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Impact of Oil Pollution on Environment of the Niger Delta, Nigeria: The Structural Equation Modelling Approach

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ABSTRACT
Between 1996 and 2013, an estimated 757 thousand barrels of crude oil were spilled, while 45.9% of total natural gas produced was flared in the Niger Delta region of Nigeria. The extended period of uncontrolled oil and gas production has resulted in large scale degradation of the Nigeria's oil-producing region. While the effects of pollution on the environment have been explored by previous studies, little attention has been paid to the separate impact of oil and gas pollution on the environment. This study was therefore designed to examine the independent effects of oil and gas production on the environment (air, water and land) of the Niger Delta. The study was anchored by an exploratory survey. Afiesere, Ekeremor and Iwerekan communities in Delta State and Ayetoro, Ilaje and Oroto communities in Ondo State were purposively selected based on large cases of oil spillage and gas flaring. A sample size of 400 was generated using Taro Yamane Formula. However, only 200 copies of a structured questionnaire were purposively administered due to the prevalence of insecurity in the communities. The selected respondents had some level of education, were receptive and not aggressive towards the field enumerators. A structural equation modelling technique was adopted for the data analysis. The age of the respondents was 37±10 years, females were 56% and fishermen/farmers were 80%. A minority 6% did not have primary education. Major findings revealed that while oil spillage was the major pollutant of water (β=0.55), gas flaring was the major pollutant of air (β=0.53). Both oil spillage and gas flaring negatively affected land in almost the same way (β= 0.33 and β=0.29, respectively). In conclusion, oil spillage has a strong impact on the environment of the Niger Delta. There is therefore the need for the government to renew its regulation towards controlling oil pollution in the oil-rich communities of the Niger Delta.

Keywords: oil pollution, environment, structural equation modelling, Nigeria

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I. INTRODUCTION

Since its independence in 1960, Nigeria has engaged itself in a number of sources of revenue to provide sustainable development. The first decade of independence credited agriculture as the mainstay of the Nigerian economy. With the discovery of oil in Oloibiri in 1958 in large quantity, attention was shifted from agriculture to oil activity. This was consolidated by booms in international oil market in the 1970s. Since then, Nigeria has been running a mono-cultural economy, relying majorly on oil exportation for the implementation of over 80% of its budgets and development plans (Ayinde et al., 2015; Aregbeyen and Kolawole, 2015). Thus, the oil sector is the most attractive sector in the Nigerian economy (Adelagan and Out, 2020). However, in spite of the huge funds accruing from its oil and gas sector, the Nigerian state has not been able to meet up with the expectations of the citizenry. The economy is infrastructure deficient (Ogunlana et al., 2016), beset with poverty (Chiedu, 2018) and scores poorly on the human development index (Ita, 2020). The pitfalls of commercial oil exploration are more pronounced at the sub-national level. Not only is the base of production poorly developed, the Niger Deltan environment is badly managed (Oyebode, 2018).

At the close of the twentieth century, the Niger Delta region[1] was rated as the most oil-polluted area in the world by environmental experts (Omoweh, 1995; Manby, 1999).The rhetoric has not changed till present. A

[1] The Niger Delta region is presently composed of nine-states. They include Akwa-Ibom, Bayelsa, Cross- River, Rivers, Delta, Edo, Abia, Imo and Ondo States. The region is characterized by wetlands and water bodies with large mangrove forests and a network of creeks and rivers criss-crossing the entire region, with an aquatic splendor. The large expanses of mangrove forests are estimated to cover approximately 5,000 to 8,580 km² of land (Nwilo and Badejo, 2008)

major contributor to this is the perennial gas flaring of associated gas during oil production, which has impacted on the natural and human environment, making the region less habitable. More gas is flared in Nigeria than elsewhere in the world (Croitoru, 2020). Estimates are notoriously unreliable, but roughly 2.5 billion cubic feet of gas associated with crude oil is wasted in this way every day. This is equal to 40% of all Africa's natural gas consumption and 15% of Germany's annual natural gas consumption while the annual financial loss to Nigeria is about USD 2.5 billion (Croitoru, 2020).

Gas flaring is a natural by-product of oil production (Omoweh, 1995). It is a means of disposing of waste gases and occurs during the processing of crude oil through the top of a pipe or stack in which the burner and igniters are located (Esu and Dominic, 2013). This illustrates that gas in the production process burns clean until oil enters into the flare pipelines through the operating machine. Gas flaring poses serious environmental and health hazards particularly when it occurs very close to local populations (Nkwunonwo and Mafimisebi, 2013). Vast quantities of toxic chemicals are released through flaring, including nitrogen dioxide, sulphur dioxide, and volatile organic compounds. Persons inhaling air polluted with such chemicals and substances may suffer from a number of respiratory ailments. These chemicals were reported by Mafimisebi and Ogbonna (2016) to contribute to prevalence of asthma, breathing difficulties, pains and chronic bronchitis among those living in the Niger Delta. Moreover, the flares burn at temperatures of thirteen to fourteen thousand degrees Celsius, bringing about not only air and noise pollution but acid rain that rots corrugated roofs and generates sulphur emissions (Mafimisebi and Thorne, 2016).

Another environment-damaging aspect of oil operations is oil spillage which simply describes non-commercial releases into soil or water of crude oil or its waste, caused by equipment failure, operation mishaps, human error or deliberate destruction of facilities arising from criminal activity (Nwilo and Badejo, 2008). Oil spills have been a common phenomenon in the Nigerian oil producing states particularly between 1976 and the 1996, during which time a total of 4,835 spills leaked about 2,446,322 barrels of oil into the lands and waters of the Niger Delta region (Ordinioha and Brisibe, 2013). And between 1996 and 2010, 3658 spill cases occurred with total oil spilled reaching 757 thousand barrels (Ordinioha and Brisibe, 2013). The extent of environmental damage of oil spills rests heavily on pipeline sabotage (Ikelegbe, 2005; Amnesty International, 2013). Possible damaging implications of spillage on the community are summarized by Olisemauche and Avwerosuoghene (2015) to include soil degradation, loss of critical natural ecosystems, and the toxic contamination of surface drinking water with high hydrocarbon levels[2]. This highlights the possible impact of oil spillage on safe living in the victim area. Noting that the environmental effects of oil spillage and gas flaring are contagiously damaging, Olisemauche and Avwerosuoghene (2015) ranked environmental degradation as second to economic depression, as one of the problems Nigeria is currently facing.

While the literature is awash with studies that have investigated the impact of oil pollution on the environment of the Niger Delta, most researches have adopted skeletal analytical techniques such as descriptive analysis (averages, ratios and percentages), simple regression (one-variable), parametric tests (t-test and ANOVA) to non-parametric analysis (Chi-square and dummy analysis). There are few studies that have applied more robust and informing approaches like logistic regression, computable general equilibrium and partial regression analysis. However, these popular research methods lack precision and reliability given that the variables making the structure of the inquiry are not directly observable. This study is credited to provide answer for this inadequacy by employing structural equation modelling which specifically traces an effect to its origin by measuring latent variables through observed variables and evaluates the level of statistical significance between variables in a more informed manner.

II. REVIEW OF RELATED LITERATURE

Raji and Abejide (2013) explored the impact of oil production on the Niger Delta environment over time, with particular attention to the Ijaw oil-producing communities. By using scientific reports and statistical data, they argue that the environmental problems facing the Niger Delta people are multifaceted with oil and gas exploration being major contributor through its attendant effect on water and land degradation. The paper cited lack of compliance with environmental laws and poor institutional structure for enforcement as factors undermining the desire of the region for a clean environment, particularly toward sustainable development. Ede and Edokpa (2015) updated this assertion by claiming laws on environment, as they pertain to air quality regulations, are presently very weak in Nigeria and existing environmental standards do not include specific provisions for all possible emission sources.

In their empirical quest to evaluate the degree of damage to water and land occasioned by fossil fuel booms, Oloruntegbe, Akinsete and Odutuyi (2009) took water and soil samples from four locations in the oil exploration areas of Niger Delta for experiment and two locations outside the area for control. The samples were

[2] Water samples taken in the Niger Delta have contained hydrocarbon levels as high as 680 times the level allowed in drinking water in the European Union (Manby, 1999).

investigated for temperature, pH, dissolved oxygen, salinity, oil and grease and heavy metal sediments. The results of the analysis revealed immense hydrocarbon pollution (high temperature, low pH, reduced dissolved oxygen, increased salinity, oil and grease, and heavy metal ions concentrations) relative to what obtains elsewhere. Except for temperature, the acceptable limits for aquatic lives and agricultural practices were exceeded.

The research of Oloruntegbe, Akinsete and Odutuyi (2009) concluded that the effects of these deviations are noticeable in decrease infishing resources, damage to marine flora and fauna, loss of biodiversity, deforestation, coastal and marineerosion and flooding in the Niger Delta. Similar logic was used by Nkwocha and Pat-Mbano (2010) in assessing the effect of gas flaring on the built environment. A sample of 106 buildings from two gas-rich rural communities (Obrikom and Omoku) was used for the investigation which lasted 11 months. The research combined modelled and measured estimates, emissions inventory, expert judgment and location data to show that SO_2, NO_2 and PM_{10} were the major pollutants that may have acted as causative agents of the observed impact (corrosion of roof tops, coloration of walls, leakage of roof tops, etc), due to their toxic properties. There was high positive correlation between pollution levels and the level of impact on the sampled buildings. Nkwocha and Pat-Mban's findings were in tandem with those of Drisko and Jenkins (1998).

Ede and Edokpa (2015) evaluated the air quality in the Niger Delta region, with the conclusion that suspended particulate matter in the region's atmosphere ranged from 40 μg/m3 in Brass to 98 μg/m3 in Port Harcourt; carbon monoxide concentrations were highest in Mbiama (191 μg/m3); nitrogen dioxide concentration was highest in Bonny (187 μg/m3), and sulphur dioxide concentrations ranged from 19 μg/m3 in Ukwugba to 90 μg/m3 in Port Harcourt. The short-term limits for the pollutants exceeded World Health Organization (WHO) standards. Earlier, Opafunso (2005) administered well-structured questionnaires in select oil and gas producing communities in Rivers, AkwaIbom, Delta and Bayelsa States to identify the problems associated with gas flaring. His results showed that the environmental impact of gas flaring in these communities include retardation of plant growth, depletion of aquatic animals and disturbance of mangrove swamps. The observed health effects include excessive heat radiation from gas flares, high noise levels of the burning flare stack, perpetual lighting from the flames and breathing in of toxic gases. The study concluded that there was a significant relationship between environmental hazards from gas flaring and discomfort suffered by the inhabitants of oil producing communities.

Oyinloye and Olamiju (2013) was one of the few studies that assessed the environmental impact of oil spillage using secondary data. Their research relied on supervised image classification method. Employing sophisticated software (ILWIS 3.2 GIS) to classify ground cover into oil spill area, bare land/cultivation, built up areas and vegetation, they found that oil spillage was increasing unabated, damaging the ecosystems of Jesse Town of Delta State. In support of this, Ejiba, Onya and Adams (2016) maintained that oil spillage has resulted in substantial destruction of the once green delta environment turning large section of the region into wastelands. This situation if not managed properly could spiral into hopelessness especially amongst the youth and present itself as a recipe for social conflicts.

Egwaikhide and Aregbeyen (1999) drew attention to the paradox of oil wealth in the Niger- Delta region. Although the region produces the largest proportion of the country's crude oil, only a few of the transformational effects and benefits generated by oil have accrued to the region and its residents. Besides this, the region has suffered substantial negative externalities arising from oil production activities. The externalities include seismic surveys, canalization, poor waste disposal, oil spillage and gas flaring. The paper concluded that a satisfactory solution to the externality problems lied in a fiscal restructuring that would ensure that the oil producing firms bear the full costs of their externality-generating activities. The study therefore recommended a pollution tax to be borne directly by the oil firms in addition to the assignment of sufficiently-high weight to the derivation principle. And Babatunde (2010) noted the weaknesses of existing legal and institutional arrangements as the constraints to effective pollution control and management in Nigeria. The study identified untreated industrial and human wastes, gas flaring, oil spills, heaps of uncollected garbage and indiscrimination disposal of hazardous waste as the major sources of pollution in the country. According to the study, there was the need to improve the institutional capacity and adopt economic management measures for management of pollution problems in the country.

Iheriohanma (2016) blamed the environmental cost of oil activities on the multinational oil companies who use less stringent enacted laws to take advantage of the host communities. The research submited that social and environmental cost of oil production in the Niger Delta region has been extensively and unprecedentedly damaging. Earlier, Odisu (2015) wasunequivocal in his claim that the Shell Petroleum Development Company (SPDC) has not done remarkably well in terms of environmental remediation and improvement in quality of lives in oil-bearing communities whose inhabitants are plagued with occupational disruptions and environmental hazards. Nonetheless, there are studies that noted that the damaging environmental impact of fossil fuel exploration seemed natural (Kretzmann and Wright 1997; Manby 1999). The thrust of such studies is that it is practically impossible to produce oil and gas without causing some pollution and related accidents.

III. 3METHODOLOGY

The analytical technique used in this study is centered on the structural equation modelling (SEM). The choice of SEM is linked to the presence of latent variables in the model and the need to demonstrate indirect interactions among the variables which possess causal power on one another. This technique is described as follows.

3.1 The Structural Model

The structural model contains exclusively the latent variables which are not directly observable. These variables are oil pollution and environmental impact. It is no puzzle that there is no area-bound time series data on oil pollution in Nigeria. Rather what we have is aggregate number of oil spills and corresponding volumes of oil lost and the total units of gases flared at a point in time. This is not considered representative of the intent of this study. Also, data on how much of environmental damage due to oil pollution is not available in Nigeria. The inability to measure these key variables directly is what informs the use of SEM. The working hypothesis is that oil pollution affects environment directly. The following path diagram summarizes the structural model.

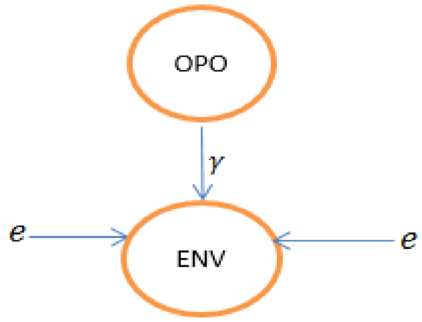

Figure 1: Path diagram of latent variables

Where OPO is oil pollution (exogenous latent variable) and ENV is environmental impact (endogenous latent variable). γ is the structural parameter of the model and e is structural disturbance term which is normally distributed with zero mean and constant variance and they are non-autocorrelated.

3.2 The Measurement Model

The measurement model discusses the constructs for the latent variables. The constructs or proxies are specifically related with the theoretical foundation as well as empirical context of the present study. Oil pollution is rooted in oil spills and gas flares, so these two are taken as observable exogenous variables, proxy for latent oil pollution. Environmental paralysis is indicated by damage to water, land and air. The path analysis of the measurement model is therefore given as:

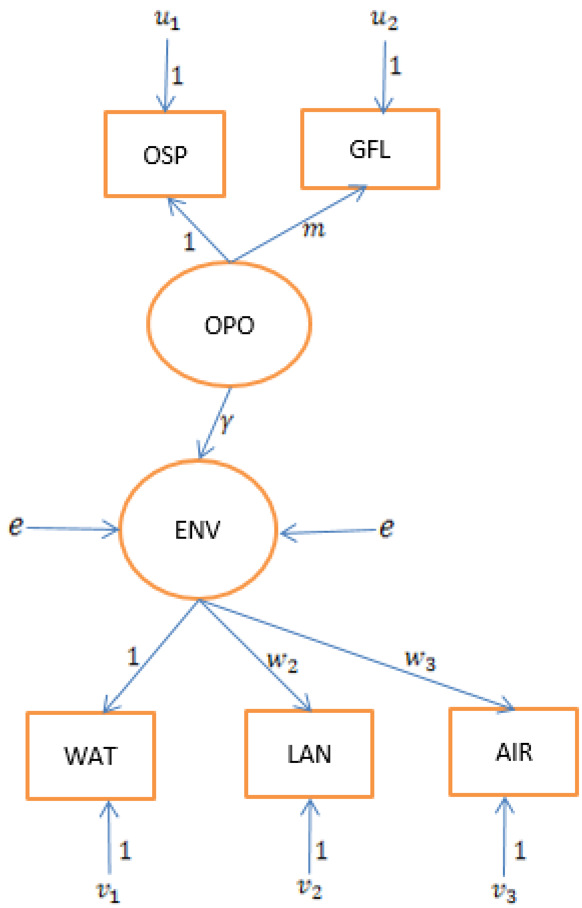

Figure 2: Path diagram of observed variables

Oil spillage is measured by respondent's response to degree of exposure to oil spillage (OSP) and gas flaring is measured by respondent's response to degree of exposure to gas flaring (GFL). Impact of oil pollution (OPO) on the environment (ENV) is indicated by water pollution (WAT), land pollution (LAN) and air pollution (AIR). m, w_2 and w_3 are measurement parameters of the model and $e, u's$ and $v's$ are all measurement errors. The constant term 1 that appears next to paths from measurement errors to indicators represent the assignment of a scale to each term; and the constant term 1 on the path running from a latent variable to an indicator sets the latent variable's scale to that of the observed variable.

In reduced form, the structural and measurement models can be presented as:

$$p = \gamma q + e \qquad (1)$$

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ m & 0 \end{bmatrix} [q] + \begin{bmatrix} u_1 \\ u_2 \end{bmatrix} \qquad (2)$$

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ w_2 & 0 \\ w_3 & 0 \end{bmatrix} [p] + \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix} \qquad (3)$$

Where p is environmental impact and q is oil pollution. x_1 is oil spillage and x_2 is gas flaring (exogenous observed variables); y_1, y_2 and y_3 are water pollution, land pollution and air pollution, respectively (endogenous observed variables); γ is coefficient of causal path from exogenous to endogenous latent variables; m, w_2 and w_3 are factor loadings; and e, $u's$ and $v's$ are residual terms.

3.3 Population and Sample

The population in this study is the total number of people living in the Niger Delta. However, Afiesere, Ekeremor and Iwerekan communities in Delta State and Ayetoro, Ilaje and Oroto communities in Ondo State were purposively selected based on large cases of oil spillage and gas flaring. A sample size of 400 was generated using Taro Yamane Formula. However, only 200 copies of a questionnaire were purposively administered due to the prevalence of insecurity in the communities. The selected respondents had some level of education, were receptive and not aggressive towards the field enumerators. The structured questionnaire contained information on respondents' demographics, oil pollution experience, observed land degradation, the extent of water pollution and the experience of polluted air. The SEM developed from the latent variables (oil pollution and environmental damage) and observed variables (oil spillage, gas flaring, air pollution, water pollution, and land pollution) was applied in estimating the data using Ordinary Least Squares method.

IV. RESULTSAND DISCUSSION OF FINDINGS

4.1 Demographic Characteristics of Respondents

The average age of respondents was 37±10 years; they were mostly female (56%); majority (60%) were married and more than one-third had at least four children. About 70% of the participants claimed they have been living in the sampled communities since they were born. This would lend credibility to their opinions regarding oil pollution and its environmental impact within their neighborhoods. The reported average income of respondents was 17,000 naira per month. As of the period of survey, this was less than the minimum wage in both Ondo and Delta states (30,000naira per month). The respondents' sources of wealth were mostly fishing and farming. About 46% of respondents did not go beyond primary school while 6% did not have any formal education.

4.2 Impact of Oil Pollution on the Environment

According to most respondents (73% on average), oil spillage has caused land pollution in the oil communities, including land degradation and land infertility. There were also cases that unplanned discharge of oil contributes to making roads not motorable, making the community to be generally dirty. The participants also responded that incidences of oil escaping on their rivers have made water in the local communities not suitable for drinking (81%), not suitable for cooking (68%), not suitable for bathing (72%) and not suitable for washing (77%). In addition, the respondents related indiscriminate air pollution in their local areas to scenarios of oil spillage. Similar story holds for the impact of gas flaring on the environment. The inhabitants of the host communities claimed that activities involving gas flaring have paralyzed their farms (61%), houses (63%), roads (54%) and markets (55%). This marked the major impact of gas flaring on land pollution. They were also of the opinion that flaring gases in areas close to where they live has made their water not suitable for drinking (72%), not suitable for cooking (71%), not suitable for bathing (65%) and not suitable for washing (84%). In relation to air pollution, the respondents added that gas flaring is a major contributor to early weary of their roofs (69%), quick dirtiness of their cloths (78%) and too hot weather (69%). Generally, the respondents submitted that gas flaring has decreased habitability of their communities.

4.3 Structural Equation Modelling Analysis

Covariance Matrices

Covariances showcase the degree of associations between the variables. We take a two-dimension approach by separating the relationships between latent variables from observed variables. Table 1 presents the covariances between the latent variables while Table 2 shows the covariances among the observed variables. With covariance being 2.39, it is noted that strong association exists between the latent variables. This is pro-intuitive. Oil pollution positively co-moves with environmental damage. The observed variables also demonstrate similar patterns of relationships as the latent variables. There exist direct relationships between all the variables. In particular, judging from the covariance between oil spillage and gas flaring (2.43), it goes that both oil spillage and gas flaring are complementary. So areas of oil spillage are candidate areas of gas flaring as well.

Table 1: Covariance Matrix: Latent Variables

	OPO	ENV
OPO	3.56	
ENV	2.39	5.34

Table 2: Covariance Matrix: Observed Variables

	SPI	FLA	LAN	WAT	AIR
SPI	3.67				
FLA	2.43	4.21			
LAN	2.54	3.51	4.56		
WAT	1.56	3.51	2.49	3.22	
AIR	3.46	4.01	3.21	2.51	3.87

Measurement Parameters (Exogenous Variables)

We begin with the estimation of how much variation in latent exogenous variable (OPO) is accounted for by observed exogenous variables (OSP and GFL). As noted previously, there is no oil community-specific time series data on OSP and GFL in Nigeria. Therefore, responses of the sampled community members with regard to their exposure to OSP or GFL or both are taken as proxies for both measures of fossil fuel pollution. The analytical process of these opinions results in what is contained in Table 3. There, it is revealing that about 43% of oil pollution in the Niger Delta is traced to oil spillage while gas flaring is responsible for more than 38%. This finding lends credibility to numerous reports and research findings that claim fossil fuel exploration has caused the environment less green and habitable because of perennial scenarios of oil spillage and gas flaring. Also, by obtaining that oil spillage takes larger blame than gas flaring on the degree of environmental hazards, this study re-establishes previous findings of Takon (2014) and Amnesty International (2013). The latter in particular believes oil spillage is sometimes unpreventable particularly in a regime of inadequate maintenance procedures, but the latter is more a natural phenomenon until recently when there are sophisticated machinery to prevent the gases flared from escaping to where people live. As a result, gas glaring is often a direct result of poor housing and settlement networks: homes are expected to be distant from where oil and gas are explored.

Table 3: Estimates of path coefficients for exogenous variables

Hypothesized relationship	Path coefficient	T-ratio
OSP → OPO	0.4297	6.2310*
GFL → OPO	0.3813	5.3912*

→ indicates direction of relationship
* indicates significance at 5%

Measurement Parameters (Endogenous Variables)

Environmental impact (ENV) is proxied by three types of pollution: water pollution (WAT), land pollution (LAN) and air pollution (AIR). Respondents were asked whether they were affected by these pollution disturbances and if their frequencies of occurrence can be linked to oil and gas exploration activities. Table 4 contains how the variation in ENV is measured by WAT, LAN and AIR. The estimates are instructive. Water pollution shares about 34% of environmental damage, land pollution 28% and AIR 25%. It follows that the foremost measure of environmental hazards is water pollution. The dwellers of the oil communities even gave the researcher samples of their black-coloured water. The water, they said, is not suitable for drinking, cooking, bathing or washing. Second on the list is land pollution which takes care of about 28% of the wreck to environment. The roads in these communities are in abysmal situation. The respondents complained that their land is degraded, infertile and not motorable. Air pollution is also felt in the forms of acid rain, air-borne diseases, weary roofs, inhaling toxic air and smelly environment.

Table 4: Estimates of path coefficients for endogenous variables

Hypothesized relationship	Path coefficient	T-ratio
WAT → ENV	0.3391	9.3255*
LAN → ENV	0.2840	3.4512*
AIR → ENV	0.2531	4.5691*

Notes: → indicates direction of relationship
* indicates significance at 5%

Factor Loadings

Next in the analytical technique is the regression of measured exogenous variables on observed endogenous variables. In the domain of structural equation modelling, the resulting estimated path coefficients are called the factor loadings. Hence we empirically measure the explanatory power of OSP and GFL to influence changes in WAT, LAN and AIR. The results are as given in Table 5.

Table 5: Impact of Oil Pollution and Environment

Hypothesized relationship	Path coefficient	T-ratio
OSP → WAT	0.5522	8.3421*
OSP → LAN	0.3319	5.2254*
OSP → AIR	0.0823	1.7893**
GFL → WAT	0.1299	1.9325**
GFL → LAN	0.2881	2.3291**

GFL → AIR	0.5334	3.5991*

→ indicates direction of relationship
* indicates significance at 5%
** indicates significance at 10%

Oil spillage poses a large threat to safe water. If water is polluted in 100 cases, about 55 of such cases are due to leakage of oil. This raises alarm with regard to inadequate potable water in the Nigerian oil communities. There is a little variation between this finding and that of UNICEF in March 2018 that more than 70% of populations living in oil-rich Niger Delta region of Nigeria do not have access to drinkable and healthy water. Most of the rivers in the region are oil rich, so any exploration darkens the water, inhibiting usefulness of the water for other purposes including drinking, cooking, washing and bathing. Some elderly residents of the visited communities gave an anecdotal estimate of money spent on water daily as 150 naira: this occurs in populations where more than 70% live below the poverty line.

Oil spills also account for 33% of land pollution. The respondents blame accidental oil discharge for degraded and non-motorable road networks; they also thought that absence of clean-up strategies for spilled oils are responsible for general dirtiness of their communities and that their land has become infertile because oil spills damage the necessary soil nutrients for crop growth. Impact of oil spillage on air pollution is modest: the respondents submitted that oil spillage takes blame for only 8% of cases of air pollution. In other words, oil spills are less likely to be a major factor causing acid rain, air-borne diseases, bad air and unfriendly weather in the oil communities.

Flared gases are the major carrier of air pollution. The respondents gave an affirmative nod that more than 53% of cases of air pollution are due to gas flaring activities. They claimed that waste gases have made their house roofs to wear too early, result in their cloths getting dirty often, caused their weather to be too hot and have generally turned their community inhabitable. Another major environmental impact of gas flaring is land pollution. According to the respondents, there is about 29% chance that flared gases have paralyzed their farms, houses, roads and markets. The odds are relatively low (13%) that escaped gases cause water pollution. In other words, gas flaring is less likely to blame when water becomes less suitable for drinking, cooking, bathing and washing.

While the results of this study point that oil spillage is the leading cause of water pollution as gas flaring is the major causative agent of air pollution, these findings are not new altogether. Raji and Abejide (2013) and Oloruntegbe, Akinsete and Odutuyi (2009) have asserted that water and land pollution is rife in areas affected by oil spills. And Ede and Edokpa (2015) associates air pollution principally to gas flaring. Oyinloye and Olamiju (2013) has also concluded that oil spillage is increasing unabated in the Niger Delta and this is damaging the ecosystems in the region. This is not so different from more recent findings such as those of Ejiba, Onya and Adams (2016) and Iheriohanma (2016).

V. CONCLUDING SUMMARY

The preoccupation of this study was to investigate the impact of oil pollution on the environment of the oil-rich Niger Delta region of Nigeria. Two states (Delta and Ondo) were selected from the region and a total of 200 locals in the sampled oil communities participated in the study. Their opinions on the damage to their environment as a result of fossil fuel exploration was analyzed structurally. Oil pollution comes in two major nodes: oil spillage and gas flaring. Oil spills are often accidental discharge of oil from its channels. They occur primarily because of poor maintenance checks and deliberate vandalism of oil pipelines, the former being accountable for more than 60% of incidents of oil spillage. Flared gases are direct by-products of oil and gas production, so cases of gas flaring are part of the production process. Although there are notable innovations to prevent gases flared from escaping to settlements, Nigeria has not measured up with its oil-producing counterparts in a bid to making air and environment safe for its people. As a result, oil spillage and gas flaring are part of daily life of inhabitants of the Niger Delta. Oil pollution breeds other forms of pollution including water, land and air pollution. Polluted water is a direct consequence of oil spillage. In the sampled oil-rich communities, most of their rivers are oil rich. So, any offshore spillage instantaneously causes the water to become black and unsuitable for daily purposes such as drinking, washing, bathing and cooking. When oil spillage rather occurs onshore, not only is land degraded and made infertile, but the roads become not motorable and the community is generally dirty. This makes land pollution to be rife in the communities. The respondents are unanimous to blame unchecked oil spills for woes affecting their land.

Air pollution is also by-product of oil pollution. However, gas flaring is associated to air pollution more than oil spillage. The respondents give mild nod when asked whether oil spillage is responsible for attendant effects of air pollution such as acid rain, inhaling bad air, air-borne diseases and unfriendly weather. But they answered in strong affirmative on gas flaring. In addition to these effects, polluted gases cause clothes to get dirty too often, house roofs to get weary too often, weather to be too hot and the community to be generally inhabitable. This thereby increases expenses on clothes, houses and general up-keep. To control social disorder and economic slump that characterize the Niger Delta, the Nigerian government needs to reawaken serious measures for the clean-up of environmental destruction that has followed oil pollution. A team of technical professionals should rather be commissioned for long-term clean-up of the polluted oil-rich areas. Meanwhile, some amount should be earmarked for immediate compensation before general assessment of damage is determined. This would address emotional and psychosocial disturbances of affected victims.

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