

SOCIO-ECONOMIC EFFECTS OF CHEMICAL POLLUTION ON AGRICULTURAL PRODUCTION IN MINERAL MINING COMMUNITIES OF SOUTH- EAST NIGERIA¹Esheya Samuel Esheya*, ²Chukwuemeka Uzoma Okoye and ²Noble Jackson Nweze¹Department of Agricultural Economics & Extension, National Open University of Nigeria, Kaduna Campus. ²Department of Agricultural Economics, University of Nigeria Nsukka, Nigeria.*Corresponding author: sesheya@noun.edu.ng**Abstract**

This study investigated socio-economic effects of chemical pollution on agricultural production in mineral mining communities of South-East Nigeria. It was carried out in three (3) states: Abia, Ebonyi and Imo states. The study was guided by three research questions and one null hypothesis. Multi-stage and purposive simple random sampling techniques were employed for selecting the respondents. Data were obtained from primary sources from a sample of 400 respondents by the use of structured questionnaire. Data collected were analysed using percentage, frequency, mean, and multiple regression analysis. Results indicate that explosives, sulphuric acid, pesticides, persistent organic pollutants, acetylene, nitric acid, radioactive chemicals, fumigants and volatile organic compounds were the commonly used chemicals by mineral mining companies. Contamination of air, water and land with resultant death of soil micro-organisms, reduction in farmland and soil fertility, poor growth and premature death of crops; poor crop yield and frequent outbreak of civil crises were among the severe socio-economic effects of chemical pollution in mineral mining communities in Nigeria. Based on the results of the multiple regression analysis, the independent variables in the three regression models significantly influence the yield of yam, cassava and rice respectively. This study recommends that it would be necessary to improve the socio-economic status of the farmers and strengthen cooperation between various parties to solve chemical pollution and related problems facing the mineral mining host communities to achieve the twin goals of food security and environmental safety in mineral mining host communities of South- East Nigeria.

Keywords: Mineral Mining, Host Communities, Chemical Pollution, Socio-Economic Effects, Agricultural Productivity.

Introduction

Societies derive many benefits from chemicals as they are vital to human development. But without good management and disposal practices, chemical substances and wastes could pose significant risks to human health and the environment, with women and children being most vulnerable to their negative effects (Abosede, 1999). The mining of minerals involves a lot of chemical synthesis as a means of converting the natural products in the environment into other forms needed for man's day to day survival (Bowen, 2009). Man in the process of creating products, more often than not creates challenges either consciously or unconsciously vis-à-vis pollution. Thus, usage of chemicals in minerals mining processes have

created life threatening ecological hazards and deterioration of health and social fabrics of the inhabitants of the mineral mining communities (ATSDR, 2003).

Industries throughout the world is faced with the challenge of sustainable development, which requires balancing the protection of human health and safety and the natural environment with the need for both sustained economic activity and growth (Adekoya, 1995). Mining industrial waste products are generated in larger volumes than other industries, and mine wastes are primarily disposed of on land and these pose significant health and environmental risks to mankind (Steffen, Robertson & Kirsten, 1991).

Unarguably, chemicals play fundamental roles in the society, and their processes and products is indisputable. However, when improperly managed, some chemicals can have dire and far-reaching consequences on human health and the environment (USEPA, 2000). Managing and reducing the risks of chemicals in a sound manner is therefore an essential part of sustainable development (Buccini, 2004).

The South- Eastern region of Nigeria is rich in mineral and as such the area is best described as a sensitive and fragile ecosystem. Despite its vast resources endowment and immense potential for socio-economic growth and contributions to the overall development of Nigeria, the area remains under threat from rapidly deteriorating economic and environmental conditions as well as social tension occasioned by mineral mining and related activities (Onwuemessi, 2012). The production of staple food crops is the major means of livelihood for rural households in South-Eastern Nigeria. Unfortunately, this is under heavy threat by chemical pollution and related damages arising from the activities of mineral mining companies (Termado and Juan, 2012). This calls for proactive roles by mining companies in setting standards of operation and practice that maintain international standard and regulations (Esheya, 2012).

Available records indicate that the Nigerian government and the mining companies are aware of these negative socio-economic and environmental effects of mineral exploitation but they have not made any concerted effort towards averting the adverse effects of chemicals in mineral extraction, production and distribution activities on the environment of the host communities. According to Gbersu (1995), the damaging situation is even on the increase.

Although some studies have been carried out on this subject matter but their findings only present a partial picture of the pervasiveness of chemicals in modern society. Thus, there is dearth of economic literature on the socio-economic effects of chemical pollution on agricultural production in mining communities of South- East Nigeria, and this study is meant to close this existing information gap. The major

objective of this study was to examine the socio-economic effects of chemical pollution on agricultural production in South-East Nigeria. The specific objectives were to: identify the types of chemicals used by mineral mining companies in the zone; describe the socio-economic effects of chemical pollution on agricultural production; and determine the factors which influence the yield of yam, cassava and rice in the mineral mining communities of South- Eastern Nigeria.

Methodology

South-East geopolitical zone of Nigeria which is the study area is made up of five states: Abia, Anambra, Ebonyi, Enugu and Imo States. These states are among the five states that make up the South-East geopolitical zone of Nigeria (NPC, 2006). Multi-stage simple random sampling and purposive sampling techniques were employed for selecting the respondents. Three out of the five states in the South-East geopolitical zone were purposively selected namely: Abia, Ebonyi and Imo States. Two (2) L.G.A.s were purposively selected in each state based on intensity of mineral mining and related activities.

Four (4) villages (two mineral mining and two non-mineral mining areas) were selected from each of the Local Government Areas while eight (8) mineral mining companies were purposively selected for the study because of the preponderance of pollution in the areas due to mining activities. Fifty (50) farmers were randomly selected in each L.G.A while twelve (12) workers were randomly selected in each mineral mining company. Thus, a sample size of four hundred (400) respondents was selected for this study.

Data were obtained mainly from primary sources using a set of structured questionnaires. Data collected for this study were analysed with the aid of descriptive and inferential statistics. Objectives (i) and (ii) were realised using descriptive statistics such as percentage, frequency, mean and a 4-point rating scale while objective (iii) was achieved using a multiple regression analysis.

The implicit form of the regression model is:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, \varepsilon)$$

(Eboh, 2009).

Where:

Y = Crop yield (yam, cassava & rice in kg/ha)

X₁ = Farm size (hectares)

X₂ = Labour cost (₦)

X₃ = communal crisis (Dummy: Crisis = 1, no crisis = 0)

X₄ = proximity to mine site (Distance in kilometres)

X₅ = Extension awareness (Awareness = 1, Otherwise = 0)

X₆ = Farming experience (years)

X₇ = Age of farmer (years)

X₈ = Educational qualification of farmer (years of formal education)

X₉ = chemical pollution (Dummy: chemical pollution = 1, no chemical pollution during the cropping season = 0)

ε = Error term

Types of Chemicals Used by Mineral Mining Companies

Results in Table 1 shows the types of chemicals used by mineral mining companies in the mineral mining communities of South- East Nigeria. From the results, it was observed that cyanides are the only chemical that is not in popular use in the study area as it accounted for 49.0%. Explosives, Sulphuric acid, Pesticides, Persistent Organic Pollutants, Acetylene, Nitric acids and Petrochemicals have percentages of 89.6%, 63.5%, 96.9%, 78.1%, 58.3%, 90.6% and 93.8% respectively indicating very high usage. Others include: radioactive chemicals (88.5%), Fumigants (82.3%), Volatile Organic Compounds (97.9%). Agency for Toxic Substances and Disease Registry (ATSDR) (2003) has shown that mineral mining involves a lot of chemical synthesis in the process of converting the natural products in the environment into other forms convenient for man's consumption. Thus, man in the process of creating products for human use, also creates problems either consciously or unconsciously vis-à-vis chemical pollution (Heater, 2003).

Results and Discussion

Table 1: Percentage Distribution of Respondents by Types of Chemicals Used by Mining Companies

S/N	Variable	Mining Workers (N= 96)		Farmers (N = 252)	
		Frequency	Percentage	Frequency	Percentage
i.	Explosives	86	89.6	73	24.3
ii.	Cyanides	47	49.0	28	9.3
iii.	Sulphuric acids	61	63.5	14	5.6
iv.	Pesticides	93	96.9	127	50.4
v.	Persistent Organic Pollutants (POP)	75	78.1	11	4.4
vi.	Acetylene	56	58.3	-	-
vii.	Nitric acid	87	90.6	34	13.5
viii.	Petrochemicals such as methanol, propylene, xylene, hydrocarbons, etc.	90	93.8	58	23.0
ix.	Radioactive chemicals such as uranium, promethium, astatine etc.	85	88.5	-	-
x.	Fumigants/other additives	79	82.3	26	10.3
xi.	Volatile Organic Compounds (VOCs) such as formaldehyde, toluene, methylene chloride etc.	84	97.9	41	16.3

*Multiple responses were recorded.

Source: Field Survey, 2014.

Socio-Economic Effects of Chemical Pollution

The findings in Table 2 indicate that contamination of air, water and land were the fundamental and most severe socio-economic effects of chemical pollution in mineral mining communities. Death of soil micro-organisms and reduction in soil fertility (3.6), poor growth, yield and death of crops (3.7), and permanent displacement of farmers (4.2) are among the

severe socio-economic effects of chemical pollution in mineral mining communities of South- East Nigeria. Agricultural crops can be injured when exposed to high concentrations of various soil and air pollutants (Taylor, Green and Stout, 2006). These attack ranges from visible markings on the foliage, reduced growth and yield, to premature death of the crops.

Table 2: Mean Rating of Respondents by Severity of Socio-Economic Effects of Chemical Pollution

S/N	Item	Mean	Decision
i.	Chemical pollution causes ecological imbalance	1.5	Not Severe
ii.	Chemical pollution deprives humans the intended use of water	3.5	Severe
iii.	Chemical pollution contaminates the air causing respiratory diseases	3.8	Severe
iv.	Chemical pollution causes poor growth, yield and death of crops	3.7	Severe
v.	Chemical pollution causes permanent displacement of farmers	4.2	Severe
vi.	Chemical pollution causes acid rock drainage	1.8	Not Severe
vii.	Chemical pollution causes loss of agricultural farm land	3.4	Severe
viii.	Chemical pollution kills soil organisms thereby reducing soil fertility	3.6	Severe
ix.	Chemical pollution contaminates water and make it unfit for irrigation	4.2	Severe
x.	Chemical pollution endangers aquatic, wild life and domestic animals	4.7	Severe

* Multiple responses were recorded; Mean score = 2.50 and above

Source: Field Survey, 2014.

The results in table 2 above further indicate that loss of agricultural farm land (3.4), contamination of intended domestic and irrigation water (4.2), outbreak of respiratory diseases (3.8) are also among the severe effects of chemical pollution in the study area. Opinion of the respondents indicated that the mineral mining companies do not provide significant chemical pollution control measures in their areas of operation. This accounts for the high level of air, water, soil, and even noise pollution observable in the host communities. Findings also show that mineral mining companies do not pay adequate compensation to displaced and affected farmers thereby making re-settlement very difficult. This and other inhuman treatments often triggered off civil crises in the mineral mining host communities (Eboh, Okoye and Ayichi, 1995).

Factors Influencing Yam, Cassava and Rice Yields

The analysis of Ordinary Least Square (OLS) results of factors that determine crop

yields (yam, cassava and rice) in mineral mining communities of South East Nigeria were presented in tables 3. The R^2 values were 0.5410, 0.8113 and 0.5304 for yam, cassava and rice models respectively. These imply that 54%, 81% and 53% of the variations in the model were explained by the independent variables included in the model. The F-value of 44.27 (0.0000), 161.51(0.000), and 42.41 (0.0000) for yam, cassava and rice models respectively were significant at 1 percent critical value suggesting that all the models were of good fit.

Summarily, the independent variables in the three regression results shown in table 3 influenced the yield of yam, cassava and rice almost similarly. Findings indicate that these nine factors specified influenced crop yields almost similarly across the sampled states. Farm size, farming experience and level of formal education had positive and significant influence on yam yields while occurrence of civil crisis and farm's proximity to mine sites had negative and significant influence on crop yields. This

implies that mineral mining and related externalities have negative influence on crop productivity (Okon, Esheya, & Udom, 2021).

Age of the farmer, extension awareness and labour cost had negative but no significant influence on the yield of crops. However, the occurrence of chemical pollution had negative

and significant influence on the yields of cassava and rice while its influence on yam yield was negative. Thus, rational yam farmers in mineral mining host communities completely avoid areas where this prestigious crop could be prone to chemical pollution and related damages (Thakadu, 2005).

Table 3: Estimates of OLS Models of Factors Influencing Yam, Cassava and Rice Yields

Dependent Variable: Crop Yield (Yam). Variable:	Yam		Cassava		Rice	
	Coef.	t-value	Coef.	t-value	Coef.	t-value
CONSTANT	3.528731 73.88*** (0.477616)		4386.328 5.31*** (827.7318)		3.95119 (.1801939)	21.93***
AGE	-.0002776 0.30 (.0009146)	-	.0924326 0.01 (15.40753)		-.0859748 (.100088)	-0.86
FMSIZE	0069007 (.0010105)	6.83***	6193.488 33.13*** (186.9721)		.402931 (.0547613)	7.36***
LABOUR	.0002015 1.47 (.0001371)		-.7333306 0.32 (2.313477)	-	-.0871808 (.0557234)	1.56
CRISIS	-.0333151 (.0192379)	-1.73*	-208.4922 0.67 (309.4811)		-.0222043 (.0065493)	3.39***
PROXIMITY	023739 (.0180099)	1.29	-171.6103 0.57 (303.6985)		-.0124976 (.0065711)	1.90*
EXTAWARE	-.0121606 0.66 (.0184618)	-	-523.3835 1.74* (300.6586)		-.0278139 (.0065594)	-4.24***
FMEXP.	.0099226 8.62*** (.0011511)		33.53971 1.72* (19.45627)		.2370815 (.0537076)	4.41***
EDUCATION	.0086969 5.61*** (.0015502)		12.47395 0.48 (26.11959)		.0058038 (.0046994)	1.23
POLLUTION	-.0197756 0.87 (.0226245)	-	-795.4509 2.12** (374.9095)		-.037354 (.008043)	-4.64***
R ²	0.5410		0.8113		0.5304	
Adjusted R ²	0.5288		0.8063		0.5178	
F- value	44.27		161.51		42.41	
No. of observations	400		400		400	

Figures in parenthesis are standard errors. ***, ** indicate significance at 1% & 5% respectively.

Source: Field Survey, 2014.

Conclusion

The risk posed to the means of livelihood and health of the farm households in mineral mining communities by chemical pollution is real. Since little documented research has quantified the level of the threat, and little attention had been paid to reducing the risks, households continue to be exposed to toxic levels of chemical pollution. Mineral mining can bring broader benefits to a country at the expense of localized costs such as loss of agricultural output, some of them born by already poor disadvantaged group. This redistribution should be considered to better understand local opposition to mineral mining projects and demands for better compensation. Failure to recognize these social costs would

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grossly overestimate the net contribution of mineral mining to an economy.

Recommendations

- i. There is need to undertake environmental impact assessment for any mineral mining industry before its establishment
- ii. Host communities must be co-opted in the running and oversight of the industries directly impacting their area.
- iii. Mineral mining companies must adhere to international standard of practice for minimizing chemical pollution in their host communities.

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