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Research Article

EVALUATING THE RELATIONSHIP BETWEEN GAS FLARING AND AGRICULTURAL OUTPUT IN ETHIOPE WEST LOCAL GOVERNMENT AREA

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Abstract

The study examined the effect gas flaring on agricultural output in Delta State, Nigeria. The agricultural output consists of cassava, yam and pepper. Likewise, farmers' income was included in the model as a control variable. The study relied on primary data through collection of questionnaires using simple random sampling of 800 respondents. Two gas flare stations located in Sapele and Oghara were used for the study. The targeted respondents provided information of the yields of crops on 200, 400 and 600 kms away from the flow stations. The information was processed, classified and econometric technique was utilized to explore the relationship. Accordingly, the study found that gas flaring had significant negative effect on all three agricultural output. Therefore, it was recommended that government put in place necessary and effective polices to eliminate gas flaring or even reduce it to the barest minimum.

Keywords: *Gas flaring, Agricultural productivity, Regression Model.*

1. Introduction

One of the most difficult issues currently facing the world is gas flaring which is a process of getting rid of waste gases that naturally arise during the refining of crude oil through the top of a pipe or stack where the burner and igniters are positioned (Raji & Abejide, 2013). According to Ukhurebor *et al*., (2024), gas flaring is an important aspect of the combustion mechanisms in the burning of related, undesirable or surplus fluids that are released during the ordinary over pressuring process in several industrial activities, most especially in the petroleum resource industries. The authors submitted that gas flare is one of the major sources of greenhouse gas emissions which cause climate change. In addition to the generation of noise and heat, it makes substantial adjacent areas uninhabitable and, hence, causes detrimental consequences to the entire ecosystem as well as waste energy leading to economic losses.

Gas flaring, which is a common practice in many countries, has been associated with environmental and health concerns that has becomes an issue of national importance. In the Niger Delta. gas flaring significantly reduces agricultural output by damaging soil, air, and water quality, impacting crop growth and productivity. The combustion of petroleum-based products, mostly oil, gas, and coal, has warmed the planet by producing carbon dioxide, the principal greenhouse gas (Ellen & Barry, 2005). Several tons of carbon and other pollutants are emitted into the atmosphere on a daily basis that poses threat to nearby communities around the world. According to the World Bank Global Gas Flaring Tracker report, thousands of gas flares at oil producing facilities around

the globe burned almost 139 billion cubic meters of gas in 2022. The report submitted that 350 million tons of CO2 equivalent emissions are produced annually by gas flaring along with 42 million tons of unburned methane. Observably, studies have indicated that crops within 200 meters of flaring sites experience nearly 100% yield loss, with losses gradually decreasing with distance. For instance, the rural population in sub-Saharan Africa (SSA) accounts for 61.4% of the total population where more than 60% of the population are smallholder farmers. In Nigeria, agriculture contributes 22.4% of total gross domestic product while over 70% of Nigerians work in the agricultural sector at a subsistence level (Uchegbulam *et al*., 2022). Flaring of associated gas from oil exploitation has several consequences on the environment. There are several hundreds of cases involving gas flaring from petroleum related activities that have occurred in the Niger Delta since the first noted case of gas flaring in 1956. The flaring of associate gases from petroleum and its derivatives has continued to affect the entire ecosystems of the region (David *et al*., 2023). Gas flaring has been made illegal in Nigeria since 1984, yet the country still ranked among the top 10 gas-flare countries with about 7.9 billion cubic meters of gas flared in 2023 and about 444.9 billion standard cubic feet of gas flared in 2023 (Ezinna *et al*., 2024)

Observably, of serious concern is agricultural productivity in the oil-producing areas which has been severely hampered by gas flaring. The combustion process raises the soil temperature, with a decline in crop yield and acid rains as its two major ripple effects. The smokes which emanate from the flares also lead to black rainfall and water bodies which affect aquatic and Wildlife (McGreevey& Whitaker, 2020). The economic costs of gas flaring are mind-boggling. According to data obtained from the Nigerian Gas Flare Tracker showed that 25.9 billion Standard Cubic Feet of gas valued at ₦600.5 billion were flared between January and November 2023. Analysts argued that such a whooping amount would comfortably finance the capital expenditure of Ministries of Education, Power, Defence and Transport which stood at a combined total of ₦500 billion in 2022. Also, the volume of gas flared is capable of generating 42,600 megawatts of electricity which would have helped solve the electricity problem of the country. Accordingly, millions of dollar worth of useful gas are flared every day.

A number of studies have been conducted on the effect of gas flaring on agricultural output and most of the studies found evidence of negative relationship between the variables (Obioma, 2019; Elijah (2022; Uchegbulam, *et al*., 2022). These studies were aggregated in nature and therefore failed to assess the response of sector specific output productivity to changes in gas faring thereby creating a lacuna in the extant literature. It is against this backdrop that the current study is germane. The rest of the paper is organized as follows. A brief review of related literature is contained in section two while technique of data analysis is outlined in section three. Whilst section four presents results of findings, the paper is concluded with policy remarks in section five.

2. The Literature Review

Gas flaring is the burning of natural gas and other petroleum hydrocarbons in flare stacks by upstream oil companies in oil fields during operation. It is the controlled combustion of associated gas generated during various processes including oil and gas recovery, petrochemical process and landfill extraction (Generon.com, 2019). Gas flaring is an important aspect of the combustion mechanisms in the burning of related, undesirable or

surplus fluids that are released during the ordinary or unexpected over pssuring process in several industrial activities most especially in the petroleum resource industries (Ukhurebor, *et al*., 2024). It is one of the major sources of greenhouse gas emissions that affect climate change. In addition to making disturbing noise and heat, it makes the surrounding areas uninhabitable and, hence, causes detrimental consequences to the entire ecosystem as well as waste energy thereby resulting in economic losses.

On the other hand, agricultural productivity refers to output from agricultural crops. It consists of all the factors of production such as labour, capital, farming experiences, availability and management of water and other biological factors. Capital refers to cash and other man-made farm assets that are required to carry out production. The concept of productivity is simple; at a given level of input, there is a given level of output. More productive societies and processes will yield more output at the same level of input. Agricultural productivity is measured as the ratio of agricultural outputs to inputs. While individual products are usually measured by weight which is known as crop yield, varying products make measuring overall agricultural output difficult. In a similar vein, agricultural production means the production of any growing grass, crops or trees attached to the surface of the land or farm animals with commercial value. The main factors that influence productivity in the agriculture industry include farm size, access to inputs and markets, farm management practices, environmental factors and access to credit facilities (Uzoekwe, 2019).

From the empirical corridor, copious empirical studies in the extant literature that have assessed the effect of gas flaring on agricultural output abound and mixed findings have been reported. In their study, Ukegbu and Okeke (2017), they observed that effects of gas flares on the growth, productivity and yield of selected farm crops near Izombe flow station in Imo State recorded severe decline. The study found evidence of 100% loss in crop yield in all crops cultivated about 200 meters away from the flare, a 45% loss for those about 600 meters away, and a 10% loss in yield for crops about 1000 meters away from the flare. The effects were reduced with increase in distance from the flare site. In a similar study, Uzoekwe (2019) submitted that most oil fields in Nigeria are characterized with flaring of substantial quantity of associated gas in the process of crude oil production. His study evaluated the effect of gas flaring on the fertility of agricultural soil in oil and gas producing community in the Niger Delta in Nigeria. The study collected soil samples around four flare stations, East, West, North and South at 200m, 400m, 600m and 800m distances. These samples were compared to other sets collected from far away from the gas flare points which serve as control. Following standard protocols of testing, the results indicated a significant variance between the soil characteristics in flaring locations and the control for each of the parameters. Also, the study observed decline in some of the parameters as the distance away from flare stack increased thereby suggesting possible evidence of flare from oil field on soil characteristics with the result that the fertility of the soil may have be impended. Similarly, Kiani and Olisa (2021) assessed to what extent environmental and government efforts are posited to address gas flaring in Okrika and Eleme Local Government Areas of Rivers State. The study employed questionnaire technique in data collection and utilized simple percentage for the analysis. It was observed by the study that over 70% of the respondents submitted that flaring

of gas in the region had deteriorated the environment and the socio-economic health, income and vegetation in the region.

In a related study, Elijah (2022) examined the effect of crude oil exploration and associated gas flaring on the physiochemical properties of the soil, water and air quality in the Niger Delta region. Accordingly, the physiochemical parameters of rain water, soil and air quality in some selected communities were tested by the study and results revealed that gas flaring had significant negative impact on the soil, water and air components of the environment most especially impacting areas very close to the flaring site. In another study, Alimi and Gibson (2022) averred that weak regulations and limited environmental monitoring make gas flaring an attractive choice for oil producers. Their study employed infant health data from Demographic Health Surveys and satellite-detected data to scrutinize the effects of gas flaring on disease incidence and infant mortality in oil-producing Niger Delta region of Nigeria. Accordingly, they found evidence of strong positive association between gas flaring and the incidence of respiratory diseases and fever among children younger than five years of age. Likewise, Uchegbulam, *et al*., (2022) appraised the effect of gas flaring on the sustainability of the environment. They found that the upstream emissions from flared gas led to precipitations of acid rains and anthropogenic emissions thereby leading to over 250 toxins that have caused innumerable adverse effects on the Niger Delta communities. Likewise, the study further noted that the toxins from the adverse emissions caused climatic changes and global warming to the international community. Accordingly, the environmental effects encompass air, soil, water, heat, light, noise pollution and loss of biodiversity and vegetation which have inflicted severe impacts on the socioeconomic health of the Niger Delta residents. This is besides deterioration of roofing sheets in houses.

In a recent study, David, *et al*., (2023) documented the effect of oil pollution on sources of livelihoods in the Niger Delta. A simple random sampling technique was employed for the selection of 837 crop farmers. Also, descriptive statistics and inferential statistics were similarly utilized to test the hypotheses. The study found that within the period under review, average number of oil spills is 186.5 while the quantity of oil spilled is 48,346.5 barrels, quantity recovered was 3,327.6 barrels while quantity loss to the environment is 45,018.9 barrels. Likewise, the study further found that gas flaring affected farmers crop yields and also exerted significant negative impact on farming activities leading to low productivity and degradation of fishing and farming sites. Among other things, the study recommended the use of Geographical Information Systems (GIS) as an operational tool in ascertaining Information on the exact position and size of the oil spill. In a more recent study, Ezinna *et al*., (2024) saw gas flaring as double jeopardy of wasting valuable energy resources and environmental degradation which are major contributors to Green House Gases emissions, global warming, climate change crisis resulting in acid rains as well as agricultural and aquatic food chain disruption. The study attempted to determine if zero hunger can be achieved in the area by 2030 in the midst of agricultural rich environment. The study adopted documentary research method, leveraged on Public–Private Partnership (PPP) and Win–Win Concept as

frameworks of interpretation and revealed that ending gas flaring is associated with inherent economic growth, environmental preservation and sustainable livelihood in and beyond Niger Delta.

In Bangladesh, Aktar *et al*., (2024) assessed the influence of gas flaring on soil quality in the surrounding areas of Kailashtilla largest gas field. The study assessed the effect of chemical, microbiological and physical characteristics on soil samples collected from three union zones. The study found presence of considerable influences on soil quality with several physical and chemical characteristics failing to meet the standards for healthy plant growth. Also, the study found that gas flaring severely affected bacteria in the soil, with the highest number being found farthest from the flaring zone. Finally, findings indicated that particular gas flaring may have a deleterious influence on soil bacteria, which could have further consequences for the ecosystem.

3. Methodology

The study employed survey research design method in data collection process that was filtered and classified for further empirical investigation. The study was carried out in Oghara in Ethiopia West Local Government and Sapele Local Government which in Delta State. Two gas flaring stations, namely Seplat energy flow station, Sapele and Pan Ocean flow station in Oghara were used for the study.

Method of Data Collection

The study used personal interview and analytical technique of econometrics. Accordingly, a sample of 800 questionnaires were distributed to respondents. The information collected focused on the yields from cassava, pepper and yam from farms situated on 200, 400 and 600 meters away from the flow points respectively. Likewise, selected respondents from the sample were interviewed personally and through some commissioned agents to ease the difficulty arising from logistics.

Method of Data Analysis

The study used econometric technique for the analysis of the data. The model assessed effects of gas flaring on cassava, yam, pepper and income of farmers as follows.

$CAS = \square_0 + \square_1 GSF + \square t$.....(1)

$YAM = \square_0 + \square_1 GSF + \square t$.....(2) $PEP = \square_0 + \square_1 GSF + et$.....(3) $INC = \square_0 + \square_1 GSF + \square t$.....(4)

Where:

CAS = output of casava, YAM = output of yam, PEP = output of pepper, INC = farmer's income, α0, β0, ωo and δ0 are constants while α1, β1, ω1 and δ1 are the parameters to be estimated. Likewise, εt, μt, et and πt represent white noise errors. Accordingly, probit regression techniques adequate for primary data were employed for the estimations.

4. Presentation of Result

Table 1: Estimation Results

Model 1

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Dependent Variable: CAS				
Variable	Coefficient	Standard error	t-stat	Prob
GSF	-0.24	0.08	-3.00	0.02
R^2 = 0.87, DW = 1.98, F-stat = 3.43				
Model 2				
Dependent Varia ble: YAM				
GSF	-1.22	0.23	-5.30	0.00
R^2 = 0.79, DW = 1.88, F-stat = 4,20				
Model 3				
Dependent Variable: PEP				
GSF	-0.39	0.14	-2.76	0.03
R^2 = 0.94, DW = 2.00, F-stat = 3.34				
Model 4				
Dependent Varia ble: INC				
GSF	-0.77	0.24	-3.21	0.00
R^2 = 0.92, DW = 1.86, F-stat = 2.99				

Source: Extracted from Eview 12

From the results in Table 1, the models displayed relatively robust goodness of fits which range between 0.79 to 0.94 suggesting that gas flaring accounts for 87% variation in casava output, 79% in yam output, 94% in pepper output and 92% in farmers' income level. Likewise, The DW statistics revealed absence of auto correlation while the F-statistics indicated evidence of statistically significant for all four models. A cursory look at the results show that gas flaring exerted significant negative effect on all four variables. For instance, the findings show that a unit increase in gas flaring led to 0.24% decrease in casava output, 1.22% decrease in yam output, 0.39% decrease in pepper output and 0.77% decrease in farmers' income level. These findings are similar to the studies of Uzoekwe (2019), Elijah (2022), David, *et al*., (2023) and Aktar *et al*., (2024) who have earlier documented similar evidence.

5. Conclusion and Recommendations

The study focused on the relationship between gas flaring and agricultural productivity in the Niger Delta region of Nigeria. The output of agricultural sector upon which effect of gas flaring is assessed include casava, yam and pepper. Similarly, the extent to which gas flaring affects farmers' income was also investigated. The study employed econometric technique for the investigation and found that gas flaring exerted significant negative impact on agricultural output as well as the income of the farmers in the Niger Delta. The major conclusion which

can be drawn from the study is that increase in gas flaring helps to contribute to food depletion leading to high prices of these essential commodities. This is besides its adverse effect on health of the people living or farming close to the gas points. Also, this explains the reasons while most rural dwellers who depend on farming as means of livelihood wallow in abject poverty. Therefore, it is recommended that government may take urgent steps to address gas flaring in the Niger Delta region in order to boost food production and increase farmers' income.

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