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Analysis of Poverty Status Determinants among Smallholder Farmers in Nigeria

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Abstract: This study analysed the factors responsible for poverty among the smallholder farmers in Nigeria using farm level data from Benue State. The Two-Stage Least Squares estimation method was employed for data analysis. A unit increase in technical efficiency estimates is seen to generate the highest degree of fall in poverty among the respondents. On the other hand, a unit increase in economic inefficiency is seen to generate the highest degree of rise in poverty among the respondents. This suggests that household technical efficiency (which measures the ability of a farmer to produce maximum output from a given bundle of inputs) and household total economic efficiency (which measures the ability of a farmer to maximize profit) are highly responsible for changes in poverty among the smallholder farmers in Nigeria. Improvement in the farm efficiencies would go a long way in increasing the productivity and income generation of smallholder farmers thereby improving the performance of the agricultural sector in Nigeria. This would enhance the employment opportunities of the households in agricultural production thereby increasing their per capita income and cushioning the negative effect of large household size and large number of unproductive dependents on income and consequently reducing poverty in Nigeria.

Key words: Determinants, estimation, farmers, poverty, smallholder, status

INTRODUCTION

Nigerian agriculture is dominated by the small scale farmers who produce the bulk of food in the country. Despite their unique and pivotal position, the small holder farmers belong to the poorest segment of the population and therefore, cannot invest much on their farms (Ajibefun, 2002; Federal Republic of Nigeria, 2007). The vicious circle of poverty among these farmers has led to the unimpressive performance of the agricultural sector.

According to Ajibefun (2002), there is crucial need to raise agricultural growth as such growth is the most efficient means of alleviating poverty. 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.

Poor households are more in agricultural occupation (62%) than in non-agricultural occupation (54%). The gap in poverty level of farm households and non-farm households was at 9%. About 56% of farmers living in the urban areas were poor, while about 63% of those in the rural areas were poor (Federal Republic of Nigeria, 2005). Twenty-five percent (25%) of the core poor households were in agriculture while 20% of the core poor households were in non-agricultural activities. Furthermore, 37% of non-poor were in agriculture and 63% of moderately poor were in agriculture.

For many households in Nigeria, especially in the rural areas, agriculture is the main activity, and previous and current analysis of poverty has shown that poverty is disproportionately concentrated among households whose primary livelihood lie in agricultural activities (Federal Republic of Nigeria, 2007). Agriculture has been focused as a central element of poverty reduction strategy in

Nigeria (Federal Republic of Nigeria, 2005; Federal Republic of Nigeria, 2007). It is, therefore, important to understand the factors responsible for poverty among the farming households especially the smallholder farmers in Nigeria.

The broad objective of this study is to analyse poverty status determinants among the smallholder farmers in Nigeria. The specific objectives are to:

- Quantify the poverty status among the smallholder farmers in Nigeria; and
- Identify the determinants of poverty status among the smallholder farmers in Nigeria. The following hypothesis was stated and tested:
  - The selected explanatory variables have no significant effect on the poverty status of the smallholder farmers in Nigeria.

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METHODOLOGY

The study area: For this study, farm level data were collected on 393 smallholder farmers in Benue State, Nigeria. 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. Located between Longitudes 6º35′E and 10ºE and between Latitudes 6º30′N and 8º10′N. The State has abundant land estimated to be 5.09 million ha. This represents 5.4% 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% 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%, 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 State Agricultural Development Programme workers. 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 constant sampling fraction of 1% in order to make the sampling design to be self-weighting thereby avoiding sampling bias (Eboh, 2009). Based on the foregoing, 393 smallholder 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 questionnaire, copies of which were administered to the selected 393 smallholder farmers in Benue State.

Analytical technique: The P-alpha measure of poverty and the Food Energy Intake (FEI) method were used for the measurement of poverty among the respondents while the Two-Stage Least Squares (2SLS) regression model was adopted for the analysis of the poverty determinants among the respondents. Wald tests of linear parameter restrictions were carried out to test for joint significance of parameters and linear restrictions of parameters.

Model specification:

Estimation procedure of the poverty line: In this study, consumption expenditure rather than income data was used. This is informed in part by the conceptual problems that arise in using income as an indicator of household welfare, and partly by measurement error (especially under-reporting of income) prevalent in countries like Nigeria (Aigbokhan, 2000). Indeed, there is usually substantial underestimation of income as compared with expenditure, which results in undue overestimation of poverty. Aigbokhan (2000) observes that using two thirds mean income and two thirds mean expenditure in the 1996/97 data resulted in head-count poverty levels of 59.9 and 51.7%, respectively.

Food Energy Intake (FEI) method: The method, which has been widely used since Greer and Thorbecke (1986), has its formula as:

$$LogE = a + bC + \in \quad (1)$$

where E is food expenditure and C is calorie consumption and ϵ is the error term.

The poverty line, Z, is then derived as:

$$Z = e^{(a+Rb)} \quad (2)$$

where e is natural constant (2.71829), R is the recommended daily allowance of calorie intake (2,900 calorie - FAO Recommendation).

The use of consumption expenditure also has its problems. Notable among these are the issues of consumption from own production, which is more prevalent in rural areas, and the issue of household size and within household distribution of consumption (Aigbokhan, 2000). The former was reasonably taken care of in the survey data in arriving at the value of total expenditure. For the latter, adjustment are usually made using adult equivalence scales, in which case each adult has a value of 1.0 while each non adult has a value of say, 0.5 (Aigbokhan, 2000). However, given the complexities of deriving such scales from the data that was used, adjustments was made only for household size to derive per capital values.

The FEI method was adopted in estimating the poverty line for this study. This was done in two stages. The first stage was to run a regression of the cost of a basket of commodities consumed by each household in

the sample over the calorie equivalent as represented in Eq. (1).

To derive the values for the variables in this equation, the following steps were taken. First, the total value of food expenditure (E) was obtained by summing the value of consumption from own product. This was converted to it's per capital value by dividing it by the household size (where the adult equivalent cannot be calculated due to absence of information on household composition). The calorie equivalent C was obtained by summing the calorie equivalent of the food items listed for each household.

The next stage was to calculate the cost of the basket by estimating Eq. (2). This gives the food poverty line or the cost of acquiring the Recommended Daily Allowance (RDA) of calories, which for the study is, 2,900, the minimum energy intake requirement recommended by FAO (Federal Republic of Nigeria, 2005; NBS, 2005).

The next stage after the estimation of poverty line is to express overall poverty in a single index. The simplest and most common measure is the head-count ratio (H), which is the ratio of the number of poor to total population. The head-count ratio (H) measure is defined as:

$$H = q / n \tag{3}$$

where q is the number of poor and n is the total sample population. This gives the proportion of the population with income below the poverty line (Aigbokhan, 2000; Federal Republic of Nigeria, 2005; NBS, 2005).

The head count ratio has been criticized for focusing only on the number of the poor, and being insensitive to the severity of poverty and to change below the poverty line. That is, it treats all the poor equally, whereas not all the poor are equally poor. Also, neither a transfer from the less poor to the poorer, nor a poor person becoming poorer would register in the index, since the number of the poor would not have changed. However, Foster *et al*. (1984) proposed a family of poverty indices based on a single formula capable of incorporating any degree of concern about poverty through the poverty aversion parameter α. This is the so called P-alpha measure of poverty or the poverty gap index. The index is defined as:

$$P_a = 1/N \sum_{i=1}^{q} (Z - Y_i / z)^a \tag{4}$$

where z is the poverty line, q is the number of households/persons below the poverty line, N is the total sample population, y_i is the income of the ith household, and a is the Foster *et al*., (1984) parameter, which takes the value 0, 1 and 2, depending on the degree of concern about poverty. The quantity in parentheses is the proportionate shortfall of expenditure/income below the poverty line. By increasing the value α, the aversion to poverty as measured by the index is increased. For example, where there is no aversion to poverty a = 0, the index is simply:

$$P_O = 1/Nq = q/N = H \tag{5}$$

which is equal to the head count ratio. This index measures the incidence of poverty. If the degree of aversion to poverty is increased, so that α = 1, the index becomes:

$$P_1 = 1/N \sum_{i=1} (z - y_i / z)^1 = HI \tag{6}$$

Here the head-count ratio is multiplied by the income gap between the average poor person and the line. This index measures the depth of poverty; it is also referred to as "income gap" or "poverty gap" measure.

Although superior to P_0, P_1 still implies uniform concern about the depth of poverty, in that it weights the various income gaps of the poor equally. P_2 or income gap squared index allows for concern about the poorest of the poor by attaching greater weight to the poverty of the poorest than that of those just below the line. This is done by squaring the income gap to capture the severity of poverty:

$$P_2 = 1/N \sum_{i=1} (z - y_i / z)^2 \tag{7}$$

This index satisfies the Sen-Transfer axiom, which requires that when income is transferred from a poor to a poorer person, measured poverty decreases. However, given the peculiarity of the respondents, poverty gap measure was used for this study.

Household poverty status determinants: The link between poverty status and poverty reduction among the smallholder farmers is indirect through the relationship between productivity, income and poverty (Norman, 1975; Ajibefun, 2000; Ajibefun, 2002; Ater, 2003; Ajibefun and Daramola, 2003; Amalu, 2005). 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 increase in income (all things being equal) and consequently poverty reduction (Norman, 1975; Ajibefun, 2000; Ajibefun, 2002; Ater, 2003; Ajibefun and Daramola, 2003).

Any attempt to view poverty determinants among the smallholder farmers requires that the interaction among the crucial variables peculiar to the smallholder farmers

be highlighted. The appropriate model therefore, must contain equations explaining the variables and showing their interrelationships. That is, household farm level efficiencies, household income and household poverty status do inter-dependently determine the fortunes of the poor smallholder farmers (Norman, 1975; Olayide *et al*., 1980; Pitt and Lee, 1981; Brock, 1994; Battese and Coelli, 1995; Csaki and Lerman, 1997a; Kurkalova and Jensen, 1998; Ajibefun, 2000 ; Ravallion and datt, 2002; Ater, 2003; Ajibefun and Daramola, 2003; Umeh and Asogwa, 2005; Njimanted, 2006; Asogwa *et al*., 2007). Therefore a simultaneous equation approach is ideal in the econometric investigation of poverty determinants among the smallholder farmers in Nigeria.

In comparing the poverty status of the smallholder farmers in Nigeria with different farm level efficiencies, allowance must be made for differences in their socio-economic characteristics like family size, farm size, age, farming experience, household expenditure, household food security just to mention a few. This is because such variables have effect on household poverty (James and Felix, 2001; Ravallion and Datt, 2002; Bigsten *et al*., 2003; Chirwa, 2004). Therefore, a number of household characteristic variables were included in the poverty equation.

The structural models therefore, contain household poverty gap equation and household farm level efficiency equation. The models consist of 17 variables, 2 of which are endogenous while 15 are predetermined. The system is complete in that it contains two equations in two endogenous variables. Since changes in the variables in the structural equations are very much influencing each other, adopting the simultaneous equation approach will help reduce the of multicollinearity and eliminate the effect of simultaneous equation bias (Olayemi and Olayide, 1981; Kmenta, 1990; Koutsoyiannis, 2003; Bierens, 2006; Njimante, 2006). Given the above conditions, the equations of the model were specified as follows:

$$y_{1,t} = \alpha_1 + \beta_2 Y_{2,t} + \gamma_1 X_{1,t} + \gamma_2 X_{2,t} + u_{1,t} \qquad (8)$$

$$Y_{2,t} = \alpha_2 + \gamma_1 X_{1,t} + \gamma_2 X_{2,t} + \gamma_3 X_{3,t} + U_{2,t} \qquad (9)$$

t =1,2,3.....n

where,

$y_{1,t}$ = Household poverty gap
$Y_{2,t}$ = Vector of household farm level efficiency estimates
$X_{1,t}$ = Vector of household income
$X_{2,t}$ = Vector of household characteristics variables
$X_{3,t}$ = Vector of household farm level efficiency variables

Table 1: Poverty status among the households farmers in Nigeria

Poverty index	Figure
Total poverty gap	400371.3
Average poverty gap	1018.76
Average expenditure shortfall	1654.43
Normalised expenditure shortfall	0.4415
Poverty incidence (P_o)	0.6158
Poverty depth (P_1)	0.2719
Poverty severity (P_2)	0.1546
Welfare gap (P_1/P_o)	0.4415
Coefficient of variation (cv_p)	0.424

Field survey (2010)

βs, γs and αs = The parameters to be estimated
$u_{1,t}$ and $U_{2,t}$ = Error terms

The equations of the model satisfied both the order condition and the rank condition for simultaneous equation system model identification. The application of the order condition and the rank condition of model identification shows that each equation of the model is over-identified. That is for each of the equations of the model K–M > G-1, and it is possible to construct at least one non-zero determinant of order (G-1) from the coefficients of the variables excluded from one equation but contained in the other equation of the model (Olayemi and Olayide, 1981; Kmenta, 1990; Koutsoyiannis, 2003; Njimanted, 2006). Since both equations 8 and 9 are over-identified, consistent estimates of the structural parameters of equation 8 (which is the equation one is interested in) could be obtained based on Two-Stage Least Squares estimation method, which is the best performing single-equation method for the estimation of the structural parameters of over-identified (simultaneous equation) models (Kmenta, 1990; Koutsoyiannis, 2003; Bierens, 2006).

RESULTS AND DISCUSSION

Consumption poverty as measured by the head-count index is 0.6158 (Table 1). This implies that 61.58% of the population was living in absolute poverty.

The depth of poverty, severity of poverty and welfare gap is 0.2719, 0.1546 and 0.4415, respectively. The implication of this result is that out of the 61.58% of the population living in poverty, 27.19% of the respondents are living in extreme poverty, 15.46% are living in chronic poverty whereas 18.93% are moderately poor. This results to a welfare gap of 44.15%.

The results further indicate that the coefficient of variation of household food expenditure among the poor is 0.4240. This indicates that household food expenditure vary widely among the poor, suggesting that there is poverty inequality among the respondents.

Poverty status determinants: The result in Table 2 shows that at 5% level of significance, the hypothesis that the specified (selected) explanatory variables have no significant influence on poverty is rejected by the result of the Wald test of joint significance and linear restrictions

Table 2: Two-stage least squares estimation results of thepoverty status determinants among the respondents

Variable	Estimate	t-ratio
Constant	1.399617	3.003
Technical efficiency estimates	- 1.206639	- 1.768*
Allocative efficiency estimates	0.573373	2.059**
Economic efficiency estimates	0.719400	1.797*
Farm income	0.0000003	2.706**
Non-farm income	0.000001	4.257**
Per capita income	- 0.000002	- 5.339**
Farm size	- 0.020145	- 2.775**
Household size	0.024343	3.809**
Age	- 0.002869	- 2.818**
Farming experience	0.002615	2.876**
Dependency ratio	- 0.023841	- 2.524**
Household members working	- 0.008090	- 0.740
Household membership of farmer association	- 0.040139	- 2.776**
Household food expenditure	- 0.000037	- 27.041**
Non-food expenditure	0.0000001	2.650**
Per capita expenditure	- 0.000002	- 3.919**
R^2	0.774891	
Adjusted R^2	0.765312	
Wald statistics	962.30***	

Field survey (2010); **: t-ratio is significant at 1% level of significance; *: t-ratio is significant at 5% level of significance, ***: Wald statistic is significant at 5% level of significance

of the parameters, suggesting that there is a significant impact between poverty status and the selected explanatory variables. The model fits the data fairly reasonably. For example, the coefficient of determination (R^2) is 0.7749, suggesting that the model has a high goodness of fit. This indicates that 77.49% variation in poverty status is accounted for by variations in the selected explanatory variables, suggesting that the model has high explanatory power on the changes in poverty status among the respondents. The adjusted R^2 also supported the claim with a value of 0.7653 or 76.53%. This implies that the selected explanatory variables explain the behavior of poverty status among the respondents at 77% level of confidence. The calculated Wald statistic value of 962.30 which is greater than the critical value of 22.36 at 5% level of significance implies that there is a significant impact between poverty status and the selected explanatory variables.

Furthermore, the result of the study showed that at 5% level of significance, technical efficiency estimates, per capita income, farm size, age, household membership of farmer association, dependency ratio, household food expenditure and per capita expenditure have negative and significant influence on the poverty status of the households while allocative efficiency estimates, economic efficiency estimates, farm income, non- farm income, household size, farming experience and non-food expenditure have positive and significant influence on the poverty status of the households. This suggests that increase in the technical efficiency estimates, per capita income, farm size, age, household membership of farmer association, dependency ratio, household food expenditure and per capita expenditure of the households will result to fall in poverty among the households while increase in allocative efficiency estimates, economic efficiency estimates, farm income, non-farm income, household size, farming experience and non-food expenditure will result to increase in poverty among the respondents.

The implication is that 10% increase in the technical efficiency estimates (that is increase from zero towards one, which is the production frontier), will result to 12.07% fall in poverty (and this means that the rate of total output to total inputs for a farm is rising). This implies that as poverty decreases average productivity increases, suggesting that output is being maximized from a given quantum of inputs. In addition, 10% increase in per capita income, farm size, age, household membership of farmer association, dependency ratio, household food expenditure and per capita expenditure of the households will result to 0.00002, 0.20145, 0.02869, 0.08090, 0.40139, 0.23841, 0.00037 and 0.00002% fall in poverty respectively among the smallholder farmers in Benue State within the study period.

Furthermore, 10% increase in the allocative efficiency estimates (that is increase from one, which is the cost frontier towards infinity), will result to 5.7337% increase in poverty (and this means that the ratio between total cost of producing one unit of output using actual factor proportions in a technically efficient manner and total cost of producing one unit of output using optimal factor proportions in technically efficient manner is rising). This implies that as the cost of technical efficiency increases poverty increases, suggesting that production cost is not being minimized. Similarly, 10% increase in the economic efficiency estimates (that is increase from one, which is the economic frontier to infinity), will result to 7.194% increase in poverty (and this means that the costs per unit of output for a farm is rising). This implies that as the cost of maximizing output increases poverty

increases, suggesting that profit is not being maximized. Furthermore, 10% increase in farm income, non-farm income, household size, farming experience and non-food expenditure will result to 0.000003, 0.00001, 0.24343, 0.02615 and 0.000004% increase in poverty respectively.

All the variables satisfied their respective *a priori* expectations except farm income, non-farm income and farming experience. The deviation of farm income and non-farm income from the a priori expectations is attributable to inequitable distribution of farm income and non-farm income among the respondents. Sawada and Estudillo (2006) observed that inequality tends to increase poverty.

Inequality in farm income among the respondents can be attributed to inequality of access to farm inputs. According to Hobswan, (1973) and Aigbokhan, (1988), the peasant farmers constitute a politically weak segment of the population, and as a result governments tend to identify the more politically strong components of this group and direct policies to and through them for patronage. Consequently, with a relatively small population of farmers (the progressives) being in planning and plan implementation, the differential effects of benefits from planning would therefore affect the structure of inequality by increasing it. Inequality in non-farm income among the respondents is due to the fact that farmers differ greatly in their relative access to income generation from non-farm sources. Mikloda (2006) observed that non-farm income is inequality increasing.

According to Reddy *et al*. (2004) greater efficiencies in the use of resources are associated with the large farms than the small farms. 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 explains why the poverty status of the farmers increased as their years of farming increased.

A unit increase in technical efficiency estimates is seen to generate the highest degree of fall in poverty among the respondents. On the other hand, a unit increase in economic inefficiency is seen to generate the highest degree of rise in poverty among the respondents. This suggests that household technical efficiency (which measures the ability of a farmer to produce maximum output from a given bundle of inputs) and household total economic efficiency (which measures the ability of a farmer to maximize profit) are highly responsible for changes in poverty among the respondents.

The policy implication of the foregoing finding is that any policy that is directed towards improving the farm productivity and farm specialization of the smallholder farmers would go a long way in increasing their productivity and income generation. This would enhance employment opportunities of the smallholder farmers in agricultural production. Consequent upon this is increase in per capita income and cushioning of the negative effect of large household size and large number of unproductive dependants (as is characteristic of typically agrarian society like Nigeria) on income and consequently poverty reduction.

CONCLUSION

In conclusion, improvement on the farm efficiencies and specialization would go a long way in increasing the productivity and income generation of smallholder farmers thereby improving the performance of the agricultural sector in Nigeria. This would enhance the employment opportunities of the households in agricultural production thereby increasing their per capita income and cushioning the negative effect of large household size and large number of unproductive dependents (as is characteristic of typically agrarian society like Nigeria) on income and consequently reducing poverty among the smallholder farmers in Nigeria.

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