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# Land Degradation, Soil Conservation Practices and Poverty Incidence in Southwestern Nigeria

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**Abstract:** Access to land and its fertility status are of paramount importance to enhancing the welfare of rural people in Nigeria. In the Southwestern part, land degradation and persistent growth in human population are major constraints to access to fertile land for agricultural production. This study analyzed the effect of owing fertile land and use of some soil conservation practices on poverty. Data were collected from 303 farmers from 3 states using multi-stage sampling procedure. Results show that about 35.64% of the farmers were poor and the poverty line using the Foster-Greer-Thorbeck (FGT) approach was ₦1, 445.30. The Probit regression reveals that residence in Oyo State and being married significantly reduced poverty, while household size increased it ($p<0.05$). Increasing the number of fertile land areas under fallow significantly reduces probability of being poor ($p<0.01$). Farmers that were using crop rotation, cover crops and organic manure have significantly lower probability of being poor, while those using zero tillage have significantly higher probability of being poor ($p<0.05$). It was recommended that adoption of improved soil conservation practices will assist farmers to increase farm outputs and reduce their poverty levels, while fertilizers should be made available at affordable prices.

**Key words:** Land degradation, soil conservation, poverty, probit regression

## INTRODUCTION

The use of land for agricultural production is one of the strongest influences affecting environmental quality in many developing countries. Specifically, practices like unguided application of agrochemicals, bush burning and uncontrolled farm mechanization affect the quality of soil and vegetative covers, thereby resulting into land degradation (Scherr, 1999). Policy makers are now confronted with the challenges of finding a way of stimulating economic growth and reduce poverty, while the issue of natural resource degradation requires an urgent attention. The general consensus is that although, these goals cannot be abandoned, the welfare of future generations is seriously threatened because resources are not managed in sustainable ways (Vosti, 1992, 2001).

The gravity of the problem can be well conceptualized if one realizes that agriculture is the principal engine for economic growth and development and it is the main source of livelihood for the rural poor in many developing countries (Malik, 1998). Therefore, given the projections of population growth, agricultural land expansion, agricultural intensification and poverty in the next few decades, there exists a serious conflict between the goals of environmental protection and poverty reduction (Pinstrup *et al*., 1997; Scherr, 1997).

The problems of poverty and environmental degradation in many developing countries are closely related (WCED, 1987). Because of increased population pressure, the long time needed for regenerating natural resources once degraded and persistent economic hardship in many African nations, natural resource degradation is a common phenomenon among the poor, as they try to escape the scourge of poverty. No doubt, poor farmers face the consequences of land degradation and are implicated in some of its processes. Specifically, rich farmers own more land than the poor and are able to clear large expanse of forests, use large quantities of agrochemicals and open up/expose soils to erosion through agricultural mechanization. In like manner, poor farmers play some important role in unsustainable agricultural intensification, expansion of farming into marginal lands and overexploitation of forest resources. However, because they lack sufficient asset base to cushion its effects, the poor are more seriously affected by the consequences of environmental degradation (Scherr, 1999).

In Nigeria, increasing poverty level despite several past policy interventions, is a matter of serious concern. For instance, analysis of 2003/2004 data revealed that national poverty incidence is 57.8%, with rural area having 64.1%, while urban has 35.4% (NBS, 2005). This situation poses a daunting challenge to the achievement of the Millennium Development Goals (MDGs). Therefore, given the several forms of environmental degradation, the general consensus is that for any meaningful economic growth and development to be experienced, Nigeria needs to 1st and foremost address widespread poverty, especially among its rural populace.

Moreover, Nigerian small-scale farmers largely depend on traditional methods of farming. These farmers are facing various land use constraints, which is 1 of the major sources of decline in agricultural productivity. Suppose rural households choose to stay on degraded land, without appropriate soil conservation practices, its declining productivity will not be able to support growing rural populations, not to consider the nation as a whole. Therefore, shortage of good quality agricultural land for smallholders is a major problem (FAO, 1998). Consequently, some households are forced to abandon existing agricultural areas in search of new forest land. Where land is scarce, land fragmentation and continuous cropping persist with little or no soil conservation investments (FAO, 1991).

It should be stressed that poverty influences households' decisions for any investment in soil conservation practices (Barbier, 2001). Therefore, decline in the welfare of people could degenerate into serious ecological crises, with serious implications on the environment (WCED, 1987). Sustainable development would therefore, be compromised under a situation where poverty makes short-term survival to take precedence over long-term productivity. This study intends to find the effect of land degradation and use of soil conservation on the poverty level of rural households in southwest Nigeria. The key questions to be answered are: How does ownership of fertile/degraded land affect the poverty level of farmers. What influence does use of soil conservation have on poverty level across different socio-economic groups?.

## MATERIALS AND METHODS

**Study area and sampling procedures:** The study was carried out in Southwestern part of Nigeria. Specifically, the states selected were Oyo, Osun and Ekiti. These states enjoy tropical climate with 2 distinct seasons; rainy season from April to October and dry season from November to March. The traditional practice of slash and burn agriculture predominates and this is expected to be followed by a period of fallow for the soil to regain the lost fertility. However, with growing population and scarcity of land, the practice of fallowing is gradually being phased out and this aggravates land degradation.

Multi-stage sampling method was used to select the households. At the 1st stage, 3 states were randomly selected from the States in Southwest Nigeria. The 2nd stage involved selection of 2 Local Government Areas (LGAs) from each state and from these we selected 2 villages each. In Oyo state, data were collected from Akinyele and Lagelu LGAs. A total 100 households were sampled from 4 villages. In Ekiti State, a total 100 farming households were sampled from 4 villages from Ikole and Ado Ekiti. Finally, in Osun State, a total of 103 farming households were sampled from 4 villages from 2 randomly selected local government areas. The selected LGAs were Obokun and Ife Central. Data were obtained for the 2003 cropping season.

### Analytical approaches

**Descriptive and distribution of land:** The study use descriptive analytical methods like percentage, mean etc. for the description of the data. The Gini-coefficient was used to analyze the distribution of the different categories of land owned by farmers. To calculate Gini coefficient, Morduch and Sicular (2002) noted that where items are ordered so that $Y_1 \le Y_2 \le Y_3 \le ...... \le Y_n$, the Gini-coefficient can be computed as:

$$I_{Gini}(Y) = \sum_{i=1}^{n} a_i(Y)Y_i \text{ and } a_i(Y)\frac{2}{n^2\mu}\left(i - \frac{n+1}{2}\right) \quad (1)$$

where,

n = The number of items.

i = The rank (1...n).

μ = The mean of the items. The closer this value is to 1, the higher the inequality.

**Probit regression:** In order to analyze, the land ownership/use, socio-economic and soil conservation factors that explain poverty among the farmers, a Probit regression was carried out. Following Foster *et al*. (1984), poverty line was computed as the 2/3rd of the mean per capita monthly expenditure of all the members of the sampled households. The FGT index allows for the quantitative measurement of poverty status among subgroups of a population (i.e., incorporating any degree of concern about poverty) and has been widely used (Kakwani, 1990).

The headcount ratio measures the ratio of the number of poor individuals or simply measures the poverty incidence (i.e., the percent of the poor in the total sample). The analysis of poverty incidence using FGT measure usually starts with ranking of expenditures in ascending order $Y_i \le Y_2 \le ... \le Y_n$:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^\alpha \quad (2)$$

where,

- $\alpha$ = Non-negative poverty aversion parameter, which can be 0 for poverty incidence, one for poverty gap or two for poverty severity.
- $Y_i$ = The per capita expenditure of ith poor household.
- $n_i$ = The total number of sample households.
- q = The number of households below the poverty line.
- Z = Poverty line.

The Probit model that was estimated using the LIMDEP 7.0 statistical package can be stated as:

$$\begin{aligned} P_i = {} & \beta_1 + \beta_2 STA_i + \beta_3 SEX_i + \beta_4 MSTA_i \\ & + \beta_5 SIZE_i + \beta_6 EDU_i + \beta_7 LIV_i + \beta_8 VEG_i \\ & + \beta_9 FFCL_i + \beta_{10} FFAL_i + \beta_{11} DEGC_i + \beta_{12} DEGF_i \\ & + \beta_{13} HAR_i + \beta_{14} MULC_i + \beta_{15} CLEA_i + \beta_{16} CROT_i \\ & + \beta_{17} ORGM_i + \beta_{18} ZERO_i + \beta_{19} FERT_i + \beta_{20} COVC_i \\ & + \beta_{21} SICK_i + e_i \end{aligned} \quad (3)$$

where,

- $P_i$ = Poverty status dummy (poor = 1, 0 otherwise).
- $STA_i$ = State dummy variable (Oyo=1, 0 otherwise).
- $SEX_i$ = Sex (male = 1, 0 otherwise).
- $MSTA_i$ = Marital status dummy (married = 1, 0 otherwise).
- $SIZE_i$ = Size of the household.
- $EDU_i$ = Education dummy (formal education = 1, 0 otherwise).
- $LIV_i$ = Land area under livestock farming (ha).
- $VEG_i$ = Land area under vegetable production (ha).
- $FFCL_i$ = Fertile food cropland areas (ha).
- $FFAL_i$ = Fertile fallow cropland areas (ha).
- $DEGC_i$ = Degraded cash cropland areas (ha).
- $DEGF_i$ = Degraded food cropland areas (ha).
- $HAR_i$ = Harrowing (yes = 1, 0 otherwise).
- $MULC_i$ = Mulching (yes = 1, otherwise = 0).
- $CLEA_i$ = Clean clearing (yes = 1, otherwise= 0).
- $CROT_i$ = Crop rotation (yes = 1, otherwise = 0).
- $ORGM_i$ = Organic manure (yes = 1, otherwise = 0).
- $ZERO_i$ = Zero tillage (yes = 1, 0 otherwise).
- $FERT_i$ = Fertilizer application (yes = 1, otherwise= 0).
- $COVC_i$ = Cover crop (yes = 1, otherwise= 0).
- $SICK_i$ = Number of times sick during cropping season.
- $e_i$ = Error term.

We tested the hypothesis that number of fertile land under fallow does not significantly reduce poverty.

It should be noted that also, many independent variables were initially proposed, but some collinear ones were later removed. We determined the level of variable collinearity using the SPSS 10.0 statistical package. With these, the tolerance levels of the variables were determined using the variance inflating factors (Gujarati, 1995). Variables with low tolerance were therefore removed.

## RESULTS AND DISCUSSION

Descriptive analysis of some socio-economic characteristics of the household heads reveals that 91.75% are males, while only 32.01% are married Those with formal education constitute 55.12%, while 41.91% are engaged in mixed farming (keeping livestock along with crop cultivation). From Table 1, average age is 52.83 years and average household size is 6.87. The farmers had average years of farming of 28.76 years. As reflected by the standard deviation and coefficient of variation, wide variations exist among these data.

The farmers were asked for some of the indicators for judging that a plot of land has been degraded. The results in Table 2 show that for lands planted to cash crops, the highest proportion (52.80%) assessed fertility level using the previous crop yields. However, 34.65% consider the colour of the soil, while only 15.51% would judge fertility based on intensity of weed growth. Relating this to food

Table 1: Descriptive statistics of farmers' socio-economic characteristics

| Socio-economic characteristics | Mean | S.D. | Coefficient of variation |
|---|---|---|---|
| Age | 52.83 | 12.96 | 407.62 |
| Household size | 6.87 | 3.14 | 218.98 |
| Years of farming | 28.76 | 13.42 | 214.29 |
| Per capita household expenditure | 2556.58 | 1921.17 | 133.07 |
| Times sick | 2.35 | 2.48 | 94.74 |
| No. of season cultivated in 5 yreas | 7.11 | 2.28 | 312.04 |

Table 2: Farmers indicators for perceiving degraded cash and food crop farms in southwestern

| Characteristics | Cash crop | Food crop |
|---|---|---|
| Soil color | 34.65 | 58.75 |
| Soil depth | 33.99 | 32.67 |
| Ease of tilling | 19.47 | 64.69 |
| Intensity of weed growth | 15.51 | 29.70 |
| Types of weed most common | 21.45 | 37.62 |
| Previous performance of cereals | 26.73 | 82.84 |
| Previous performance of root tubers | 30.69 | 81.19 |
| Previous yield of cash crop | 52.80 | - |
| Soil texture | 35.97 | 46.20 |
| Water drainage | 34.32 | 50.17 |
| Type of soil | 37.29 | 67.00 |
| Years of cultivating the land | 33.33 | 70.30 |

crops, 82.84% of the farmers judge fertility levels with the performance of cereal crops, while 81.19% used the performance of tuber crops. Similarly, 70.30% considered the number of years during which the land has been used for crop cultivation without fallowing.

Table 3 shows the categories of different uses to which farmers subject their land and their distribution (measured by Gini-coefficient). Average cash cropland is 1.25 ha with variability index of 68.83%. However, because the farmers were mainly into food production, average land areas devoted to food production is 1.79 ha. Other uses of land for vegetable cultivation and livestock husbandry take an average of 0.15 and 0.07 ha, respectively. An average of 1.03 ha of the farmers land is kept under fallowing. Similarly, from farmers' perception of fertility, 76.92 and 79.22% of the farmers' cash cropland and food cropland, respectively are considered to be fertile. Similarly, 80.27% of the land under fallow is fertile.

The Table 3 further shows that food cropland has the lowest Gini-coefficient. This shows that they are more equitably distributed. However, land use categories like fallow land, degraded cash cropland, degraded food cropland etc are distributed more unequally due to the largeness of their Gini-coefficient values.

Table 4 presents poverty analysis using the conventional Foster *et al*. (1984) approach. The poverty line based on Mean per Capita Household Expenditure (MPCHE) is N1445.30. With this, 35.64% of the farmers were moderately poor (falling below the 2/3rd MPCHE). However, 3.96% are severely poor (falling below 1/3rd MPCHE). Of the 35.64 poverty incidence, we proceeded to calculate the contributions of each group of soil conservation users and non-users to this value. It shows 90.10% used clean clearing, this group contribute 32.34% to poverty. Clean clearing is a method whereby farmers do not allow crop residues and plants cleared from a farm to decompose on the farm. In this case, these are either gathered at some points outside the farm for decomposition or burning. While, only 10.23 and 13.86% of the farmers could afford the use of tractor and harrowing, respectively, the group contributed 4.62 and 2.31% to poverty, respectively. Soil nutrient enhancing management practices like mulching, crop rotation, use of organic manure, planting of cover crops and application of fertilizers are not so widely used by the farmers. Specifically, the contributions to poverty were 7.26 and 8.58% for those using cover crops and organic manure, respectively. However, those using bush burning contributed 24.42% to poverty.

**Factors explaining rural poverty:** The results of the Probit regression presented in Table 5. It shows that the data presented a good fit for the data as reflected by the statistical significance ($p<0.01$) of the chi-square ($\chi^2$) of the Maximum Likelihood Estimate (MLE). It has state variable being statistically significant ($p<0.01$). This shows that farmers from Oyo state have lower probability of being poor. Proximity to urban area (Ibadan) may be

Table 3: Land areas owned by farmers in southwestern Nigeria

| Land use category | Mean | S.D. | Coefficient of variation | Gini coefficient |
|---|---|---|---|---|
| Cash cropland (ha) | 1.25 | 1.82 | 68.83 | 0.7008 |
| Fallowing land (ha) | 1.03 | 3.30 | 31.16 | 0.8724 |
| Food cropland (ha) | 1.79 | 1.70 | 105.72 | 0.4893 |
| Livestock land area (ha) | 0.07 | 0.24 | 28.79 | 0.9279 |
| Vegetable land area (ha) | 0.15 | 0.34 | 44.38 | 0.8425 |
| Fertile cash cropland (ha) | 1.00 | 1.56 | 63.93 | 0.7255 |
| Fertile food cropland (ha) | 1.42 | 1.48 | 95.71 | 0.4455 |
| Fertile fallow land (ha) | 0.83 | 3.08 | 26.81 | 0.8945 |
| Degraded cash cropland (ha) | 0.25 | 0.74 | 29.47 | 0.9243 |
| Degraded food cropland (ha) | 0.37 | 0.73 | 33.36 | 0.9077 |
| Degraded fallow cropland | 0.20 | 1.17 | 27.42 | 0.9284 |

Table 4: Use of some cultural/soil conservation practices in Southwestern Nigeria

| Cultural/soil conservation practice | Users (%) | Poverty contribution by Non-users | Poverty contribution by users |
|---|---|---|---|
| Use dung of livestock kept on the farm | 14.52 | 29.04 | 6.60 |
| Burning bush | 74.26 | 11.22 | 24.42 |
| Use tractor | 10.23 | 33.33 | 2.31 |
| Use harrowing/ploughing | 13.86 | 31.02 | 4.62 |
| Use mulching | 58.75 | 17.49 | 18.15 |
| Use clean clearing | 90.10 | 3.30 | 32.34 |
| Use crop rotation | 67.00 | 15.84 | 19.80 |
| Use organic manure | 24.42 | 27.06 | 8.58 |
| Use zero tillage | 32.01 | 20.46 | 15.18 |
| Apply fertilizer | 66.34 | 14.85 | 20.76 |
| Plant cover crops | 26.07 | 28.38 | 7.26 |

Table 5: Results of probit regression of the determinant of poverty in Southwestern Nigeria

| Factor | Coefficient | t-statistics |
|---|---|---|
| Constant | -1.51989355900 | -2.620 |
| State | -0.66214808430 | -2.901 |
| Sex | 0.46567342640 | 1.090 |
| House size | 0.31978878850 | 7.082 |
| Marital status | -1.60852146000 | -4.378 |
| Formal education | -0.19563492840 | -0.843 |
| Livestock land area | 1.20247279100 | 2.128 |
| Vegetable land area | 0.01956754477 | 0.056 |
| Fertile food cropland | -0.08963236972 | -1.056 |
| Fertile fallow land | -0.49788886130 | -3.503 |
| Degraded cash cropland | -0.42625250920 | -1.240 |
| Degraded food cropland | -0.76759330440 | -0.321 |
| Harrowing/tractor | -0.93567330880 | -2.750 |
| Mulching | 0.07136807708 | 0.303 |
| Clean clearing | 0.07821280380 | 0.224 |
| Crop rotation | -0.49308772860 | -1.980 |
| Organic manure | -0.54250232900 | -2.010 |
| Zero tillage | 0.68602869350 | 2.732 |
| Fertilizer | -0.16804245520 | -0.708 |
| Cover crop | -0.52470774510 | -2.124 |
| Time sick | -0.01368108298 | -0.893 |

responsible for this due to direct market outlets and opportunities for off-farm activities. Similarly, house hold size is statistically significant ($p<0.01$). This shows that increasing household size will increase the probability of the households becoming poor. This is expected because desire to have many children lies largely with poor households and it is the cause of poverty. Omideyi (1988) noted that in rural Nigeria, the net effect of high family size is lower income, little savings and increased poverty. Also, marital status variable is statistically significant ($p<0.01$). This shows that those married farmers have lower probability of being poor.

Increasing land areas devoted to livestock production increases the probability of being poor significantly ($p<0.05$). Similarly, the number of fertile land area under fallow variable is statistically significant ($p<0.01$). This implies that probability of being poor reduces as farmers have enough fertile lands under fallow. Our working hypothesis is hereby rejected.

Those farmers that were using harrowing for land preparation have lower probability of being poor. This is expected because usage of harrowing/tractor for land preparation shows that the farmer has large number of hectares. Cultivation of large number of hectares can lead to higher income if the farms are well managed. The farmers that were using crop rotation have lower probability of being poor and the parameter is statistically significant ($p<0.05$). Theoretically, crop rotation enhances soil nutrients if the pattern of the rotation is well selected. With this, farmers output may increase with consequential reduction in the level of poverty. Also, those using organic manure have lower probability of being poor. In absence of inorganic fertilizers, the only options available to farmers for enhancing the nutrient contents of their farms is to use organic manure.

Also, those farmers that were using zero tillage have significantly higher probability of being poor. This shows that use of zero tillage may lead to higher level of poverty as farm profit decreases. Ideally, in southwestern Nigeria, use of zero tillage on already degraded land may lead to reduction in farm profit as more labour is being engaged for weed control. Similarly, zero tillage exposes the plot to direct soil erosion. Where ridges are made, it is possible to control erosion by construction of bunds. However, those farmers that were using planting cover crops have significantly lower probability of being poor ($p<0.05$). Cover crops rejuvenate the soil nutrients and prevent excessive soil erosion. These may result into increased productivity and poverty reduction.

## CONCLUSION AND RECOMMENDATIONS

Land degradation in southwestern is recently a phenomenon driven by population pressure and scarcity of virgin forest. As the ultimate goal of policy makers is to reduce poverty, this study investigates the effect of several land ownership and use patterns on the poverty levels of the farmers. The policies that can be derived from this study are stated as follows.

First, household size increases poverty. Efforts to sensitize rural population on the need and way of population control for poverty reduction will yield positive results. Second, use of soil conservation practices like crop rotation, planting of cover crops, addition of organic manure hold great potential for poverty reduction. Agricultural extension officers are therefore, to liaise with research institutes in order to disseminate proven soil management techniques to farmers. Finally, despite that farm land are degrading, not many farmer applied fertilizers on their farms due to its high prices and scarcity. The onus therefore, rests on the government to implement a workable and efficient plan for fertilizer production and distribution. Also, efforts by researchers should be directed at developing crop hybrids that can withstand environmental stress.

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