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Environmental degradation and its effects on the poverty status of broiler farmers in Calabar metropolis, Cross River State, Nigeria

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Abstract:

The economic growth process in Nigeria has proven to be environmentally unsustainable and socially inequitable. The effects of poverty, population growth, and degradation are interactive; hence, there is a need to determine the poverty status of broiler farmers and their effects on environmental degradation in Calabar Metropolis in Cross River State. The specific objectives were: To assess the socio-economic characteristics of the broiler farmers, estimate the poverty status of these farmers in the area, assess the effect of environmental degradation on the poor farmers, and estimate the determinants of poverty among the broiler farmers in the area. Descriptive statistics and logistic regression model were used to evaluate the extent of the impact of variables such as sex, marital status, education, farming experience, number of birds, access to improved breeds, and ownership of assets of broiler farmers in Calabar South and Calabar Municipality of Cross River State. Structured questionnaires were administered to 47 heads of households of broiler farmers to generate primary data. Based on the results, three logit coefficients were significant at the 10% significance level in predicting whether a broiler farmer was poor or non-poor, and four other variables were significant at the 5% level. The estimated adjusted R^2 value of 0.794 indicates that the strength of association between the independent and the dependent variables is about 79.4%. Also, water/air pollution and solid waste management were positive and significantly related to environmental degradation in the area. The study suggests that improving the broiler farmers' socioeconomic status would enhance their productivity and increase profitability, thus reducing the poverty rate among them.

Keywords: Broiler farmers, poverty status, environmental degradation, logit coefficients

Introduction

Combating poverty occupies a dominant space on the agenda of governments and the international community in recent times, as expressed by the Millennium Development Goals (MDGs), aiming to halve the number of people living in poverty by 2015, with the livestock subsectors playing a significant role in its actualization. Poultry is the largest livestock group, estimated to be about

14,000 million, mainly consisting of chickens, ducks, and turkeys (FAO, 2020). Poultry products (eggs and meat) contribute 30% of all animal protein consumed worldwide. Poultry is the most commonly kept livestock, and over 70% of those who keep livestock are reported to keep chickens (Armar-Klemsu & Maxwell, 2023).

Poverty is one of human deprivation's most serious manifestations and is intricately linked to human capital

development. The World Bank estimates that about 950 million people in developing countries live in conditions of poverty. Over half live in South Asia (over 350 million) and East Asia (150 million), and another 280 million absolute poor live in predominantly rural areas of Sub-Saharan Africa. Poverty is estimated to afflict many people in Europe, the Middle East, North Africa, Latin America, and the Caribbean (Shaheen & Asad, 2000).

Despite Nigeria's plentiful agricultural resources and oil wealth, poverty has been widespread and has increased since the late 1990s. Some 70 percent of Nigerians live on less than US\$ 1.25 a day. Poverty is especially severe in rural areas where up to 80 percent of the population lives below the poverty line. According to the Human Development Report of the United Nations Development Programme (2005), the poverty situation in Nigeria has been on the increase since 1980 (Federal Bureau of Statistics (FBS), 1999).

With an increase in population and the corresponding decrease in marginal productivity of land, coupled with a recent government policy aimed at increasing the caloric intake per capita per person to 2,200kcal of crude protein via consumption of between 60 and 65 grams, as well as adequate proportionate increase in animal protein relative to protein from other sources, poultry production enterprises had formed a significant crux of most government poverty alleviation programmes lately. This has made broiler production more attractive both to rural and peri-urban dwellers. In Cross River State, broiler production is common in rural and peri-urban areas. The Lacuna and limited understanding of the underlying causal mechanism linking poverty and broiler production prompted the focus of this study on the sector (Sara, 1999).

Materials and methods

This study was conducted in Calabar Municipality and South Local Government Areas of Cross River State, jointly called Calabar Metropolis. Calabar Metropolis is a coastal town between latitudes 04°.15 and 5°.15N and longitudes 8°.15E of the Equator. Calabar has an area of 7,245,935 sq km and a population of about 2.4 million. Calabar Metropolis is an urban area with high population density, and urban crop production and animal husbandry are predominantly practiced.

This study used the multi-stage random sampling technique to select broiler farming households. A field survey was carried out, which involved a detailed appraisal of the objective and the use of structured questionnaires. Thus, the respondents were poultry farm households, randomly selected within the study area. A total of 47 questionnaires were administered in the study area.

In estimating the determinants of poverty in the study area, we rely on the relative poverty approach, using the income of Broiler farmers to ascertain their poverty status, which also served as the dependent variable in the logistic regression analysis. To determine the poverty status of the broiler farmers, which essentially requires classifying them into "poor" and "non-poor" categories, we follow the NBS, 2005 and 2012, in estimating Two-Thirds of the Total Per Capita Expenditure (Income) or the "relative poverty line".

P-alpha poverty measure (Foster-Greer-Thorbecke index) was used to measure poverty among the respondents. In contrast, the binary logistic regression model was used to estimate the determinants of poverty among broiler farmer households. Following Foster-Greer-Thorbecke (1984) and World Bank (1996):

$$P_{\alpha} = \frac{1}{n} \sum_{i=1}^n q_i \left[\frac{Z - Y_{pt}}{Z} \right] \propto \quad (1)$$

Where Z is the poverty line value; Y_{pi} is the income of the i th poor groups of persons; n is total population; n is number of income earning group below the poverty line; q_i is number of persons in the i th group below the poverty line $q = \sum q_i$; is the number of income earners below the poverty line. The analysis of poverty status using the FGT measure of poverty involves the ranking of income in ascending order of magnitude, such that, $Y_{1i} \leq Y_{2i} \leq Y_{qi} < Z_i \leq Y_{(q+1)i} \leq \dots \leq Y_{ni}$

This class of poverty measures is flexible in two ways. One, α is a policy parameter that can be varied to approximately reflect poverty “aversion,”; two, the P_{α} class of poverty indices is a decomposable subgroup.

When $\alpha = 0$

$$P_0 = q/n = H \quad (2)$$

Where H is the head-count ratio, the proportion of total income receiving units below the poverty line. When $\alpha = 1$, the poverty measure becomes the poverty-gap index (PG)

$$P_{\alpha-1} = PG = \frac{1}{n} \sum_{i=1}^n q_i \left[\frac{Z - Y_{pt}}{Z} \right] = HI \quad (3)$$

$$\text{Where, } I = \frac{1}{q} \sum_{i=1}^n q \left[\frac{Z - Y_{pt}}{Z} \right] = HI \quad (4)$$

The income gap ratio. I is the mean of the poverty gaps expressed as a portion of the poverty line. This measure is insensitive to income distribution among the poor; hence, to reflect the degree of inequality or severity of poverty among the poor, a greater weight has to be given to the poorest income-earning units, which is achieved by assigning values greater than 1 to α .

When $\alpha = 2$, the squared poverty gap index (SPG) is generated as given by,

$$P_{\alpha-2} = SPG = \frac{1}{n} \sum_{i=1}^n q_i \left[\frac{Z - Y_{pt}}{Z} \right]^2 \quad (5)$$

The Logistic Regression Model

The logit regression model is characterized by a binary dependent variable with mutually exclusive and exhaustive outcomes. The dependent variable is the poverty status of the respondents, which is one if poor and zero if non-poor. Following Maddala (1990) and Babcock *et al.* (1995), the model specification gives rise to a system of two probabilities, thus:

$$\text{Prob}(Y_{i=j}) = \frac{\varepsilon^2 e^{B_j X_i}}{e^{B_j X_i} + e^{B_k X_i}} \quad (6)$$

Where $j=0$ or 1 ,

Expanding equation (1),

$$\text{Prob}(Y_{i=j}) = \frac{e^{n_j X_i}}{e^{n_0 X_i} + e^{n_1 X_i}} \quad (7)$$

The equations above have an indeterminacy problem and need to be removed. We therefore assume that n_0 in the denominator is zero, i.e., $n_0=0$. Then, in $X_i = 1$, hence,

$$\text{Prob}(Y_{i=j}) = \frac{e^{n_j X_i}}{1 + e^{n_1 X_i}} \quad (8)$$

$$\text{Prob}(Y_{i=j}) = \frac{e^{n_j X_i}}{1 + n^2 e^{n_k X_i}}$$

Then, the probability of being in each group ($j = 0$ or 1) is:

$$\text{Prob}(Y_{i=0}) = \frac{1}{1 + \sum_{k=1}^2 e^{\beta_k X_i}} \quad (9)$$

$$\text{Prob}(Y_{i=1}) = \frac{e^{\beta_1 X_i}}{1 + \sum_{k=1}^2 e^{\beta_k X_i}} \quad (10)$$

Where β_j is a vector of parameters that relate the explanatory variable X_i to the probability that Y_j

Where β_j is a vector of parameters that relate the explanatory variable X_i to the probability that Y_j

$Y_i = j$ = Poverty status of the broiler farmer

Thus;

Y = Poverty status (categorical); poor=0 and non- poor =1

X_1 = Sex of household head (categorical covariate)

X_2 = Marital Status (categorical covariate)

X_3 = Educational Status (continuous covariate)

X₄ = Farming experience (continuous covariate)

X₅ = Stocking density (continuous covariate)

X₆ = Access to improved breeds (categorical covariate)

X₇ = Ownership of Assets (continuous covariate)

Similarly, with environmental degradation, the model can be specified thus;

Y = Poverty status (categorical); poor=0 and non-poor =1

X₁ = water pollution (categorical covariate)

X₂ = air pollution (categorical covariate)

X₃ = solid waste management (continuous covariate)

X₄ = Deforestation (categorical covariate)

X₅ = land degradation (categorical covariate)

Results and Discussion

Socio-economic characteristics of Broiler Farmers in Calabar Metropolis

The Socio-economic characteristics of broiler farmers in Calabar Metropolis are shown in Table 1. Sex distribution among the broiler farmers revealed more females (68.1%) than males (31.9%) counterparts. This is because broiler farming requires a small take-off grant, which is easily accessible to women, usually through thrift savings, thus enabling more women to be involved. Through broiler farming, women provide substantial support to the family in times of financial difficulties.

The marital status of the broiler farmers shows that the majority (67.1%) of the broiler farmers were married. Broiler Farming offers an alternative livelihood option to most married women in the study area, thereby contributing to the household economy regarding income generation. The results for household size show that 70.2% of the broiler farmers have a family size of 1 – 3 members, while 29.8% have a family

size of 4 – 6 members, indicating the availability of family labor for broiler farming operations. These results conform with studies carried out by Agarwal and Narain. (1999).

Most (74.5%) of those involved in broiler farming are in their active, productive year (31-50 years). Only 12.77% of the broiler farmers are over 50 years old. It can be seen from Table 3.1 that 70.2% of the broiler farmers had tertiary education, followed by 25.5% with secondary education, while only 4.3% had primary education. Table 1 shows that 31.9% of the broiler farmers owned assets valued above one million naira (₦1,000,000.00, about \$ 6,250) while 29.8% of them owned the lowest range of assets (N5,000 (\$31.25)– ₦150,000(\$937.5)). The rest (38.3%) owned assets ranging from ₦150,000(\$937.5) to N1,000,000 (\$625).

Most broiler farmers (42.5%) had 6-10 years of experience, followed by 0 – 5 years (31.8%), while only 25.5% had 11-12 years of broiler farming experience. The result showed clearly the predominant involvement of experienced people in broiler farming in the study area. This observation, coupled with the respondent's years of broiler farming experience of over 6 years (68%), has created a situation whereby broiler farmers stick to a particular production system. This study is contrary to Etim & Udoh (2006).

Determinants of Poverty

Diagnostic Statistics

The improvement in fit made by the explanatory variables included in the model was measured by chi-square statistics of 41.663, which is significant at the 1% probability level, indicating that the

independent variables included in the model jointly significantly predicted the dependent variable in the logistic regression.

The strength of association between the dependent and the independent variables is captured by the Nagelkerke's R^2 , whose estimated value is 0.794. This indicates that the strength of association between the dependent and the independent variables is about 79.4%.

The result of the study shows that three of the logit (effect) coefficients are

significant at the 10% significance level in predicting whether a broiler farmer in Cross River State was poor or non-poor. These include sex, marital status, and the value of assets the broiler farmer owns. Furthermore, education, farming experience, and the number of birds kept are factors. Access to improved breeds was significant at the 5% level in predicting broiler farmers' poverty status. The coefficient interpretation was based on the logit estimate (b) and the odds ratio.

Table 1: Distribution of Broiler Farmers by Socioeconomic Characteristics

Variables	Frequency	Percentage
Sex of Farmer		
Male	15	31.91
Female	32	68.09
Total	47	100
Marital Status of Farmer		
Married	29	61.70
Single	18	38.30
Total	47	100
Size of Household		
1 – 3	33	70.21
4 – 6	14	29.79
Total	47	100
Age of Farmer		
21 – 30	6	12.77
31 – 40	18	38.29
41 – 50	17	36.17
Above 50	6	12.77
Total	47	100
Educational Level in years		
Primary (1-6 years)	2	4.26
Secondary (7-12 years)	12	25.53
Tertiary (above 12 years)	33	70.21
Total	47	100
Farming Experience		
0 – 5	15	31.92
6 – 10	20	42.55
11 – 20	12	25.53
Total	47	100
Value of Assets Owned		
5000 – 150000	14	29.79
150001 – 300000	7	14.89
300001 – 600000	6	12.76
600001 – 1000000	5	10.64
Above 1000000	15	31.92
Total	47	100

Source: *Computed from field survey, 2024.*

The result (Table 2) shows that the sex of broiler farmers has a positive logit effect of 5.482, which implies the predominance of females in broiler farming in the study area, that female broiler farmers increase the likelihood of being non-poor by 5.482 times. Thus, the odds ratio of 240.25 means that as more females take to broiler production, their likelihood of being non-poor will increase by 5.482 percent. This is based on poverty estimates by Thornton (2010), which indicate that rural households headed by males are poorer than female-headed households, with all three poverty measures higher for male-headed households in 1996 and 2004. This study is similar to studies carried out by Bastos (2009)

We found that the marital status of broiler farmers has a positive logit effect of 2.706, implying that if broiler farmers were married, their likelihood of being non-poor increases by 2.706 times. Thus, the odds ratio of 14.972 means that if the number of married female broiler farmers increased by 14.972, then the likelihood of non-poor will increase by 2.706%. Being married with children encourages broiler farmers to be more serious about their business. This is because of their financial needs to feed and train the children.

Ownership of assets was not significant in determining the poverty status of Cross River State broiler farmers. It also carried a positive logit coefficient of 0.000, which means that the ownership of assets has no significance in the predictions of the poverty status of broiler farmers. This can be traced to the fact that most broiler farmers, being married women, lack access to key factors of production such as capital, land, and information. Women are often denied access to the formal credit system due to a lack of collateral and are mainly small-scale operators. Thus, the odds ratio of 1.00 indicates that even if the broiler farmers

increase their ownership of assets by 1.00, it will make a difference in their likelihood of being non-poor. However, Effiong *et al.* (2024) reported contrary results in their studies.

Education is one of the significant determinants of the poverty status of any individual. It significantly affects the poverty status of Cross River State broiler farmers. Thus, it is reflected in the posited logit coefficient of 0.827, confirming that most broiler farmers (970.2%) had tertiary education. These places are involved in broiler farming among the high-skilled businesses, mainly involving the literate masses in society. High productivity and wages directly result from high educational attainment, increasing human capital. Therefore, increasing the educational level of people experiencing poverty will reduce poverty. This is in line with the assertion by Bastos *et al.* (2009) that poverty is a vicious cycle in that low education leads to poverty, and poverty is due to low education.

Moreover, even though they are publicly provided, low-income people struggle to access schools. This is because of the high opportunity cost of choosing to go to school over working for survival. This study shows that the poverty status of Calabar broiler farmers significantly depended on educational attainment because of the high technicality involved in broiler production. Therefore, broiler farming requires a high level of education to improve productivity and decrease the probability of being poor.

This is necessary since high educational attainment will boost farmers' understanding of innovation and newly improved techniques for better performance. Thus, the odds ratio of 2.827 implies that if the years spent in school increase by 3, the likelihood of being non-poor would increase by 1 percent.

Though farming experience has a significant input on broiler production and in predicting the poverty status of broiler farming in Calabar, it has an adverse logit effect of -0.459, which tries to peg the minimum years needed to do well in broiler farming. This may be traced to the unwillingness of the broiler farmers to adapt

to newly improved techniques when they have experience in the job. Thus, the odds ratio of 0.632 implies that if the experience in broiler farming is increased by 0.632, the likelihood of being poor is reduced by 0.46 percent. Similarly, this result aligns with studies carried out by Omonona (2000).

Table 2: Logistic regression results (Dependent Variable: Poverty Status)

Independent Variables	Logit Estimate (b)	Odds ratio Exp (b)	Standard Error	Wald	significance
Sex (1)	5.482	240.250	3.030	3.272	0.70*
Marital status (1)	2.706	14.972	1.320	3.171	0.075*
Education	0.827	2.287	0.370	4.986	0.026**
Farming experience	-0.459	0.632	0.231	3.964	0.046**
Number of Birds	0.005	1.005	0.002	4.352	0.037**
Access to improved Breeds (1)	-6.680	0.001	3.415	3.827	0.05**
Ownership of Assets	0.000	1.000	0.000	3.599	0.059*
Water pollution	3.462	200.250	1.030	2.248	0.50*
Air pollution	2.502	10.972	1.220	1.571	0.065*
Solid waste management	0.655	2.421	0.430	3.646	0.028**
Deforestation	-0.509	0.612	0.201	2.965	0.047**
Land degradation	0.005	0.005	0.002	3.552	0.044**
Constants	-12.088	0.000	5.306	5.189	0.021**
Diagnostic statistic:					
Nagelkerke R ²	0.794				
Chi-Square	41.663***				
-2 log-likelihood	21.759				
No of iterations	12				

*** (Significant at 1) ** (Significant at 5%) and * Significant at 10%.

Source: *Computed from field survey, 2024.*

We find that the number of birds the farmer keeps has a positive logit effect of 0.005, which implies that as the number of birds increases, the probability of being non-poor also increases. This is because, as the number of birds increases, all other production variables, such as capital, labor, and information access, are adequate. Output would increase, resulting in an increase in income and a reduction in poverty status. This assertion aligns with FOS's (1999) and Omonona's (2000) assertions. Our finding

shows that an increase in birds usually translates into higher income and lower incidence of poverty.

Therefore, several birds have the odds ratio of 1.005 (approximately 1), which implies that as the number of birds increases by one, the likelihood of being non-poor is roughly increased by 0.005 percent.

Access to improved breeds has an adverse logit effect of 6.680, meaning that the likelihood of being poor increases as access to improved breeds decreases. This

means that the probability of being non-poor increases as access to improved breeds increases, leading to an increase in income, as it is a significant contribution to determining the poverty status of broiler farmers in Calabar in particular and in Cross River State as a whole. Access to improved breeds has mainly been responsible for the increase in broiler production in the state. In addition to production and productivity, access to improved breeds guarantees high-quality birds and disease resistance (Thornton, 2010). The odds ratio of 0.001 means that if access to improved breeds increases by 0.001, the probability of being poor decreases by 6.680 percent.

Effects of environmental degradation on poor broiler farmers

As revealed in Table 2, the results indicate that water pollution has a significant relationship with poverty. Although the pollution caused by organic and chemical discharges has been widespread, its preponderant impacts are on people experiencing poverty, reflecting the skewed distribution of sewage, sanitation, and piped water facilities across the rural-urban divide and in poor urban slums. In the older parts of cities prone to in-migration, sewage infrastructure is poorly designed and corroded, resulting in the mixing of raw sewage and drinking water. Thus, even piped drinking water in poor urban localities is highly contaminated. Residents are compelled to use groundwater accessed through dug wells and shallow hand pumps where it is unavailable. Such water also contains bacterial and chemical impurities, as does the water flowing through streams and rivers, which is used for washing. Also, people experiencing poverty tend to settle in the low-lying urban areas, which are affordable but prone to flooding, water pollution, and disease. The poor broiler

farmers depend on rainwater that accumulates in ponds, rivers, and springs, and on groundwater extracted through dug wells and hand pumps for personal and farm activities. This conforms with the study carried out by Effiong *et al.*, 2024

Also, air pollution was seen to have a significant positive influence on poverty. The poor farmers are most exposed to fumes [and polluted rivers] and least able to protect themselves. Studies revealed that, from the estimated 2.7 million deaths each year from air pollution, 2.2 million are from indoor pollution, and 80% of the victims are rural poor in developing countries. Smoke from fuelwood is more dangerous to health than tobacco smoke, but every day, women have to spend hours cooking over smoky fires. The poor broiler farmers also work long hours in factories in unsafe conditions; in particular, women and children are the most vulnerable, exposed to dust and chemical inhalations in sweatshops and household industries producing textile items, carpets, and leather goods.

Traffic congestion and vehicular emissions are becoming increasingly severe problems in big cities. Poor farmers are the most exposed to auto emissions and other toxic fumes, as they tend to live close to the main trunk roads, resulting in respiratory infections. In the rural areas, poor broiler farmers are more exposed to the detrimental effects of chemical agricultural inputs. Excess use, drifting sprays, leaky applicators, and the lack of knowledge of handling dangerous substances enhance the risk of ill health. This study is in line with Shaheen and Asad (2000).

On the other hand, the untreated waste is loosely covered with soil and tends to absorb moisture, contaminating the underground water, which the poor use for drinking, cooking, and washing. Adverse terms of trade for food and cash crops have

led to intersectoral income transfers and the impoverishment of the poor rural population. Small and landless farmers are traditionally the worst affected, with their indigence leading to increased pressure on natural resources. Parastatals tend to collude with processors and traders in extracting rents from the management of price supports; by the same token, they ignore small farmers who, lacking storage facilities and in perpetual debt, are compelled to sell at distress prices. Also, subsidies rarely benefit small farmers, tenants, and sharecroppers, as they are denied access. Cheap tractors have tended to be labor-displacing and are symptomatic of the more generalized land consolidation process induced by farm mechanization (Grepperud, 1996).

Conclusion and Recommendations

Environmental degradation affects the health and nutrition status of low-income people and lowers their productivity. This can happen directly through lower yields per unit of labor or land because of reduced soil quality, and indirectly through the reduced physical capacity of labor to produce because of malnutrition and poor health. Even in cases where people with low incomes are healthy, labor productivity can be low due to increased time allocated to less productive activities, such as fuelwood collection. As a result of deforestation, family members have to go further afield to collect fuel, which takes time away from more productive cropping activities. Also, as fuelwood becomes scarcer, animal dung is substituted, resulting in non-replenishment of soil nutrition and, eventually, soil exhaustion.

This study has affirmed that environmental degradation and the poverty status of broiler farmers are interconnected. The significant determinants of poverty status include educational attainment, the

number of birds in stock, farming experience, and access to improved breeds. In contrast, environmental degradation factors include water/air pollution, deforestation, waste management, and land degradation. The study, however, suggests the need for poverty alleviation policies to address these variables ab initio. Other explanatory variables that did not significantly affect the prediction of broiler farmers' poverty status in the study area include sex, ownership of assets, and marital status.

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