

Efficiency and Income among the Rural Farmers in Nigeria

Simon T. Penda* and Benjamin C. Asogwa

*Department of Agricultural Economics, University of Agriculture, P. M. B. 2373,
Makurdi, Benue State, Nigeria
E-mail: stpenda@yahoo.com

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ABSTRACT This study analysed the relationship between efficiency and income among the rural farmers in Nigeria. Farm level data from Benue State of Nigeria was used for the study. The stochastic frontier was used to obtain the efficiency estimates among the respondents, whereas the quintiles analysis and deciles analysis were used for the analysis of size distribution of household income among the respondents. Correlation analysis was used for the analysis of the relationship between efficiency and income among the respondents. The study showed that technical inefficiency is worse than allocative inefficiency, implying that the low level of overall economic efficiency is the result of higher technical inefficiency. The study also showed that the top most group (the richest households) in the area receives not less than 50 percent of the total income of the area because the group probably owns and controls larger proportion of the productive and financial resources in the area. Furthermore, improvement in both farm income and non-farm income resulted relatively more from decrease in the cost of technical efficiency, which in turn increased the overall economic efficiency relatively more and hence increase in per capita income. Decrease in the cost of technical efficiency among the respondents brings about relatively more improvement in the welfare of the entire household members of the respondents and hence poverty reduction.

INTRODUCTION

The link between poverty status and poverty reduction among the farming households is indirect through the relationship between productivity, income growth and poverty (Norman 1975; Ajibefun 2000 b; Ajibefun 2002; Ater 2003; Ajibefun and Daramola 2003; Amalu 2005). It is argued that in order to reduce poverty, it is fundamental that economic policies should aim at promoting rapid economic growth (Bigsten et al. 2003; Amalu 2005; Federal Republic of Nigeria 2005; Federal Republic of Nigeria 2007). Furthermore, many authors believe that an effective approach towards more comprehensive poverty reduction is to enhance economic growth (Ravallion 2001; Dollar and Karaay 2002). However, there is general agreement in the literature that growth is necessary but not sufficient for poverty reduction (Hoekman et al. 2001; Ravallion and Datt 2002). Others argued that growth in incomes of the poor is strongly correlated with overall growth of the economy especially growth in the agricultural sector, and this

fact has been demonstrated in cross-country and individual country studies (Hoekman et al. 2001).

Chirwa (2005), therefore, argued that macro-economic policies that promote growth in income are likely to lead into poverty reduction. For instance, with respect to agriculture, changes in price will provide incentives for agricultural production and specialization, which in turn may lead to growth and distribution of income through employment generation and revenue enhancement, and consequently poverty reduction (Chirwa 2005). Similarly, at the micro level, enterprises that promote income growth and distribution and enhance the revenue of the poor households are most likely to lead to poverty reduction among the poor households. For instance, improvement in farmers' productivity and output would lead to income growth (all things being equal) and consequently poverty reduction (Norman 1975; Ajibefun 2000 b; Ajibefun 2002; Ajibefun and Daramola 2003; Ater 2003).

According to Ajibefun (2002), for Nigeria, raising productivity per area of land is the key to effectively addressing the challenges of achieving food security, as most cultivable land has already been brought under cultivation, and in areas where wide expanse of cultivable land is still available, physical and technological constraints prevent large-scale conversion of potentially cultivable land. Ater (2003) observed that productivity improvement for the Nigerian small scale

Corresponding Author:
Benjamin C. Asogwa
Department of Agricultural Economics,
University of Agriculture, Makurdi, P. M. B. 2373,
Makurdi, Benue State, Nigeria.
Telephone: +234-08065550122
E-mail: bcasogwa@yahoo.com

farmers is the ultimate if development is to take place and be sustained. This is because it is generally accepted that the small scale farmer is poor, with low productivity in rural areas and depends mainly on agriculture. Ajibefun (2000 b) opined that if the farmer is to be alleviated from poverty, the productivity and efficiency should be improved to support increased income, better standard of living and a check on environmental degradation.

The resources committed to agriculture, according to Norman (1975), should generate high productivity and the productivity should be transformed into an improvement in the quality of life of targeted Nigerians. According to Ajibefun and Daramola (2003), to achieve prosperity and overcome stagnation, there is a need to increase growth in all sectors of the economy, for such growth is the most efficient means of alleviating poverty and generating long-term sustainable development. Resources must be used much more efficiently, with more attention paid to eliminating waste. This will lead to an increase in productivity and incomes. The success in achieving broad-based economic growth will depend largely on the ability to efficiently utilize the available resources.

Hoekman et al. (2001) argued that for growth to have some meaningful impact on poverty, that growth must occur in sectors in which a large proportion of the poor derive their livelihood. It is worth noting that the agricultural sector remains the important sector for livelihood especially in rural Nigeria, which accounts for more than 70 percent of the population. However, Bigsten and Shimeless (2003) assert that the direction of causality of growth-income distribution-poverty relationship is still unclear in theory as well as in empirical studies.

Ravallion and Datt (2002) in a study of growth and poverty in India found that initial inequality in income, literacy, farm productivity and asset distribution affect the relationship between growth and poverty. Using Probit model on the Family Income and Expenditure Survey data from 1985 to 2000 in Philippines, Sawada and Estudillo (2006) found that both non-transfer and transfer incomes decreased poverty significantly but transfer income exerted greater impact. According to Desli et al. (2002), two otherwise identical firms never produce the same output, and costs and profit are not the same. This difference in output, cost, and profit can be ex-

plained in terms of efficiency, and some unforeseen exogenous shocks.

Jiandong (2002) showed that income redistribution can significantly improve efficiency at aggregate level. Simhon and Fishman (2011) found that income distribution determines how competitive prices are and thereby affects production efficiency and aggregate output. According to Kurt (2011), economic growth (efficiency) would solve the inequality problem or at least the poverty problem. Daniel et al. (2010) observed that the cotton farmers in Adamawa State, Nigeria, were not efficient in resource utilization despite the profit they made from the farming. There is little empirical evidence of the relationship between efficiency and income among the rural farmers in Nigeria to guide the development of agricultural policies aimed at reversing the deteriorating poverty situation among the rural farmers. This study, therefore, seeks to establish empirically if there is any relationship between efficiency and income among the rural farmers in Nigeria, which can be exploited as a basis for poverty reduction strategy.

Objectives of the Study

The broad objective of the study is to analyse the correlation between efficiency and income among the rural farmers in Nigeria. The specific objectives of the study are to:

- i. analyse the distribution of efficiency estimates among the rural farmers in Nigeria;
- ii. analyse the size distribution of household income among the rural farmers in Nigeria and;
- iii. analyse the correlation between efficiency and income among the rural farmers in Nigeria.

Statement of Hypotheses

The following hypotheses were stated and tested:

- i. there is no significant correlation between efficiency and income among the rural farmers in Nigeria;
- ii. there is no significant correlation between the farm income and non-farm income among the rural farmers in Nigeria;
- iii. there is no significant correlation between the farm income and per capita income among the rural farmers in Nigeria;

- iv. there is no significant correlation between the non-farm income and per capita income among the rural farmers in Nigeria;
- v. there is no significant correlation between technical efficiency and allocative efficiency among the rural farmers in Nigeria;
- vi. there is no significant correlation between technical efficiency and economic efficiency among the rural farmers in Nigeria; and
- vii. there is no significant correlation between allocative efficiency and economic efficiency among the rural farmers in Nigeria.

METHODOLOGY

The Study Area

For this study, farm level data were collected on 224 farmers in Benue State. Benue State is one of the 36 states of Nigeria located in the north-central part of Nigeria. The State has 23 Local Government Areas, and its headquarters is Makurdi. It is located between Longitudes $6^{\circ} 35'E$ and $10^{\circ}E$ and between Latitudes $6^{\circ} 30'N$ and $8^{\circ} 10'N$. The State has abundant land estimated to be 5.09 million hectares. This represents 5.4 percent of the national land mass. Arable land in the State is estimated to be 3.8 million hectares (BENKAD 1998). This State is predominantly rural with an estimated 75 percent of the population engaged in rain-fed subsistence agriculture. The state is made up of 413,159 farm families (BNARDA 1998). These farm families are mainly rural. Farming is the major occupation of Benue State indigenes. Popularly known as the "Food Basket" of the nation, the State has a lot of land resources. For example cereal crops like rice, sorghum and millet are produced in abundance. Roots and tubers produced include yams, cassava, cocoyam and sweet potato. Oil seed crops include pigeon pea, soybeans and groundnuts, while tree crops include citrus, mango, oil palm, guava, cashew, cocoa and *Avengia spp.*

Sampling Technique

In this study, the multi-stage random sampling technique was used for sample selection. Benue State is divided into three (3) agricultural zones viz., Zone A, Zone B and Zone C. Zone A and Zone B are made up of seven Local Government Areas each while Zone C is made up of nine Local

Government Areas. Using a constant sampling fraction of 45 percent, three Local Government Areas were randomly selected from Zone A and Zone B while four Local Government Areas were randomly selected from zone C under the guide of Benue ADP workers in BNARDA. From each of the selected Local Government Areas, one rural community was randomly selected. Finally, from each community, households were randomly selected on the basis of the community's population size using a 1 percent constant sampling fraction in order to make the sampling design to be self-weighting thereby avoiding sampling bias (Eboh 2009). The self-weighting nature of this multi-stage process will simplify the computation of sample estimates, including means, totals, ratios and proportions (Eboh 2009). Based on the foregoing, 224 rural farm households were randomly selected for the study.

Data Collection

Data were collected mainly from primary sources. The primary data were obtained through the use of structured questionnaires that were administered to the selected 224 rural farm households in Benue State.

Analytical Technique

The stochastic frontier was used to obtain the efficiency estimates among the respondents, whereas the quintiles analysis and deciles analysis were used for the analysis of size distribution of household income among the respondents. Correlation analysis was used for the analysis of the correlation between efficiency and income among the respondents. The hypotheses were tested using the Pearson correlation coefficients.

Model Specification

Efficiency Predictions

The computer program (Frontier 4.1) calculates predictions of individual firm technical efficiencies from estimated stochastic production frontiers, and predictions of individual firm cost efficiencies from estimated stochastic cost frontiers. The measures of technical efficiency relative to the production frontier and of cost efficiency relative to the cost frontier are both defined as:

$$EFF_i = E(Y_i^*/U_i, X_i) / E(Y_i^*/U_i, = 0, X_i), \dots\dots\dots (1)$$

where Y_i^* is the production (or cost) of the i -th firm, which will be equal to Y_i when the dependent variable is in original units and will be equal to $\exp(Y_i)$ when the dependent variable is in logs. In the case of a production frontier, EFF_i will take a value between zero and one, while it will take a value between one and infinity in the cost function case.

Economic efficiency is the product of technical efficiency and allocative (cost) efficiency.

Linear Correlation

The Pearson's 'r' otherwise known as the Product Moment correlation coefficient, is about the most widely used measure of association for interval (and ratio) scale data. It measures linear association between interval variables.

The Product Moment correlation coefficient r , can take any value between -1 and +1. A statistically significant correlation coefficient in the range $0 < r \leq 0.3$ will be regarded as weak correlation; $0.3 < r \leq 0.6$ will be regarded as moderate correlation; $0.6 < r < 1$ will be regarded as strong correlation, while a correlation coefficient of 1 will be regarded as perfect correlation.

If two variables are positively correlated, their values tend to rise or fall together. A negative correlation between two variables implies that the two variables tend to show co-movement in opposite direction. Zero correlation implies a completely absence of joint linear movement (in either direction between variables).

RESULTS AND DISCUSSION

Efficiency Predictions

Table 1 shows that predicted technical efficiency varied widely among the respondents, with minimum and maximum values of 0.00000001 and 1.00 respectively and a mean technical efficiency of 0.11. Furthermore, predicted allocative efficiency varied widely among the respondents, with minimum and maximum values of 1.05 and 75.30 respectively and a mean allocative efficiency of 1.87. Similarly, predicted economic efficiency varied widely among the respondents, with minimum and maximum values of 0.00000001 and 1.19 respectively and a mean economic efficiency of 0.12.

Table 1: Average technical, allocative and economic efficiency of Nigerian rural farmers

Total farm-level	Mean efficiency estimate	Minimum efficiency estimate	Maximum efficiency estimate	Average efficiency (%)
Technical efficiency	0.11	0.00	1.00	11
Allocative efficiency	1.87	1.05	75.30	13
Economic efficiency	0.12	0.00	1.19	12

Source: Field Survey 2010

The average level of technical, allocative and economic efficiency is estimated at 11 percent, 13 percent and 12 percent respectively. The wide range of values indicates large variations in performance across farms. The implication of these results is that the respondents were not efficient in the use of resources for production. The farmers were operating far away from the efficiency frontier. This finding agrees with that of Daniel et al. (2010) that cotton farmers in Nigeria were not efficient in resource utilization. Reddy et al. (2004) observed that greater efficiencies in the use of resources are associated with the large farms than the small farms. They pointed out that the smallness of holdings deters the use of mechanization and does not allow the use of modern inputs due to lack of purchasing power in the hands of small farmers. This finding validates the assertion of Desli et al. (2002) that in reality, rural small scale producers are not always efficient.

The results further indicate that technical inefficiency is worse than allocative inefficiency, which implies that the low level of overall economic efficiency is the result of higher technical inefficiency. This suggests that solving the technical problems may be more critical for improving the farmers' overall economic efficiency than solving allocative problems.

Size Distribution of Household Income

The result of quintiles and deciles analyses of the income of the households is presented in Table 2. The first quintile represents the bottom 20 percent of the population on the income scale. This group receives only 4.35 percent of the total income of the households. The second quintile receives only 9.77 percent of the total income of the households. The bottom 40 percent of the population (quintiles 1 plus 2) is receiving only

14.12 percent of the total income of the households. The top 20 percent (the fifth quintile) of the population receives 59.10 percent of the total income of the households.

Table 2: Size distribution of household income by income shares-quintiles and deciles among the respondents

	Quintiles	Deciles
1	4.35	1.72
2	9.77	2.83
3	11.96	4.69
4	14.82	4.69
5	59.10	5.70
6		6.20
7		6.94
8		7.72
9		9.88
10		49.63
Total	100.00	100.00

Source: Field Survey 2010

The Kuznets ratio (the ratio of the incomes received by the top 20 percent and bottom 40 percent of the population) is 4.19, suggesting that there is a high degree of inequality between high-income and low-income groups among the respondents in the study area. This finding agrees with the work of Osinubu (2003) that there was a considerable inequality of wealth among the households in Nigeria, that is, a little above average population controlled a large proportion of the wealth of all household.

To provide a more detailed breakdown of the size distribution of income, the result of the deciles (10%) shares analysis indicates that the bottom 10 percent of the population (the poorest households) receives only 1.72 percent of the total income, while the top 10 percent of the population (the richest households) receives about 50 percent of the total income, suggesting that just one-tenth of the households in the area controlled about half of the wealth of the area. This validates the finding of Osinubu (2003) that just less than half of the households controlled over two-third of the wealth of the region.

The implication of the foregoing results is that the top most group (the richest households) in the area receives not less than 50 percent of the total income of the area because the group probably owns and controls larger proportion of the productive and financial resources in the area. Todaro and Smith (2009) noted that the ultimate cause of the unequal distribution of personal in-

comes in most developing countries is the unequal and highly concentrated patterns of asset ownership (wealth) in these countries. The principal reasons why 20 percent of their population often receives over 50 percent of the national income is that this 20 percent probably owns and controls well over 90 percent of the productive and financial resources, especially physical capital and land and also financial capital (stocks and bonds) and human capital in the form of better education and health.

This study validates the assertion of Todaro and Smith (2009) that extreme income inequality leads to economic inefficiency. This is partly because at any given average income, the higher the inequality, the smaller the fraction of the population that qualifies for a loan or other credit. Indeed, one definition of relative poverty is the lack of collateral. When low-income individuals (whether they are absolutely poor or not) cannot borrow money, they generally cannot adequately educate their children or start and expand a business. Moreover, with high inequality, the overall rate of saving in the economy tends to be lower, because the highest rate of marginal savings is usually found among the middle classes.

Correlation Analysis of Efficiency and Income

The result in Table 3 shows that the null hypothesis that there is no significant correlation between efficiency and income among the rural farmers is rejected at 5 percent level of probability. The results show that there is a significant positive correlation between efficiency and income among the respondents, suggesting that efficiency and income tend to rise or fall together among the respondents. The results further indicate that efficiency is more strongly correlated with non-farm income than farm income among the respondents. These results are consistent with the findings of other studies (Dorward et al. 2004; Tchale 2009), which indicate that complementary income from other sources on and off the farm are likely to result in high on-farm productivity, as farmers use income from other sources to invest in farm operations.

Furthermore, the result shows that increase in both farm income and non-farm income resulted relatively more from increase in allocative efficiency than technical efficiency. The result further shows that increase in per capita income

Table 3: Correlation analysis of efficiency and income among rural farmers in Benue state

	Technical efficiency	Allocative efficiency	Economic efficiency	Farm income	Non-farm income	Per capita income
Technical efficiency	1.00					
Allocative efficiency	0.384**	1.00				
Economic efficiency	0.893**	0.720**	1.00			
Farm income	0.103*	0.203**	0.180**	1.00		
Non-farm income	0.137*	0.250**	0.229**	0.867**	1.00	
Per capita income	0.123*	0.162*	0.173**	0.870**	0.864**	1.00

Source: Field Survey 2010.

* Correlation coefficient (r) is significant at 5 percent level (2-tailed).

**Correlation coefficient (r) is significant at 1 percent level (2-tailed).

resulted relatively more from increase in overall economic efficiency. The implication is that improvement in both farm income and non-farm income resulted relatively more from decrease in the cost of technical efficiency, which in turn increases the overall economic efficiency relatively more and hence increase in per capita income. This suggests that decrease in the cost of technical efficiency among the respondents brings about relatively more improvement in the welfare of the entire household members of the respondents and hence poverty reduction.

CONCLUSION

The study showed that technical inefficiency is worse than allocative inefficiency, implying that the low level of overall economic efficiency is the result of higher technical inefficiency. The study also showed that the top most group (the richest households) in the area receives not less than 50 percent of the total income of the area because the group probably owns and controls larger proportion of the productive and financial resources in the area. Furthermore, improvement in both farm income and non-farm income resulted relatively more from decrease in the cost of technical efficiency, which in turn increased the overall economic efficiency relatively more and hence increase in per capita income. Decrease in the cost of technical efficiency among the respondents brings about relatively more improvement in the welfare of the entire household members of the respondents and hence poverty reduction.

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