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Households' Perception of Factors Influencing Agricultural Productivity in Ogoni Community: An Ordinal Logit Approach

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Abstract

Agriculture is the principal means of livelihood in Ogoniland of Niger Delta region of Nigeria. Ascertaining the determinants of agricultural productivity in the community is therefore important in meeting food security and income needs. This study uses survey data of 400 households in Ogoni community. The data was collected using a multistage sampling method. An ordinal logit regression model was estimated. Descriptive analyses indicate that 75.8% of the surveyed households were involved in agricultural production and that only 37.1% of the households involved in agriculture had lost their agricultural produce due to oil spoilage in the last two years. The ordinal logit regression model identifies government intervention towards cleaning of polluted land and water, land degradation, air pollution and household income as significant determinants of agricultural productivity in the community. However, land degradation and air pollution are negatively associated with agricultural productivity while government intervention towards cleaning of polluted land and water and household income are positively related to agricultural productivity in Ogoni community. On the other hand, the result indicates that corporate social responsibility of oil firms towards cleaning of polluted land and water), oil spill and education attainment of household head are not among the significant determinants of agricultural productivity in Ogoni community.

Keywords: Agriculture, Income, Participatory development, Oil spill, Land degradation and air pollution.

Contents

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1. Introduction

Agricultural growth is generally considered as one of the most effective means of addressing poverty in the developing economies. For instance, the Department for International Development (2003) estimates that a one percent increases in agricultural productivity could reduce the percentage of poor people living on less than 1 dollar a day by between 0.6 and 2 percent and that no other economic activity generates the same benefit for the poor in the developing economies. Nevertheless, the major challenge in the agricultural sector of most developing countries is how to increase agricultural productivity to meet food security needs for the growing population and to also reduce poverty and malnutrition, and to do it in a sustainable way Simtowe *et al.* (2012).

Consideration on the drivers of agricultural productivity in oil exploration communities has become an area of keen interest (Ofuoku *et al.*, 2008; UNEP, 2011). Oil exploration activities in Nigeria are mainly carried out in the Niger Delta region. Rivers State is one of the Niger Delta States. It is bounded on the South by the Atlantic Ocean. Ogoni community (also referred to as Ogoniland) is in Rivers state. The Ogoni group includes a large number of dialects which can be grouped into four namely Khana, Gokana, Eleme and Ogoi. Apart from the need for an in-depth and intensive study, the choice of Ogoniland for this study is based on the fact that the community was among the first places where oil was found in a commercial quantity in Nigeria – Shell began drilling in Ogoniland in 1958 (NEST, 1991).

Ogoni people are a distinct indigenous minority nationality. They live in an area of 1,000 square kilometers on the south eastern fringe of the Niger Delta region in Nigeria. Given an average population growth rate of 2.50 (2007 – 2010) and 831,726 population published by the National Bureau of Statistics (2006) the 2010 population of Ogoni people is estimated to be around 914,899 (Saro-Wiwa, 1995; UNPO, 2009; World Bank, 2010; Ojide and Ikpeze, 2015). Ogoniland is made up of four local government areas (LGA). They are Eleme, Gokana, Khana, and Tai local government areas. The population of each of the LGAs is as shown in table 1.

Table-1. Number of inhabitants by LGA (2010 estimate)

LGA	Inhabitants
Eleme	209,972
Gokana	251,711
Khana	323,639
Tai	129,577
Total	*914,899*

Source: NBS (2006) and World Bank (2010)

Given that improved agricultural productivity perhaps remains the single most important driver of economic growth and poverty reduction among developing economies, there is need to ascertain the determinants of agricultural productivity in oil producing communities such as Ogoniland in Niger Delta region of Nigeria. Following the concept of 'participatory development', this paper examines the factors influencing agricultural productivity in Ogoni community in Niger Delta region of Nigeria. Participatory development is concerned about what the people themselves perceive to be their challenges, interests and needs (OECD, 1995; UNDP, 2006). The null hypotheses tested in this paper are:

i. Government intervention towards cleaning of polluted land and water (GIcl) has no significant influence on agricultural productivity.
ii. Oil companies' intervention towards cleaning of polluted land and water (GIcl) has no significant influence on agricultural productivity.
iii. Household income and education attainment of household head have no significant influence on agricultural productivity.

Oil exploration was considered in terms of oil spill, land degradation and air pollution from oil exploration activities.

2. Methodology

Data used in this research were obtained using a multistage sampling method. Interview schedule was adopted as the survey instrument. The unit of analysis in the study is households in Ogoniland.

The total number of households in Ogoniland is as shown in table 2:

Table-2. Number of households by LGA (2010 estimate)

LGA	Inhabitants	Total No. of Regular Households
Eleme	209,972	45,397
Gokana	251,711	54,422
Khana	323,639	69,973
Tai	129,577	28,015
Total Population	914,899	197,807

Source: NBS (2006) and World Bank (2010)

The sample size formula specified by Yamane (1967) was applied (see equation 1). The sample size was determined using 95 percent degree of accuracy.

$$s = \frac{N}{1 + N(e^2)} \quad \text{..... ..... 1}$$

s = required sample size.
N = the population size.

e = the degree of accuracy expressed as a proportion (.05).

Using equation 1, a sample size of 400 households was obtained. This sample size was distributed in proportion to number of households in each local government in Ogoniland as shown in table 3.

Table-3. Sample Size distributed in proportion to LGA Population

LGA	Total No. of Regular Households	Sample Size (Household)
Eleme	45,397	92
Gokana	54,422	110
Khana	69,973	141
Tai	28,015	57
Total Population	197,807	400

An interview schedule consisting of 57 questions, which were developed based on reviewed literature and preliminary interviews, was used in this study. The structured interview schedule which was predominately closed ended questions was used to enhance response rate and easy merging of data from all the four communities. Some multiple choice questions also allowed respondents to comment further where necessary. As a result of the sensitive nature of the survey, indigenes of the selected communities were used as enumerators. They were trained on general techniques for successful questionnaire administration. In addition, they were given detailed review of each question – why the questions and expected range of responses – and how to ask the questions to avoid 'leading question' bias. Furthermore, they were instructed to adequately explain to the respondents the purpose of the survey as to avoid, as much as possible, biased responses. The use of educated indigenes of the communities enhanced communication and reduced security risks given the emotional and political nature of the subject of interest and the study area. The questions were asked by the enumerators who filled-in the responses into the interview schedule. This reduced the chances of misinterpreting the questions.

The respondent in each of the selected households was the head of the household or the representative (who must be a spouse or adult son/daughter). In this study, an adult is considered to be a person not less than 18 years old. The interview schedule used in the study includes sections on demography, socioeconomic related issues, and environment related issues, as well as agricultural production.

2.1. Pilot Stage and Test of the Instrument

The face and content validation of the interview schedule was conducted by research experts (including an indigene of the Ogoni community). A reliability test was also conducted on the instrument. The reliability of the instrument was determined during the pilot study of 30 households randomly selected in Tai local government area (which is one of the local government areas of the study). The interview instrument was administrated to the 30 households. The responses from the pilot study were examined using Split-half reliability index – coefficient alpha (Cronbach, 1951). The coefficient alpha in split-half technique is calculated using equation 2 (Allen and Yen, 1979):

$$\alpha = \frac{N}{(N-1)[1-\frac{\sum Var\,(Y_i)}{Var\,(X)}]} \quad \text{.....2}$$

where N = number of items
$\sum Var(Y_i)$ = sum of item variances
$Var(X)$ – composite variance

The coefficient alphas for the different sections of the instrument were computed. On the average, the research instrument achieved about 83% reliability.

2.2. Model Specification

The "Driving forces – Pressure – State – Impact - Response model" (DPSIR) framework has been extensively applied in socioeconomic and environmental studies (Walmsley, 2002; Odermatt, 2004; Fistanic, 2006; Amajirionwu *et al.*, 2008). Despite its extensive use in socioeconomic and environmental researches, the DPSIR framework has not been widely used in empirical studies (Bell and Etherington, 2009). Nonetheless, the DPSIR framework is globally recognized as a means of identifying meaningful indicators of cause-and-effect relationships (Smeets and Weterings, 1999; Walmsley, 2002; Bell and Etherington, 2009; Ojide and Ikpeze, 2015).

This study, therefore, evaluates the social aspects of DPSIR framework using ordinal logit model as stated in equation 3.

$$y^* = \sum \beta_k x_k + \varepsilon_k \text{.....3}$$

where y* is an unobserved, continuous, underlying tendency behind the observed ordinal response (rating). The X_k represent the independent variables, while the β_k represent the associated parameters. The error term (ε_k) captures stochastic (unobserved) variation. It is assumed to be distributed logistically.

Relating the unobserved y* to Y through a series of "cut points" is as represented in equation 4:

$$\left.\begin{array}{l} Y = 1 \text{ if } y^* \le \mu_1 \\ Y = 2 \text{ if } \mu_1 < y^* \le \mu_2 \\ \ldots \\ Y = j \text{ if } \mu_{j-1} < y^* \end{array}\right\} \quad \text{.....} \quad 4$$

where Y is the rating and the μ's represent thresholds of y* that delineate the categories of the ordered response variable. These threshold parameters are restricted to be positive where each one is greater than the previous. The first parameter μ_1 is normalized to 0 so that one less parameter has to be estimated. That is not a problem because the scale of the latent variable is arbitrary (Borooah, 2001).

To avoid confusion and misinterpretation of estimates, Y is restricted to a five-point Likert item or less – measuring influence of the exogenous variables on agricultural productivity in the Ogoni communities. Using equation 3, equation 5 was estimated. Variables are as defined in table 4.

$$Agric = f(GIcl, CSRcl, OS, LD, Income, AP, ET) \text{.....5}$$

Table-4. Definition of Variable

Variable Code	Description
Agric	Household agricultural productivity (very low=1, low=2, mild=3, high=4, very high=5)
AP	Air pollution (very low=1, low=2, mild=3, high=4, very high=5)
LD	Land Degradation (very low=1, low=2, mild=3, high=4, very high=5)
OS	Oil Spillage (very low=1, low=2, mild=3, high=4, very high=5)
Income	Household income (18000 & Below=1, 18100 - 50000=2, 50100 - 100000=3, 100100 – 250000=4, > 250,000=5)
ET	Education attainment of household head (no formal edu.=0, FSLC=1,SSCE=2,OND=3, B.Sc & above=4)
	CCGG to GIw below were coded as: low=1, average=2, high=3, very high=4
CSRcl	Corporate Social Responsibility of oil firms towards cleaning of polluted land and water
GIcl	Government intervention towards cleaning of polluted land and water

3. Results and Discussion

Household survey, which started on December 3, 2013 and ended on January 17, 2014, was conducted in all the four local government areas (LGAs) in Ogoniland. Tables 5 – 13 present household characteristics and agricultural production. Analysis of gender distribution of respondents in all the four local government areas (pooled data) indicate that an average of 51.3% of the household representatives were male (see table 5). Most of the respondents in the community (in the four LGAs) were within the age range of 26 – 35 years (35.8%) and 36 – 50 years (26%). About 6.3% of the respondents were 51 years and above (see table 6).

Table-5. Respondents Sex

	Male (%)	Female (%)
Tai	37 (64.9)	20 (35.1)
Eleme	27 (29.3)	65 (70.7)
Gokana	60 (54.5)	50 (45.5)
Khana	81 (57.4)	60 (42.6)
Pool	205 (51.3)	195 (48.8)

Table-6. Respondents' Age range

18-25 years (%)	26-35 years (%)	36-50 years (%)	51-65 years (%)	66 years & above (%)
125 (31.3)	143 (35.8)	107 (26.8)	18 (4.5)	7 (1.8)

Greater proportion (54%) of the respondents was household heads. Table 7 indicates that the 46% non-household head respondents were wife (22.8%), son (34.8%) and daughter (42.4) respectively. The gender distribution of households, where respondents are not household heads, is as shown in table 8.

Table-7. Category of Respondent

Household head (%)	216 (54.0)
Non-Household head (%)	184 (46.0)
Non household head	
Wife (%)	42 (22.8)
Son (%)	64 (34.8)
Daughter (%)	78 (42.4)

Table-8. If Respondent is not Household head, sex of household head

Male (%)	137 (74.5)
Female (%)	47 (25.5)
Household Size	
Minimum	1
Maximum	16
Mean	6
Standard Deviation	2

Table 8 also indicates that the average household size in the community is 6 persons with 2 as standard deviation. Majority (81.5%) of the households surveyed were indigenes of Ogoniland; while the rest are non-indigenes who are residing in the communities (table 9). About 79.5% of the households had lived in the community beyond 10 years (table 10).

Table-9. Status of Household head in the community

Ogoni indigene (%)	326 (81.5)			
Not Ogoni indigene (%)	74 (18.5)			
Status of household head in the community				
	Tai (%)	Eleme (%)	Gokana (%)	Khana (%)
Ogoni indigene	55 (96.5)	43 (46.7)	106 (96.4)	122 (86.5)
No Ogoni indigene	2 (3.5)	49 (53.3)	4 (3.6)	19 (13.5)

Table-10. Duration of the household in the LGA

Below 5 years (%)	5 - 10 years (%)	Above 10 years (%)
28 (7.0)	54 (13.5)	318 (79.5)

Analysis of literacy level of household heads reveals that only about 3.8% of the household heads in the community had no formal education. Majority of the household heads were literate with primary school (10.3%), secondary school (26.3%), national diploma (22.8) and first degree/post graduate degree (37%).

Table 11 shows that 75.8% of the surveyed households were involved in agricultural productivities. Crops farming (70%) is the major agricultural activities among the farming households. About 16.8% and 13.2% had fishery and poultry production as their major agricultural activity. Larger proportion of the households rated their productivity in crops, fishery and poultry farming as mild, high or very high (see table 12).

Table-11. Household and Agriculture

Household involved in agricultural productivity (%)				303 (75.8)
Major agricultural product by household (%)				
Crops				212 (70.0)
Fishery				51 (16.8)
Poultry				40 (13.2)
Major agricultural product by household in each L.G.A.				
	Tai (%)	Eleme (%)	Gokana (%)	Khana (%)
Crops	37 (71)	42(82)	72 (69)	60 (64)
Fishery	10 (19)	2(4)	20 (19)	19 (20)
Poultry	5 (10)	7(14)	13 (12)	15 (16)

Table-12. Productivity rating of all major agricultural activities in the household (%)

	Rating of agricultural productivity				
	Very low	Low	Mild	High	Very high
Crops	13 (6.1)	23 (10.8)	51 (24.1)	75 (35.4)	50 (23.6)
Fishery	2 (3.9)	6 (11.8)	10 (19.6)	18 (35.3)	15 (29.4)
Poultry	1 (2.5)	6 (15.0)	15 (37.5)	13 (32.5)	5 (12.5)

Table 13 indicates that only 37.1% of the households involved in agriculture had lost their agricultural produce due to oil spoilage in the last two years. Among these 37.1% households, on the average, the estimated amount of money lost per household within the period is about ninety-five thousand naira (₦95,000). However, on the average households in Khana lost most (₦111,355) followed by those in Tai (₦82,292). Households in Eleme were least affected as on the average each of the farming household lost only about two thousand, two hundred and seventy naira (₦2,270).

Table-13. Losses in agricultural produce due to oil spoilage in the last two years

Experience loss (%)			141 (37.1)
Average amount of money lost per household (Naira)			95,070.37
Estimated losses in agricultural produce due to oil spillage in each L.G.A.– average of the households that experienced losses in the past two years (Naira)			
Tai (₦)	Eleme (₦)	Gokana (₦)	Khana (₦)
82,291.67	2,267.50	56,155	111,354.54

Note: Naira-SU Dollar exchange rate as of the time of the survey = US$157.29

The result of the estimated ordinal logit model is presented in table 14.

Table-14. Ordinal Logistic Analysis of Economic Impact Models

	Agric	
Variable Value	1, 2, 3, 4, 5	
Predictor	Coef	Odds Ratio
Const (1)	-3.9158* {0.000}	
Const (2)	-2.5141 * {0.000}	
Const (3)	-1.1170* {0.031}	
Const (4)	0.5510 {0.284}	
GIcl	0.5246* {0.021}	0.59*
CSRcl	0.1970 {0.468}	1.22
OS	-0.1139 {0.477}	0.89
LD	-0.5302* {0.002}	1.70*
		Continue

Income	0.26006* {0.005}	1.30*
AP	-0.2661* {0.048}	0.77*
ET	0.05489 {0.563}	1.06
Test that all slopes are zero (G)	25.236* {0.001}	
Goodness-of-Fit Test (χ^2)	987.056* {0.000}	
Cases used	292 (73%)	
Cases with missing values	108 (27%)	

Notes: p-values are in parentheses – {}; percentages in brackets – (); * represents 5% significant

3.1. Overall Model

In this model, 73 percent of the observations were used while the rest were excluded due to missing values. The excluded observations are mainly the non-farming households since only 75.8% of the surveyed households were involved in agricultural production. The goodness-of-fit test, Chi-square (χ^2 = 987.056**)** with p-value of 0.000, indicates that the model is appropriate for the data. Similarly, the overall relationship between the independent variables and the dependent variable is significant. This is because the statistic G (25.236), with p-value of 0.001, indicates that there is sufficient evidence to conclude that at least one of the estimated coefficients in the model is different from zero. Thus, the independent variables are simultaneously significant.

The model examined seven factors namely government intervention towards cleaning of polluted land and water (GIcl), corporate social responsibility of oil firms towards cleaning of polluted land and water (CSRcl), oil spill (OS), land degradation (LD), air pollution (AP), household income, and education attainment of household head (ET). The p-values of the predictors indicate that for 0.05 alpha-level, there is sufficient evidence to conclude that government intervention towards cleaning of polluted land and water (GIcl), land degradation (LD), air pollution (AP) and household income have significant influence on household agricultural productivity in the community. However, land degradation and air pollution (AP) are negatively associated with agricultural productivity while government intervention towards cleaning of polluted land and water (GIcl) and household income are positively related to agricultural productivity in Ogoniland. On the other hand, the result indicates that corporate social responsibility of oil firms towards cleaning of polluted land and water (CSRcl), oil spill (OS) and education attainment of household head (ET) are not among the significant factors affecting household agricultural productivity in Ogoniland. This is because the coefficients of the later variables were not found to be statistically different from zero in the estimation.

3.2. Marginal Effect of Individual Predictors on the Log-odds of the Dependent Variable

The result indicates that a unit increase in government intervention towards cleaning of polluted land and water (GIcl) and household income would result in about 0.53 and 0.26 units increase, respectively, in the log-odds of being in a higher category of agricultural productivity while the other variables in the model are held constant. On the other hand, a unit increase in land degradation (LD) and air pollution (AP) would also result in about 0.53 and 0.27 units reduction, respectively, in the log-odds of being in a higher category of agricultural productivity while the other variables in the model are held constant. Crops exposure to high concentrations of different air pollutants can be detrimental to agricultural productivity. Such injuries on crops include visible markings on the foliage, reduced growth and yield, and premature death of plant.

3.3. Cumulative Predicted Probabilities for each Score Category and Probabilities for the Individual Scores of the Dependent Variable at the means of the Independent Variables

Keeping the estimated parameters fixed (that is $\beta = 0$), cumulative predicted probabilities for each of the five categories and probabilities for the individual scores of agricultural productivity in the community were calculated (see table 15).

Table-15. Cumulative Predicted Probabilities of agricultural productivity

Predictor	Coeff	Score	Cum Prob(score)	Prob (individual score)
Const (1)	-3.9158	1	0.019535	0.019535
Const (2)	-2.5141	1 or 2	0.074876	0.05534
Const (3)	-1.1170	1 or 2 or 3	0.246568	0.171693
Const (4)	0.5510	1 or 2 or 3 or 4	0.634368	0.387799
Cumulative scores (5)		1 or 2 or 3 or 4 or 5	1	0.365632

Table 15 indicates that Ogoni people have greater probability (0.387799 for very, and 0.365632 for very high – i.e.: 0.75343 all together) of being in high category of agricultural productivity.

4. Conclusion

Following the concept of 'participatory development', this paper examined the determinants of agricultural productivity in Ogoniland of Niger Delta region of Nigeria. The result indicates that about 75.8% of the surveyed 400 households earn their livelihood from agricultural production. Among the farming households, 70% had crops farming as their major agricultural activity. Only 37.1% of the households involved in the different agricultural activities indicated that they lost their produce due to oil spoilage within the last two years.

The inferential analyses of the responses from the survey revealed that contrary to previous studies (Amnesty International, 2009; UNDP, 2011) oil spill did not significantly impact on agricultural productivity in the communities. This however is in agreement with UNEP (2007). UNEP observed during the course of its study that vegetation had continued to grow and cover some oil contaminated land-areas even though remediation measures had not been carried out. UNEP concluded that this was partly because some vegetation types can vigorously survive hydrocarbon pollution and partly because many vegetation types need only limited clean amounts of topsoil to re-establish. Thus, it is possible that most crops in Ogoniland have developed resistance to oil contamination or that the farmers have adopted some strategies to ensure crop survival in oil contaminated land, both may as well be the case. However, land degradation and air pollution cause significant reduction in agricultural productivity in the communities. On the other hand, government interventions, in terms of cleaning polluted land and water, have positive effect on their agricultural productivity. This is unlike corporate social responsibility activities of the oil companies, in terms of cleaning polluted land and water, which did not have significant effect on the agricultural productivity. In addition, household income was established as one of the significant determinants of agricultural productivity in Ogoniland. This paper recommends that agricultural research institutes should seek to develop crops or seeds that are tolerant to oil polluted soil. This could improve agricultural productivity in communities hosting oil exploration activities thereby enhancing the achievement of food security in such communities. Government and oil firms should invest in such research.

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