

Identification of Some Priority Heavy Metals Driver of Environmental Degradation Caused by Agricultural Activity; A Case Study in Ebonyi State Nigeria

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Abstract

Agriculture operation remained the main emitter of top priority pollutants in the environment. This research identified actual agricultural activities that led to unabated emission heavy metal pollutant into the environment while signaling how it has contaminated agricultural yields. Descriptive statistic were used to analze quantification of the pollutants from various sources. It was reported non-sustainable agricultural operation is mother of all environmental issues verified with statistical data which showed it constituted (80%) caused ecological deterioration and deforestation. This study identified, atleast a majority (86%) of the farmers used agrochemical in their farming activities which has led to intensification of agriculture that triggered environmental degradation. Moreso, majority (88%) of the farmers used NPK fertilizer while 82% used ammonium nitrate fertilizer on their yields. It was reported that these chemical caused serious threat to life e.g N₂O in particular in severe situation. The study identified, majority (75%) of the pollutants entered into the environment through erosion (leasing) of soil nutrients. The variants responsible for determining effects conventional approach to agricultural on the environment correlation relationship was tested with multiple regression analysis the was R² 82.6% which is statistically important variables that constituted the main sources of ecological crisis. The study recommended new orientation for more sustainable context approach to agriculture to produce health food and the ecosystem.

Keywords: Unsustainable-Intensification Agriculture, Unabated-Discharge, Nature-Degradation, Ecological Crisis, Food-Contamination

1. Introduction

There is rising concerns from ecologist, environmentalist about the state of nature and its management method without prejudice to future generation accessibility to natural resources. Agriculture constitute about 80% of anthropogenic activity that led to deforestation, loss of species and desert encroachment. Agriculture is the leading source of pollution in the world. Pesticides, fertilizers and other toxic farm chemicals can poison fresh water, marine ecosystems, air and soil. In fact, it was reported that due to the surplus of nutrients from agriculture has been recognized as one of the main reasons for European water bodies not achieving good ecological status according to the European Water Framework Directive 2000/60/EC. Agricultural activity constitutes about 80% cause of annual forest deforestations. There is tendency that in future more agricultural land will be contaminated by the agrochemicals. Agricultural activities constitute main driver of global climatic change and is the only largest contributor to the rising environmental risks of the Anthropocene. This paper study tends to identify agriculture pollutant procures in the environment due to agrochemical usage as well their impact in the ecosystem.

Study by show agriculture can directly contaminate the soil through farmer's application of pesticides, herbicides and fertilizer and indirectly inputs (diffuse pollution) such as flooding and atmospheric deposition. Polluted soils can be transmitted by secondary emission such as air, surface waters, groundwater as contaminants into to oceans. Global food system is the primary driver for biodiversity loss. Biodiversity loss through agricultural operation (bush burning, tillage and farm settlement structure) will continue to accelerate, unless we change the way we produce food. The destruction of ecosystems and habitats will threaten our ability to sustain human populations and this can lead to loss of important species of biota. Industrial agriculture accounts for around 85% of deforestation worldwide. However climate change is another cause of deforestation. Extreme weather events like wildfires are responsible for an estimated 10% of degradation annually, droughts, and storm surges destroy millions of hectares of forest every year and their intensity is only increasing with global warming. The research is deemed necessary since the mainstay economic is agriculture while taking in consideration limited available of agricultural technology to the farmer. Its believe native system of farming is prevailing among local farmers hence this study is intended to investigate the consequence of unsustainable method of food production in the study area.

2.0. Materials and Methods

2.1. Study Area

The survey was conducted in Ebonyi State, Nigeria, an agrarian land whose population mainstay source of living is farming. Records shows, agriculture employed around 70 percent of the country's workforce and generated an average of 22% of GDP. There is good reason to state these non-sustainable agricultural activities has contributed to some of ecological crisis as witness impacts of climate change resulting inefficient resource management and accountability. In 2016, the population increased to 2,880,383

persons [1]. The people are known as smallholder crop farmers whom dominate agricultural production include but not limited rice, cassava, yam, potato, maize, plantain, and vegetables using inorganic method for maximum yield.

2.2. Research Design

This study adopted the multistage sampling procedure in selecting respondents for the survey. The three agricultural zones. In the first stage, three local government areas (LGAs) in each agricultural i.e. North, central and south zone. were selected. In each zone, the study selected three LGAs. In each selected LGA, three communities of farmer settlers were randomly selected. At the third stage, the study selected fifteen crop farmers in each community with track record. This made the sample size for the study four hundred and five (405) inorganic crop farmers. The main instrument for data collection was a structured questionnaire with detail explanation for easy response. It was administered to the farmers by recruited and trained enumerators on their farm gate. The paper used a questionnaire that captured the data required to answer the research questions and administered the questionnaire to the respondents. Data collected were analyzed using descriptive statistics, and the ordinary least square multiple regression was used to determine the impact of this agrochemicals usage in the environment. The level of environmental degradation (Y) was chosen as the dependent variable, while the independent variables of the respondents (rural farmers) are as follows; farming experience (X_1), Income of farmer (X_2), marital status (X_3), family size (X_4), NPK application (X_5), gender (X_6), age (X_7), genetic mutilator (X_8), educational level (X_9), growth inhibitor (X_{10}), pesticides (X_{11}), herbicides (X_{12}), preservative (X_{13}), organic fertilizer (X_{14}), farm size (X_{15}).

3.3 Implication of Agrochemical usage on food production.

The model is implicitly represented below as;

$$Y = F(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, \dots, X_{15}) \dots \dots \dots 3.1$$

The model is explicitly represented below as;

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 \dots \dots B_{15}X_{15} \dots \dots \dots \text{ET 3.2}$$

Where,

Y = Effect of use of Agrochemical in the Environment Degradation(N)

X_1 = farming experience (years)

X_2 = income level (Naira)

X_3 = marital status (married = 1, not married = 0)

X_4 = household size (number of persons)

X_5 = used NPK fertilizer (dummy variable; yes = 1, no = 0)

X_6 = gender (dummy variable; male = 1, female = 0)

X_7 = age (years)

X_8 = used genetic mutilator (dummy variable; yes=1, no=0)

X_9 = education (years spent in school)

X_{10} =used growth inhibitors (dummy variable; yes = 1, no = 0)

X_{11} = use pesticides (dummy variable; yes = 1, no = 0)

X_{12} = used herbicides (dummy variable; yes = 1, no = 0)

X_{13} = Application of preservative chemicals (dummy variable, yes=1, no=0)

X_{14} = used organic fertilizers (dummy variable; yes = 1, no = 0)

X_{15} = farm size (ha)

A priori Expectation

$B_0 > 0$

$B_1 < 0$

$B_2 > 0$

$B_3 > 0$

$B_4 > 0$

$B_5 < 0$

$B_6 > 0$

$B_7 < 0$

$B_8 > 0$

$B_9 < 0$

$B_{10} > 0$

$B_{11} > 0$

$B_{12} > 0$

$B_{13} > 0$

$B_{14} < 0$

$B_{15} > 0$

Autonomous Level of Income (B_0)

This was expected to increase with or without the effect of adopted management practices, since most of the soil are still virgin land and so needs no input before it can yield reasonable outputs.

Farming Experience (X_1)

It was expected the more experience the farmers become its will be a plus in reduction in emitting of heavy metals through agrochemical application.

Income of Farmer (X_2)

It was predicted that income quotient has significant negative effect on the unsustainable system of agriculture as the farmer tends to use more of these agrochemicals to increase their yields.

Marital Status (X_3)

This research as predicts that marital status is another driver to that push the farmers to work hard to meet the ends needs thereby contributing significantly to environmental degradation.

Family Size (X_4)

Same scenario is applicable in family size been another dominants force of need that drives farmer decision to increase their yields at all cost.

NPK Application (X_5)

Fertilizer application is expected to increase the level of nitrogen content in the soil thereby escalating environmental degradation.

Gender (X_6)

Its believe that males folk have are more active in unsustainable agriculture by using quick result based approach to increase their

yield to cater for their family.

Age (X_7)

Based the study is according to NPC (2006) youth is major habitant of the study area hence its believe it will also play a role in the results

Use of Genetic Mutilator (X_8)

It's expected that this chemical usage will be a threat to environment and safety of living organism in a long run.

Educational Level (X_9)

This study expect that educational foundation should play a positive role in discouraging use of agrochemical by farmers knowing fully the danger it may cause nature and it habitants.

Use of Growth Inhibitor (X_{10})

Its expected that as the farmers continue to use this chemical it will not only hamper the environment but will as will affects human genes in long run.

Use of Pesticides (X_{11})

This is also another key component the study expects to contribute towards environmental degradation if deploy in agricultural activities.

Use of Herbicides (X_{12})

Again this will as well be seen as priority causative factor of environmental degradation

Use of Preservative Chemicals (X_{13})

This is another element this research considered to play active role in contribution to environmental degradation.

Application of Organic Fertilizer (X_{14})

Here it's expected that farmers promote eco-friendly farming when they use organic manure.

Farm Size (X_{15})

By assumption it's expected that the greater the land use for agriculture with this chemical the higher the chances of environmental degradation.

2.2. Agricultural Pollution Into Environment Transition Mechanism

The pollutants are transfer to the environment through erosion (leaching) of soil nutrients into the water bodies, as well through atmospheric deposition. Furthermore, this pollutant can enter the environment as secondary emission such as air, surface waters, groundwater as contaminants into to oceans. Burning of forest as well decomposition and mineralization of soil nutrient is constituting major channel these pollutants e.g CO₂, N₂O, CH₄ are injected into the ecosystem. Furthermore, the routine antibiotic use in animal agriculture contributes to antibiotic resistance thereby diminishing the effectiveness of these drugs for human use.

3. Result/Discussion

3.1 Farmers Agrochemical Usage in food production.

3.1.1 Farmer Agrochemicals Usage

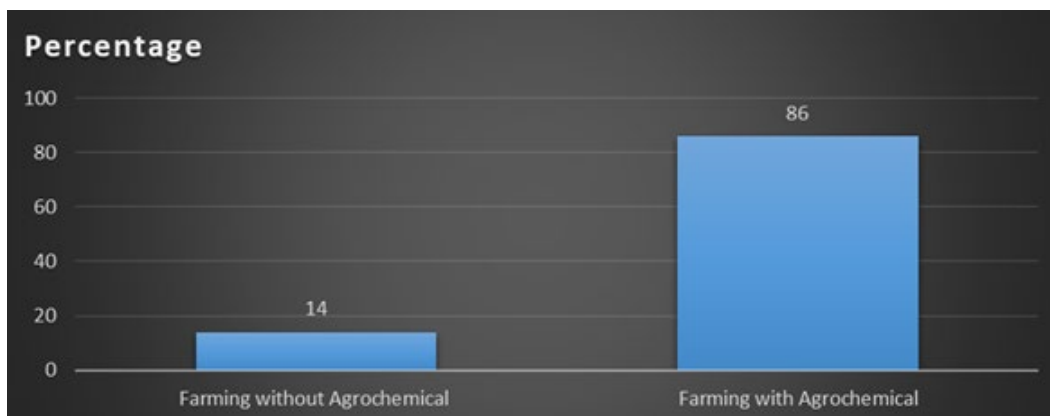


Figure 1: percentage distribution of farmers according to use of Agrochemical for farming

Source: Field Survey, 2022 *Multiple responses recorded (N=405)

The result on agrochemical used by farmers presented in figure 1 shows that the majority (86%) of the farmers used agrochemicals in the agricultural operation. Heavy application of this into the soil is very dangerous to the environment and life, there is need to introduce ecological service in the study area to cut down cost of organic farming. This will encourage sustainable farming and

reduce already accumulated nitric oxide in the agriculture land. The results agreed with United nations environment program that reported that 80% of ecological crisis is cause by agriculture This result as in accordance with who named agriculture as mother of ecological and environmental problem.

3.1.2 Frequency Distribution of Agrochemicals According the Types Used

Agrochemical Used	Frequency (N=405)	Percentage (%)
NPK fertilizer	358	88
Ammonium nitrate	336	82
Herbicides	270	67
Pesticides	341	84
Preservatives chemical	159	39
Growth inhibitor	95	23
Genetic mutilator	54	13
Source; Field Survey 2022. *Multiple responses recorded		

Table 1: Frequency distribution of farmers according to types of agrochemicals used according to survey (2022)

The results in table 1 show that NPK fertilizer contributed majority (88%) of farmers uses NPK fertilizer. This could be probably to boost their yields, follow by (82%) from ammonium nitrate fertilizer. Both result once again support study by independent group of scientist appoint by secretary general of united nation devised an indicator for determining the level of environmental

degradation. Another major (84%) recorded in this research was pesticides and herbicide (67%) these two result total aligns with a finding by indiscriminate usage of chemicals in agricultural production caused environmental deterioration, which in turn posed a threat to agricultural viability

3.2. Medium of Transfer of Environmental Pollutants

Transfer Mechanism	Frequency (405)	Percentage (%)
Erosion/flooding/leasing	305	75
Erosion/flooding/leasing	264	65
Farmworker contact	228	56
Diffusion by air	86	21
Increase in temperature range	83	20
Rainfall	78	19
Natural disaster	31	8
Field Survey, 2022 *Multiple responses recorded		

Table 2: Percentage distribution agrochemical according to method of transfer

The result on the sources of environmental pollutants presented in table 2 indicates that the majority (75%) of the pollutants enter the environment through erosion (leasing) of soil nutrients. The implication is it leads to absolute yield against actual yields expected from the applied nutrients in the soil as the plant are deprived from assimilating this nutrient also led to destruction of soil texture and contamination of water, of course endangering of aquatic lives. Another major source (65%) is contamination of agricultural byproducts. Both result is in once again agrees with the study by the indiscriminate usage of chemicals in agricultural production caused environmental deterioration, which in turn posed a threat to agricultural viability [2].

The long time danger of this to the people that feed on these ill agricultural products is serious health complication in while severe case can result to premature death. More so majority (56%) of the agrochemicals come in contact with the farmworker

during the application process. This finding agrees with (UN SDG 2019) increased pesticide usage harms farmworkers via extended exposure times and contaminate ground and surface water sources, including harming downstream users and inland fisheries Furthermore the study identified that (21%) of this agrochemical are transmitted into the atmosphere during the application phase. This finding is in accordance with a research carried out by showed that CO₂ emissions from agricultural sources account for approximately 21% of total anthropogenic GHG emissions. Other methods the agrochemical can spread across the environment includes; high temperature (20%), rainfall (19%) among others [2].

4.0. Effects of Heavy Metal On Environmental Degradation In The Study Area

The result of the multiple regression is summarizing in table 2 below.

Variant	Symbol	Coefficient	Standard Error	t-value	Level of significant
Constant	B ₀	1.359	0.098	13.867	NS
farming experience	X ₁	0.281	0.025	11.242	
income of farmers	X ₂	0.745	0.092	8.098	***
Marital status	X ₃	1.015	0.256	3.964	***
Family size	X ₄	1.455	0.903	1.611	***
NPK application	X ₅	4.254	0.335	12.694	***
Gender	X ₆	-1.231	-1.231	-1.283	*
Age	X ₇	-1.954	0.989	-1.976	*
Genetic mutilators	X ₈	1.801	0.949	1.898	**
Educational level	X ₉	5.754	0.454	12.674	*
Growth inhibitors	X ₁₀	3.467	0.506	6.852	**
Pesticides	X ₁₁	2.096	0.671	3.124	**
Herbicides	X ₁₂	1.976	0.530	3.728	*
Preservatives	X ₁₃	0.674	0.165	4.085	***
Organic fertilizers	X ₁₄	1.455	0.903	1.611	***
Farm size	X ₁₅	2.097	0.896	2.340	**
Source: Field Survey, 2022					

Table 3: Ordinary least square multiple regression analysis on the effects Agricultural activities on the Surrounding Environment in the study area.

*, represent statistical significant at 1% level of significance
 **, represent statistical significant at 5% level of significance
 ***, represent statistical significant at 10% level of significance
 NS represent not statistically significant
 $R^2 = 82.6\%$
 Adjusted $R^2 = 84.4\%$
 Durbin Watson constant = 1.445

Table: 3 shows farming experience had a significant positive influence on agrochemical usage. This implies that the more experienced a farmer is the higher he cut down agrochemical usage bearing in mind it advance effect in the environment according to study by who opined reduction the inverse effect of agriculture on the environment by adopting strong and appropriate policies and technological transmission [3].

Income had a positive and significant effect on agrochemical usage. This show that farmers tends to use more agrochemical when the have sufficient income maybe to boost their yields. Marital status generated a significant positive effect on agrochemical usage. This can simply mean married people have been known for a high sense of responsibility and the serious pursuance of means of income that invariably increase their productivity through using more agrochemical to meet their needs [3]. Household size significantly increased use of agrochemical as well rate of ecological crisis, this simply entails agriculture intensification according to FAO who reported Since population is one of the most important determinants of demand, a continuous increase in the world population increases the worldwide demand for food to meet basic human needs affirmed that farmers' family size determines the extent of their involvement in farm operations. The need for NPK fertilizer will raise the level of agrochemical as well trigger significant negative effect in the ecosystem. This quite agree with the indiscriminate usage of chemicals in agricultural production caused environmental deterioration, which in turn posed a threat to agricultural viability [4-6].

Gender had a significant and positive influence on ecological crisis, meaning that men activities has more negative impact in the environment that its folk. Maybe because men are more active in farm activities hence nature tend to be more vulnerable to the perturbation of their action. This is also pointing to the fact that more integration of gender into agricultural policy for the successful implementation of climate adaption interventions in crop farming becomes critical Age significantly increases agrochemical usage. This shows that younger crop farmers use less agrochemical. It could be because of their exposure to innovation and sustainable farming system compare to old farmers. Age of farmers were related to farmers' productivity level. Genetic mutilator has significant increase towards ecological issue. This should it contribute toward reducing quality of food product and reduce life expectancy.

Level of education shows it has both significant decreases the environmental degradation. This means the more the farmers

are educated they will understand the need to adopt sustainable agriculture and protect the environment. This is in accordance with united nation SDG 4 and 11 quality education and sustainable cities and communities respectively. Growth inhibitor show increase, meaning it will lead to the farmer loading more chemical in the ecosystem as the continue to make use of the chemical for production. Pesticides show increasing point the same toward tendency for farmer to continue to use agrochemical against the long term consequence for nature. Herbicides as well preservative both show significant increase on agrochemical usage. This in all means they above chemical constitute major environmental pollutant cause by unsustainable agriculture. The indiscriminate usage of chemicals in agricultural production caused environmental deterioration, which in turn posed a threat to agricultural viability.

Use of organic fertilizer show significant decrease in ecological damage, that simply tell us its recommendable for farmer to embrace it to reduce ecological crisis cause by agricultural pollutants continually unabated releases into the environment [1]. It is considered to be possible to reduce the inverse effect of agriculture on the environment by adopting strong and appropriate policies and technological transmission. Chlorinated water read an increase for agrochemical usage. This show us of potential damage to the environment. Hence there is need to avoid using it and use quality water consumption. Farm size also significant and negatively influences environmental degradation. This means that larger the land the less ecological issues will be experience. This quite agree with study by, shows croplands and pastures are one of the largest terrestrial biomes on the planet, occupying ~40% of land surface, probably more since its over 18 years after this was documented. Fertilizer application knowledge, signal positive influence on agrochemical usage. This tell us how it can lead to more agrochemical pollutant in agriculture land if continue use. Ammonium nitrate with positive value show it play great role in loading the ecosystem with pollutant after being used by farmer. The implication of this have already been reported here by whom clearly put it this way the indiscriminate usage of chemicals in agricultural production caused environmental deterioration, which in turn posed a threat to agricultural viability [7].

Conclusion

The research specified the preliminary factors of influence on agrochemical usage. They are:

Increase in yields that attract higher income for the farmer. This shows that agrochemical usage has huge role to play to enable farmer achieve target quantity of yields even though this does not in any way guarantee food safety for the consumers or encourage eco-friendly agricultural practice. Need for NPK fertilizer negatively impact in the environment by causing degradation as well decline in essential microbial activity in the soil. Income is strong factor that enhance the farmer proximity to use agrochemical while gender as well show that men are the major user of agrochemical this show of their active nature in agriculture then their folk. farmers are male, literate, married, experienced, smallholders who uses agrochemicals like ammonium nitrate,

NPK, herbicides, pesticides and preservative enhance their yield and preserve it since the lack basic amenities and storage facilities. The study shows that majority of the agrochemical pollutant are transfer to the environment by flooding as well contamination of agricultural by-product [8-20].

Haven seen agriculture constitute 80% anthropogenic activities as is main economy mainstay especially in tropical region of the world, it will be absolutely brilliant to encourage farmers, and corporate society to sustainable intensify agricultural production to reduce rate of land expansion for farming. The effects of the agricultural operation were significant with the results of ordinary multiple regression analysis showing the overall independent variable determinant R² 82.6% this show that the heavy metals generated during agricultural is statistically significant to influence the state of the environment in the study area. Furthermore, farmer should shift towards organic farming and ecological services to neutralize cost effect. Environmental preservation, conservation education should be made compulsory for everyone by appropriate arm to promote environmental safety practice. And lastly there is need for new orientation for more sustainable context approach to agriculture to protect our environment [21-30].

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