal of Occupational Safety and Environmental Health
A Publication of the Society for Occupational Safety and Environmental Health

IMPROVING THE PRODUCTIVITY OF WOMEN FARMERS AS A PANACEA FOR POVERTY ALLEVIATION IN KADUNA STATE, NIGERIA

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Abstract
The role of women in feeding the household can never be overemphasized. Poverty alleviation among women is therefore paramount in household development. Improving the women farmer productivity is therefore a means of improving their income and hence alleviating poverty among them. The study was conducted in Kaduna State. Random sampling was employed in selecting a hundred and sixty women farmer respondents for the study. Data were collected from the 2011 cropping season. The data collected included production and demographic characteristics of the respondents. It was found that farmer productivity influenced their poverty status. On the average, the women farmers were able to obtain just over 55% of optimal output implying that, in the short-run, there is the possibility of increasing technical efficiency of the women farmers in food crop production in the study area by 45% if the women farmers would adopt the technology and production techniques currently used by the most efficient farmers. 78% of random variation in the output of the women farmers was due to their inefficiency. Poor education, large dependency ratio were some of the sources of inefficiencies. This coupled with inadequate utilization of inputs forced the women farmers to operate at the irrational stage 2 of the production function. It was recommended that an enabling environment that will make inputs readily available to farmers timely be created.
Keywords: Women, Productivity, Poverty, Farmer, Kaduna State.

Introduction
The role of women in agricultural production in Nigeria cannot be overemphasized. Though, they are mostly landless workers with smallholdings, they play key roles in supporting their households in achieving food security and improving household livelihood. They participate immensely in agricultural production and drive rural economies. The state of the agricultural sector in Nigeria is however, worsening and underperforming thereby aggravating the food security flight and threatening poverty alleviation status of the farming households in the country. This may partly be connected to the marginalization of women farmers in agricultural and development planning. The result is that, though the women farmers might be as productive as their male counterparts, the farm productivity of the women is in most cases lower. The women farmers experience persistent structural constraints that hinder them from fulfilling their potentials. As such, improving the productivity of the woman farmer could be a panacea to reducing the farming household poverty. This study therefore, investigated whether improving the farm efficiency of the women farmers would eventually result in improved productivity of the women farmers.

Materials and Methods
Study Area: The study was conducted in Kaduna State, Nigeria. The State is located between longitudes $9^{o}\ 00^{/}$ N, $6^{o}\ 00^{/}$ E and latitudes $11^{o}\ 30^{/}$ N, $9^{o}\ 00^{/}$ E. The State is currently made up of twenty-three Local Government Areas (LGAs). Majority of the people are mainly engaged in

subsistence farming. The common crops grown are maize, sorghum, millet, cowpea, groundnut, rice, soybeans, cassava, sugarcane, yam, and various types of fruits and vegetables.

Sampling Technique: Multistage sampling technique was employed in selecting the sample for the study. In the first stage, a LGA was randomly selected from each of the three agro ecological zones that form the state. A total of three LGAs were therefore, selected for the study. Three villages were randomly selected from each of the three LGAs and forty respondents were randomly sampled from each of the villages. Therefore, a total of 360 respondents were sampled for the study. Data were collected during the 2011 cropping season through the administration of structured questionnaire. The information collected included the demographic characteristic of the respondents Data were analysed using the stochastic frontier analysis.

Analytical Technique: Productivity can be measured by technical efficiency (TE) which is the ability of a decision-maker (e.g., food crops women farmers) to produce maximum output given a set of inputs and technology. It is a well-established fact (Zibaei *et al*., 2008) that economic performance can differ considerably among farms even if they are operating under more or less similar conditions. Difference in economic performances is attributed to difference in the efficiency of the firms. Therefore, technical efficiency, its measurement and determining factors are of crucial importance in production economics. The basic method for measuring farm efficiency level is to estimate a frontier production function that envelops all the input-output data with those firms lying on the frontier curve being described technically efficient. Any farm that lies below the frontier curve is considered to be inefficient. This farm could either reduce input use whilst maintaining output or it could use the same amount of input and increase output. Hence, the position of individual farm relative to the frontier could be influenced by factors ranging from climatic, socio-economic, marketing and technological. Stochastic frontier production function method has been adopted by a number of studies to estimate technical efficiency in agricultural production. This is because agricultural production is characterized by random shocks and there is a need to separate the influence of random shocks and measurement errors (stochastic variables) from resulting estimates of technical inefficiency. Several studies have used the stochastic production function approach to determine technical efficiency (Dawson *et al*., 1991; Kalirajan. 1991; Bravo-Ureta and Rieger. 1991; Parikh *et al*., 1995; Battese and Hassan, 1999). The stochastic frontier production function is as under:

$$\ln \mathrm{Y}_i = \beta_0 + \sum_{i=1}^{4} \beta_i \ln \mathrm{X}_i + (\nu_i - \mu_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

where Y_i, is the dependent variable in the production function showing the output per hectare (Grain Equivalent) for the i^{th} farm, X_i is a vector of inputs used in the production process, β_0 - β_i are the parameters to be estimated, ν_i is the random error term which accounts for variation in output due to factors beyond the farmer's control such as measurement errors and weather conditions (Battese and Coelli, 1995). It is assumed to be independently and identically distributed normal random variables with constant variance and μ_i is the is the inefficiency term which is assumed to be non-negative truncated at zero random error term is the inefficiency term which is assumed to be non-negative truncated at zero $N \sim (\mu_{it}, \sigma^2)$ random variable associated with farm-specific factors which leads to the i^{th} farm not attaining maximum efficiency of production at t^{th} time period (Coelli *et al*., 1998; Battese and Rao, 2002). *N* represents the number of farms involved in the cross sectional survey. The technical efficiency (*TE*) of individual farm is defined by:

$$\mathrm{TE} = \frac{\mathrm{Y}_{it}}{\mathrm{Y}_{it}^{*}} \text{ .... (2)}$$

$$= \frac{\ln \mathrm{Y}_i = \beta_0 + \sum_{i=1}^{4} \beta_i \ln \mathrm{X}_i + (\nu_i - \mu_i)}{\ln \mathrm{Y}_i = \beta_0 + \sum_{i=1}^{4} \beta_i \ln \mathrm{X}_i + \nu_i}$$

where, $0 \le \mathrm{TE} \le 1$ with 1 defining a technically efficient farm. Y_{it} is the observed output and Y_{it}^{*} the frontier output. A farm is technically efficient if its output level is on the frontier, which implies that $\frac{\mathrm{Y}_{it}}{\mathrm{Y}_{it}^{*}}$ equals one in value. The inefficiency model was estimated from the equation given below.

$$\mu_{it} = \delta_0 + \sum_{i=1}^{5} \delta_i \mathrm{Z}_{it} \text{ .... (3)}$$

The variables Z_{it} are the variables in the inefficiency model.

Table 1: Variable Definitions and Measurements

Variable	Definition
OUTPUT	Value of the total grain equivalent of the output of the various crops planted
SEED	Value of the total grain equivalent of the various seeds planted.
FERT	Naira value of the various chemical fertilizer applied by the farmer.
AGRO	Naira value of all the agrochemicals applied on the farm by the farmer.
LAB	Naira value of labour employed on the farm.
AGE	Number of years the farmer has lived on earth from birth to time of the research.
EDU	Education level of household head. Value = 0 if No Formal Education, 1 if Adult Education, 2 if Some Primary Education, 3 if Completed Primary Education, 4 if Some Vocational Training, 5 if Completed Vocational Training, 6 = Some Secondary Education, 7 if Completed Secondary Education, 8 if College Education and 9 if University.
DRATIO	This is the dependency ratio. It measures the ability of the farm in meeting with the domestic needs of the household. It is also a measure of the active labour available in the household for farm activities. It is the ratio of the number of children below 15 years of age, disabled members and elders above 50 years of age to the number of economically active family members (15–50 years of age). An increase in dependency ratio reduces the ability to meet subsistence needs and also increases the personal rate of time preference.
EXT	This is the extension variable and was measured as an index. It was measured as the sum of times in the past 12 months a member of the household participated in any agricultural research /extension training or visited any extension office /research station to seek for information on the crop(s) planted.
INCOM	This measures the income level of the household in Naira. It was obtained by summing the income from the sale of crops, livestock, casual employment (agricultural /non-agricultural), own business, remittances and other sources.
PLEVEL	This variable measured the poverty level of the household. US$1.25 /day was taken as the base line. Therefore, a household that spends less than US$1.25 /day is considered as poor.

Results and Discussion

Household Poverty Level: A summary of statistics on the poverty level of the households of the crop farmers is presented on Table 2. The poverty level of the households was determined based on the international poverty line. The common international poverty line has in the past been US $1 a day. In 2008, the World Bank came out with a revised figure of US $1.25 at 2005 purchasing-power parity (PPP). Determining the poverty line is usually done by finding the total cost of all the essential resources that an average human adult consumes in one year.

Table 2: Percentage Distribution of the Months the Households were Food Secured

Poverty Level	Frequency	Percentage Frequency
Less than US $1.25 /day	251	69.72
Averagely US $1.25 /day	87	24.17
More than US $1.25 /day	22	6.11
Total	**360**	**100**

Table 3: Summary of Statistics of Variables Employed in the Production Frontier Analyses

Variable	Mean
Yield (Kg Grain Equivalent /ha)	123.76 (84.75)
Seed (Kg Grain Equivalent /ha)	1.77 (0.29)
Labour (₦)	442.22 (1909.73)
Cost of Fertilizer Cost	1114.612 (2106.11)
Cost of Agrochemicals	583.13 (372.71)
Age	35.48 (11.34)
Education	1.29 (3.68)
DRatio	1.24 (1.03)
FSize	0.76 (0.83)
Extension	0.11 (1.23)
Income	60453.27 (77303.26)
Poverty Level (US $ /day)	0.87 (3.02)

*Figures in parentheses under the mean column are the standard errors.

The result of in Table 2 revealed that about 70% of the farming households of the women farmers are poor (i.e live below the poverty line). This therefore, calls for serious attention of the policy makers.

Production Analysis: A summary of the statistics employed in the estimation of the production frontier analysis of the women food crop farmers is presented in Table 3. The Table showed that the mean output of the farmers is 128.25 with standard deviation of 97.36. The wide variation in the recorded yield may be an indication of the variation in input utilization arising from poor management of resources by the women farmers in the area. The general mean farm size was 0.76 ha with a standard deviation of 1.12.

The large variability recorded in the labour variable could be an indication that food crop production in the study area is highly labour intensive. The mean education was 1.29 and age 35 years. This implies that most of the food crop women farmers are fairly literate (had adult education) and agile. The women farmers in the study area recorded poor extension contact. Majority of them had no extension contact in the course of production. This may have negative influence on their agricultural output. This is because the farmers may not have access to necessary production information and with recorded poor income and education, may lack the ability to pay for desired production technologies /services and the necessary knowledge of the application of the technologies /services.

Productivity and Technical Efficiency Analysis: The results obtained from the stochastic frontier production function analysis are presented in Table 4. The estimate of the sigma square (σ^2) which serves as a measure of fit of the model specified is statistically significant (P<0.05). The σ^2 is the random error term which accounts for random variation in the farmer's output due to factors outside the farmer's control.

Table 4: Estimates of the Stochastic Frontier Production Model

Variable	Parameter	Coefficient
Production Model		
Constant	β_0	0.222*
LNSEED	β_1	0.512*
LNFERT	β_2	0.134*
LNAGRO	β_4	0.444
LNLAB	β_5	0.246
Inefficiency Model		
Constant	δ_0	2.658
AGE	δ_1	-1.224
EDU	δ_2	0.235*
DRATIO	δ_3	0.121**
EXT	δ_4	0.543
INCOM	δ_5	-2.110*
PLEVEL	δ_6	2.968*
FSIZE	δ_7	0.453*
Diagnostic Statistics		
Sigma Square	σ^2	0.425
Gamma, $\sigma_\mu^2 / (\sigma_\mu^2 + \sigma_v^2)$	γ	0.812
Log Likelihood Function	LLF	-165.01

*P<0.05; **P<0.10

The estimates of γ are the random variable associated with farm-specific factors which leads to the i^{th} farm not attaining maximum efficiency of production. The γ value is 0.78 which implies that the influence of the inefficiency effects on the output of the farmers is very high. The value signifies that 78% of random variation in the output of the farmers was due to the farmers' inefficiency and not as a result of random variability. Since these factors are under the control of the farm, reducing the influence of the effect of γ will greatly enhance the technical efficiency of the women farmers and improve their output. The signs of the variables included in the model are according to a priori expectations. All the efficiency variables had positive signs. This implies that if the food crop women farmers could employ more of the efficiency variable inputs, their crop output could be increased. The extent to which an input will be added will however depend on the ratio of the marginal value product (MVP) and marginal factor cost of the input.

Determinants of Technical Inefficiencies: A negative sign on an inefficiency parameter implies that the variable improves technical efficiency, while a positive sign increases technical inefficiency. The results on Table 4 revealed that age and the income level of the farmers had negative signs and therefore reduced technical inefficiency. This result is according to a priori expectations and is in line with the works of Amaza et al., (2005). The older women farmers are likely to have had more farming experience and therefore acquired more managerial skills that improve their farm efficiencies while the richer farmers were able to buy necessary input at the right time and in the right quantity. Education level, household size and extension variables were found to increase inefficiencies. This finding is contrary to a priori expectations and to the works of Amaza *et al*., (2005), Tanko and Jirgi, (2008) and Olarinde *et al*., (2010). Possible explanations could be that as members of the household get more educated, they move in search of well-paid office jobs such that only the less educated are left behind to continue with farming. The farming households depend mainly on family labour in performing farm operations. However, the result on Table 4 suggests that there was inappropriate labour management by the women farmers. The women farmers had more in active dependents that tend to reduce the quality of labour available to them. It is expected for extension contact to improve farmers' efficiency; nevertheless, though the women farmers may come in contact with extension workers, the extension workers might not have been trained enough to meet with the farm information needs of the women farmers. The farm size variable added to the farm inefficiencies. This might be due to the women farmers lacking adequate farm inputs required by their farm plots. The poverty status of the women farmers add to their inefficiencies. It therefore, follows that any policy measure that will aid in reducing the women farmers farm inefficiencies will also help to reduce poverty.

Technical Efficiency and Poverty Level: Table 5 shows the result of the technical efficiencies of the farmers. The technical efficiencies of the sampled women farmers are less than 1 (100 %), indicating that all the farmers were producing below the optimum (frontier) efficiency. The mean technical efficiency was 0.55 (55%). This implies that, on the average, the farmers were able to obtain just over 55% of optimal output from a given mix of production inputs. The distribution of the technical efficiencies and return to scale (Table 6) suggest that there is great potential to increase food crop production through improvement in technical efficiency among the sample farmers. The women farmers were operating at the irrational stage of production. They were operating in stage 2 of the production function.

Table 5: Percentage frequency distribution of technical efficiency estimates

S/No	Efficiency Level	Percentage Frequency
1.	0.1-0.19	5.96
2.	0.2-0.29	13.77
3.	0.30-0.39	8.65
4.	0.40-0.49	3.85
5.	0.50-0.59	53.85
6.	0.60-0.69	8.73
7.	0.70-0.79	2.21
8.	0.80-0.89	1.95
9.	0.90-0.99	1.03
Mean Efficiency		0.55

Table 6: Estimates of Production Elasticity

Variable	Elasticity
Seed	0.512
Fertilizer	0.134
Agrochemicals	0.444
Labour	0.246
RTS	1.336

In stage 2, the farming households operate at decreasing returns to scale. This implies that measures that will improve the farmers' accessibility and affordability to under-utilized inputs will aid in increasing their output. This has serious implication for the poverty alleviation of the households because if the productivity of the household farmers should increase through the improvement of their technical efficiencies, then the household will be able to boost output which could improve upon their revenue generation. A mean technical efficiency of 55% implies that, in the short-run, there is the possibility of increasing technical efficiency in food crop production in the study area by 45% if the women farmers would adopt the technology and production techniques currently used by the most efficient farmers.

Conclusion

It is evidenced from the study that investing in the food crop women farmers would represent a prudent venture in the nation's development. Improving the productivity of the women farmers through greater access of the women to agricultural inputs and services has the capability of increasing the agricultural yields of the women farmers. This consequently leads to the improvement of the poverty status of the household of the women farmers.

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