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Unpacking Oil Spillage and Its Effect on Food Security in the Niger Delta, Nigeria (A Study of Oil Spill Areas and Causes)

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Abstract
Since more than three decades ago, environmental deterioration in the oil-rich Niger Delta region has been uncontrolled with severe health, social, and economic consequences for its citizens as a result of oil spills. Extant research has looked at the effects and consequences of oil spills, while the areas and causes of the oil spill, which are essential in reducing this threat, have not been determined. This paper examines the area and causes of oil spillage in the Niger Delta. The paper employed secondary data from Oil Spill Monitor, Shell Company, and Amnesty International among others from 2018 to mid-2023 The Data collected were subjected to simple statistical analysis (mean and standard deviation), which informed the interpretation of the result. The results indicate that the main areas of oil spillage are swamp, seasonal swamp, land, and offshore. Also, the study found that the main causes of oil that spill into these areas are; sabotage, corrosion, equipment failure, operational and maintenance error, etc. Further, Vegetation, soil, farmland, surface water, and fishponds, were impacted as a result of oil spillage. It is concluded in the paper that the causes of oil spillage have negatively and significantly impacted the environment in the study area. The paper recommended that addressing the causes of oil spills will reduce the quantity of oil spills that negatively impact the environment in oil spillage areas.
Keywords: Oil Spillage, Food Security, Niger Delta.

1.0 Introduction
Transporting or storing oil from the oil field to storage facilities or from refineries to oil deports can result in oil spills that rocking Niger Delta communities. These spills may occur on land, in a swamp, or water. Scholars have continued to recognize the causes of oil spills. Some have looked at the causes of oil spills concerning a variety of predisposing conditions, including natural and man-made disasters. For instance, Egbe and Thompson, (2010) posited that oil spills can occur as a result of natural disasters such as earthquakes and hurricanes, they can also result from accidents, lack of maintenance of engineering equipment, and deliberate acts (including oil bunkering and sabotage). The causes of oil spills are also categorized into natural, human, and mysterious spills by Mba et al. (2019). Therefore, natural spill causes are those spills that come naturally such as natural disasters, inadequate trap systems, and shift of tectonic plates beneath the ocean floor. Human causes include vandalization of oil pipelines, sabotage, bunkering, oil siphoning, and carelessness on the side of both workers (operational) and tanker drivers (during delivery). While for mysterious spills it's difficult to determine what caused the spill specifically.

According to Amnesty International, (2018) every year, hundreds of oil spills damage the environment and devastate the lives of people living in the Niger Delta. These spillages are categorized into operational spills (corrosion, poor maintenance, and equipment failure) and third-party interference spills (with wells, pipelines, and other infrastructure by armed militant groups, criminal gangs, and others). Shell oil terminals are always polluted owing to spills from pipeline leakage and other infrastructural damages. These have

been caused by decades of poor maintenance and underinvestment. However, 1,010 spills reported by Shell since 2011, and 820 spills have been documented by Eni in the Niger Delta since 2014.

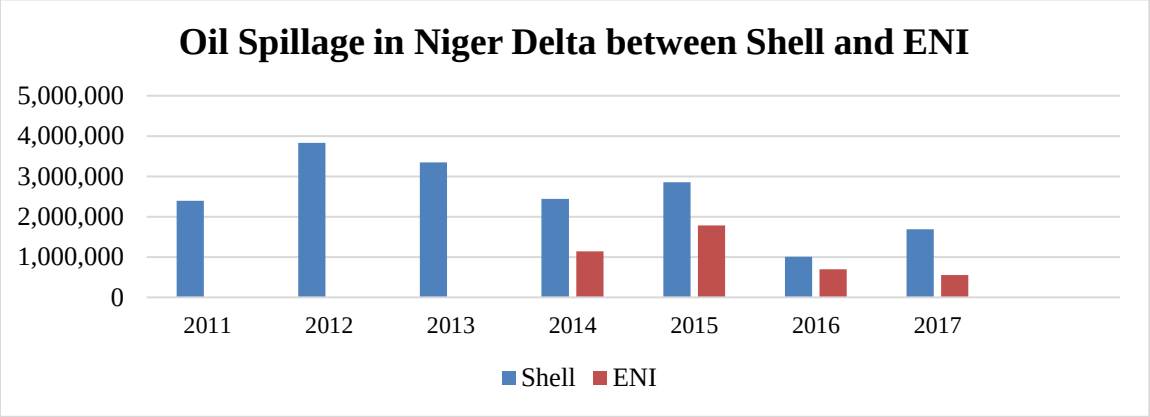


Fig 1: shows the volume of oil spill per barrel by two Oil Companies in the Niger Delta (Amnesty International 2023)

The above figure displays the volume of oil spills from Shell Petroleum Development Company and ENI Oil Company, about 110,535 barrels (17.5 million liters) and 26,286 barrels (4.1 million liters) that gave the total of 21.7 million liters of oil spill which is the equivalent of 9 Olympic swimming pools. (Amnesty International, 2023). This research aims to unpack the drivers of oil spills in the Niger Delta region and explore the implications of this for local food security. The research concentrated on the evaluation of the areas and causes of oil spillage in the Niger Delta, with emphasis on which causes have a significant effect on the volume of oil spillage, which areas are most affected, and agricultural products that are highly impacted.

2.0 Methodology

2.1 Material and Method

Data was obtained from reports published by governmental and non-governmental groups to determine the causes and location of oil spilled in the Niger Delta region throughout the study period. Thus, secondary data from the Nigerian oil spill monitor, Shell Petroleum Development Company, United Nations Environment Programme, Amnesty International, papers from seminars, and other published materials served as the main source of the data. However, the causes and locations of oil spilled in the Niger Delta region from 2012 through 2023, the annual number of oil spill incidents, the volume of oil spills per barrel, and the volume of oil recovery per barrel were recorded. All the obtained data were analyzed descriptively by using SPSS in the form of a rectangular *data matrix*. Each column in a data matrix contains a variable (year, mean, sum, minimum, maximum, and standard deviation), each row is an observation or case, and each cell contains a single value for a particular variable and observation, e.g. the mean score for every year. If the value is not available, the cell content will show somehow that the value is missing; all statistically oriented software will automatically skip that kind of value in computations.

2.2 Study Area Description

Niger Delta is one of the regions that has over 800 oil-producing communities, over 900 oil-producing wells, and other infrastructure associated with petroleum production, and it covers an area of over 70,000 km2, or 7.5% of Nigeria's total geographical area (Agochi, 2014). The region is greatly endowed with abundant natural resources and weather which supports all year-round agricultural production (Akorede *et al.*, 2017). According to Amnesty International, (2018) Niger Delta is Africa's largest oil-producing region, and one of the most polluted places on earth because for decades' oil spills have been damaging the environment and devastating lives in this part of Nigeria. The Niger Delta comprises nine states cutting across three geopolitical zones in Nigeria (Akwa Ibom, Bayelsa, Edo, Cross Rivers, Rivers, Delta in the South-South part of the nation; Abia, Imo in the South-East part; and Ondo state in the South-west part of

Nigeria; and is home to around 31 million people spread throughout 186 Local Government Areas (Ordinioha and Brisibe, 2013). The area is home to 95% of Nigeria's oil deposits, which generate 90% of the country's government's income and 95% of its export earnings (Adishi and Hunga, 2017).

The region is one of the world's most oil-impacted ecosystems, with independent estimates indicating that at least 115,000 barrels (15,000 tons) of oil are spilled into the Delta annually. These spills pollute drinking water and soil and negatively affect farming and fishing in the region whereby communities living close to oil exploration companies are adversely affected in terms of their health and food security.

Fig 2: shows the map of the Niger Delta region

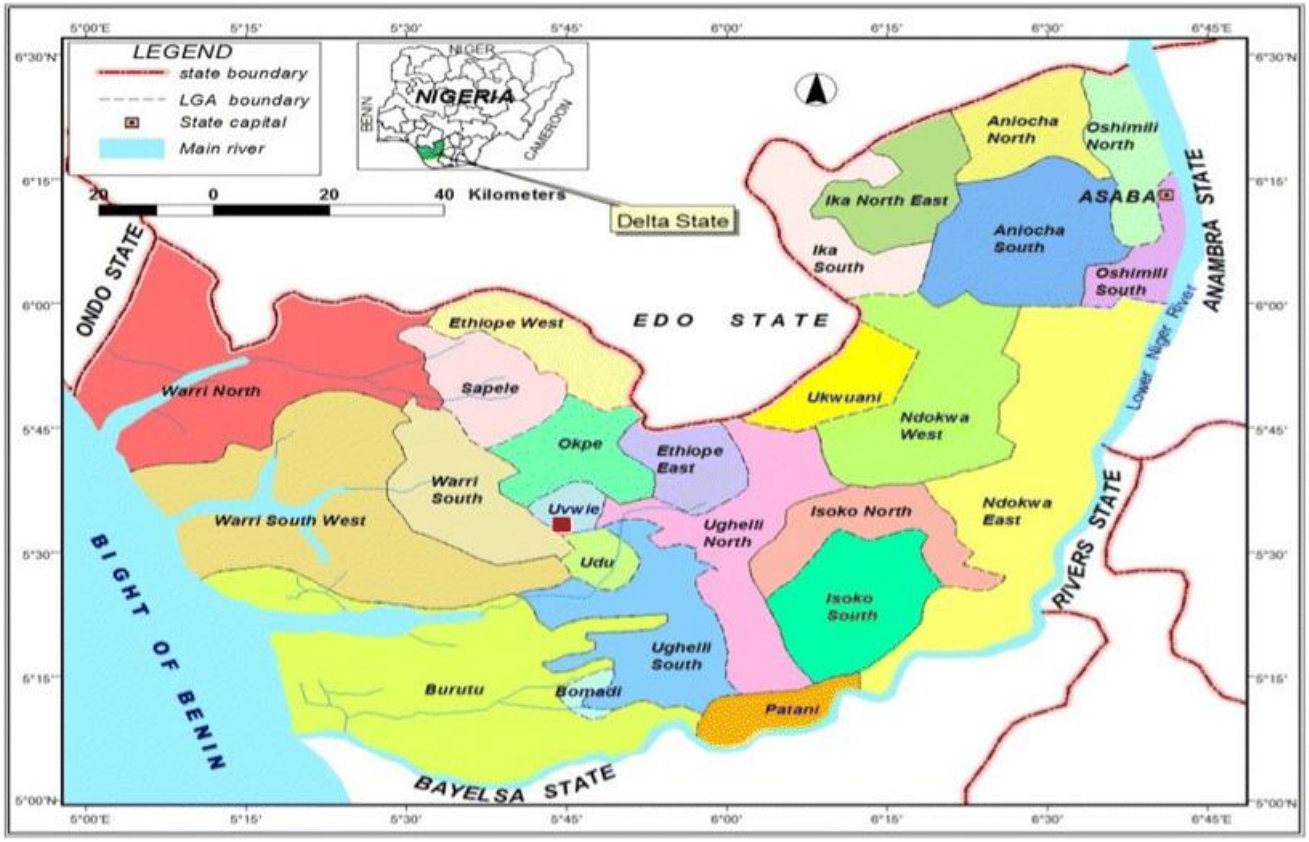


Fig 3: shows the map of Delta State in Nigeria

The paper focused on the Niger Delta region of Nigeria and purposely selected Delta State, one of the region's nine (9) states that is home to several oil-producing communities and the second leading source of on-shore crude oil production. Delta State is situated roughly between latitude 5 0 00′N and 6 0 30′ N of the Equator and longitude 5 0 00′ E and 6 0 45′ E of the Greenwich Meridian. It is one of Nigeria's extremely southern states and covers an area of 17,001 km2. The inhabitants of communities in this area are mainly crop farmers and fishers.

3.0 Results of the Data

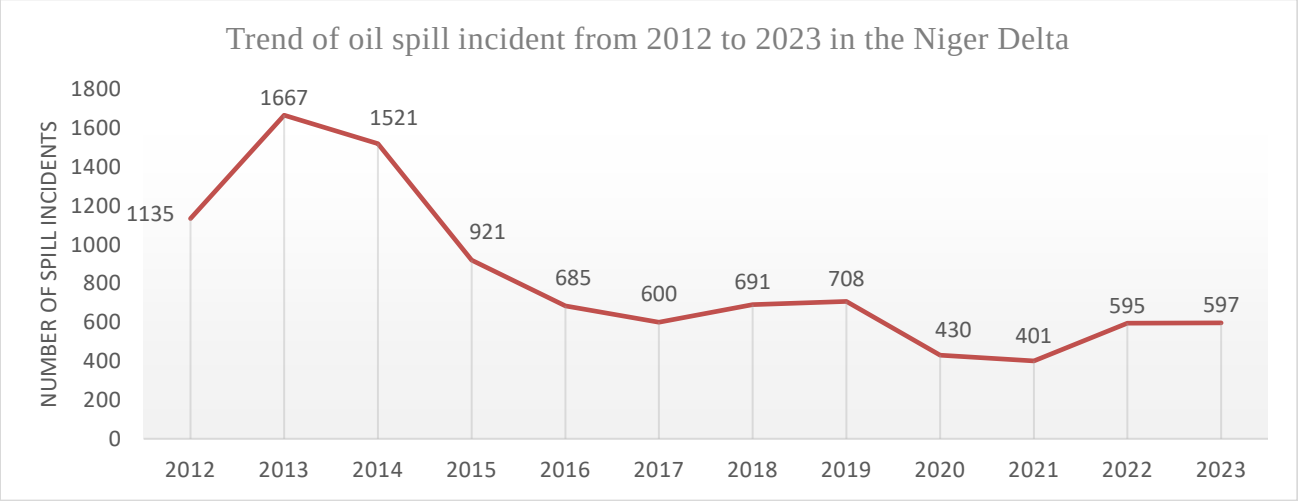
The following tables and figures determine and illustrate the areas, causes, trends, quantity of oil spilled, quantity recovered, as well as the adverse impact of this catastrophe on food security.

3.1 Trend of oil spill incident from 2012 to 2023 in the Niger Delta

The trend of incidents that occurred in the Niger Delta region from 2012 to 2023 shows that there are about ten thousand recorded oil spill incidents.

Figures 4 and 5 illustrate the trend in oil spill incidents from 2012 to 2023 and it follows a regular pattern, as there was a substantial yearly decrease preceded by an increase in this period in Delta.

Fig 4: Trend of oil spill incidents in Niger Delta from 2012 – 2023



Source: Nigerian oil spill monitor (NOSDRA, 2023)

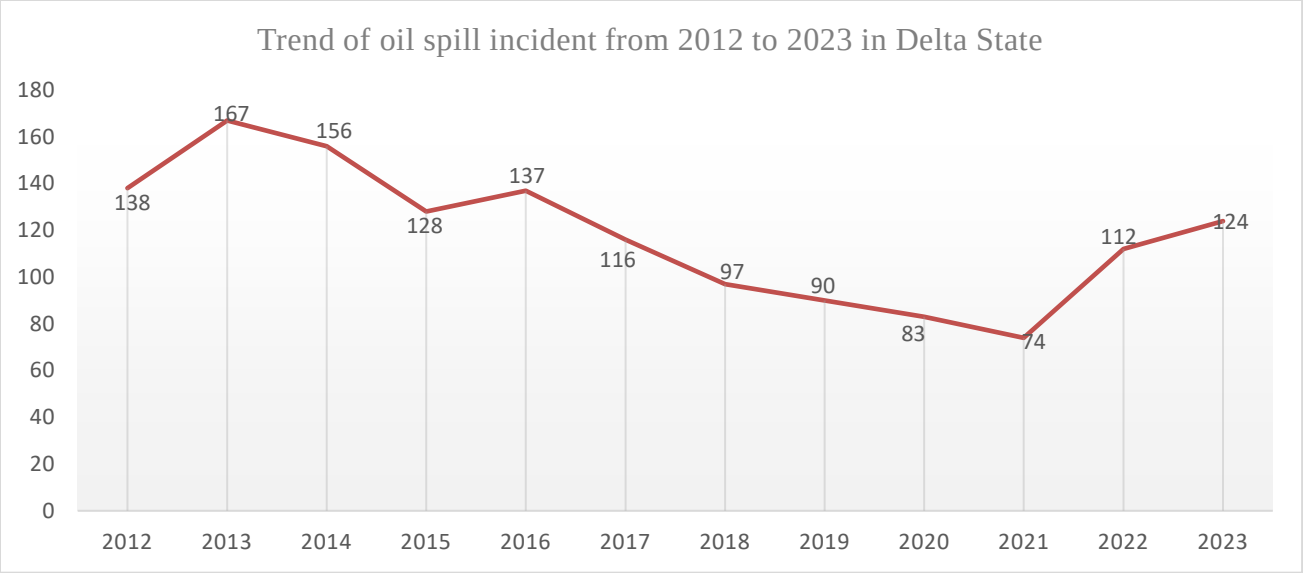


Fig 5: Trend of oil spill incidents in Delta state from 2012 – 2023
Source: Nigerian oil spill monitor (NOSDRA, 2023)

3.2 Estimated quantity of spill per barrel and quantity recovered

The data obtained from this research shows that over 33 thousand barrels of oil were spilled into the environment from 2018 to 2023. The results also showed the estimated quantity of oil spills and quantity of oil recovered per barrel from 2018 to 2023 in Delta. 2018 has (9065.29) barrels of oil spilled into the environment. 2019 had (13371.14) barrels; in 2020, the number of barrels that spilled into Delta's environment was (2540.98); while in 2021 has (1773.31) barrels of oil spills; 2022 in other hand has (3899.03) barrels; whereas in the first half of 2023 has (2548.30) barrels spilled in the study area.

Estimated Quantity of oil spill per-barrels

Year	Mean	Sum	Minimum	Maximum	Std Dev.
2018.00	91.5686	9065.29	.01	2333.00	282.60784
2019.00	146.9356	13371.14	.00	4065.00	494.94792
2020.00	30.2498	2540.98	.00	780.00	92.17851
2021.00	23.6441	1773.31	.01	1000.00	116.22214
2022.00	34.5046	3899.03	.01	575.00	97.92606
2023.00	45.5054	2548.30	.00	1845.00	245.86342
Total	64.0889	33198.04	.00	4065.00	267.57223

Table 1: shows the estimated quantity of oil spills per barrel in the Delta

However, the data below shows the amount of oil recovered per barrel in Delta from 2018 to 2023. In 2018, 6570.71 barrels of oil were recovered out of 9065.29 spilled. In 2019, 9884.11 barrels were recovered out of 13371.14 barrels spilled. However, in 2020, 992.68 barrels of oil were recovered out of a total of 2540.98 barrels leaked into the environment, and in 2021, 194.61 barrels of oil were recovered out of a total of 1773.31 barrels spilled. 2022, on the other hand, recovered 1077.00 barrels out of 3899.03 barrels of oil

spilled; eventually, 2023 recovered 1687.30 barrels out of 2548.30 barrels of oil spilled in Delta. Therefore, about thirteen thousand quantity of barrels spill into the environment in the research area.

Quantity of oil recovered per barrels

Year	Mean	Sum	Minimum	Maximum	Std Dev.
2018.00	273.78	6570.71	0.02	2000.00	479.54
2019.00	449.28	9884.11	0.20	4025.00	916.28
2020.00	43.16	992.68	0.00	585.00	123.23
2021.00	17.69	194.61	0.44	132.00	38.55
2022.00	63.35	1077.00	0.00	384.00	105.77
2023.00	153.39	1687.30	0.10	1540.00	460.68
Total	188.95	20406.41	0.00	4025.00	514.53

Table 2: shows the quantity of oil recovered per barrel in the Delta

3.3 Oil Spill Areas in Delta

From the data obtained, the areas of oil spill found in Delta include land (La), swamp (Sw), multiple (swamp, seasonal swamp, land), and others (inland water, offshore, and near shore). However, the results indicated the average of oil spills into the land from 2018 to 2023 is 6508.6 barrels, multiple has the average of 4448.6 barrels' others 19.34 barrels, and swamp 22221.54 barrels.

Table 3: shows the estimated quantity of oil recovered per barrel in the Delta

Oil Spill Areas

Areas	Year	Mean	Sum	Minimum	Maximum	Std Dev.
Land	2018.00	51.9	1403.6	.01	943.00	183.49367
	2019.00	128.3	3463.1	.01	1403.60	363.93489
	2020.00	21.1	548.1	.01	160.00	40.35490
	2021.00	8.01	256.4	.01	60.80	13.85206
	2022.00	40.4	727.6	.03	424.00	109.76551
	2023.00	9.9	109.7	.00	95.00	28.27480
	Total	46.2	6508.6	.00	1403.60	185.92229
Multiple	2018.00	69.4	347	2.00	300.00	129.93768
	2019.00	87.1	1393.6	.01	350.00	109.44646
	2020.00	217.5	1305	25.00	780.00	286.42189
	2021.00	235	1175	.03	1000.00	431.33086
	2022.00	41	123	10.00	98.00	49.42671
	2023.00	52.5	105	50.00	55.00	3.53553
	Total	120.2	4448.6	.01	1000.00	210.00066
Other	2018.00	0.8	2.38	.13	2.00	1.04673
	2020.00	1.2	3.50	.50	2.00	.76376

	2021.00	1.9	3.86	1.80	2.06	.18385
	2022.00	1.7	8.40	.10	5.00	1.99173
	2023.00	0.6	1.20	.20	1.00	.56569
	Total	1.3	19.34	.10	5.00	1.27887
Swamp	2018.00	114.3	7312.22	.03	2333.00	328.09260
	2019.00	177.4	8514.50	.00	4065.00	624.21115
	2020.00	13.9	684.31	.00	100.00	23.38426
	2021.00	9.4	338.06	.01	80.00	16.88671
	2022.00	34.9	3040.06	.01	575.00	99.89175
	2023.00	56.9	2332.40	.13	1845.00	286.93845
	Total	68.4	22221.54	.00	4065.00	306.11292

3.4 Causes of oil spillage in Delta

The data generated for this research show the causes of oil spillage in Delta. The results illustrated the causes of oil spills in Delta which include; corrosion, sabotage/theft, equipment failure, operational error, and others. However, the result pointed out the percentage of factors responsible for oil spillage in the study area from 2018 to 2023. Corrosion is (20.8%), equipment failure (15.8%), operational error (5.8%), sabotage/theft (55%), Yet to determine (0.6%), and lastly other factors has (2.1%).

Causes of oil spillage in Delta

		Year						
Causes		2018	2019	2020	2021	2022	2023	Total
Corrosion	Number	13	13	18	20	31	13	108
	% of Year	12.9%	14.3%	21.4%	26.7%	27.4%	23.2%	20.8%
Equipment Failure	Numbers	25	13	12	11	15	6	82
	% of Year	24.8%	14.3%	14.3%	14.7%	13.3%	10.7%	15.8%
Operation Maintenance	Numbers	4	7	5	4	10	0	30
Error OME	% of Year	4.0%	7.7%	6.0%	5.3%	8.8%	0.0%	5.8%
Other	Numbers	3	3	3	1	0	1	11
	% of Year	3.0%	3.3%	3.6%	1.3%	0.0%	1.8%	2.1%
Sabotage/Theft	Numbers	56	53	46	39	56	36	286
	% of Year	55.4%	58.2%	54.8%	52.0%	49.6%	64.3%	55.0%
Yet to determine (YTD)	Numbers	0	2	0	0	1	0	3
	% von Year	0.0%	2.2%	0.0%	0.0%	0.9%	0.0%	0.6%
Total	Numbers	101	91	84	75	113	56	520
	% of Year	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 4: shows the causes of oil spills in the Delta

3.5 Discussion of the Results

Based on the data analysis of this paper, the paper discovered the following:

i. About 33198 oil spills in the research area, and about 20406 of these oil spills were recovered. This indicates that about 12792 of oil was spilled into the environment and ecosystem in Delta state.

The results are in consonant with the submission of Odjuvwuederhie *et al.,* (2006) who cited from the Department of Petroleum Resources that over 6000 spills had been documented in Nigeria's 40 years of oil exploitation, with an average of 150 spills each year. In the period 1976 – 1996, 647 incidents occurred resulting in the spillage of 2,369,407.04 barrels of crude oil. With only 549,060.38 barrels recovered, 1,820,410.50 barrels of oil were lost to the ecosystem (DPR 1997).

ii. The result of this paper also pointed out the major areas of oil spills in the Delta state are Land, swamps, and multiple (land and Swamp). The results of this paper also indicate the volume of oil spilled into land and swamps in the Delta remains one of the most important repercussions of the oil spill on agricultural products. Most of the oil that spills into the land has a negative impact on farmland and palm trees which contaminates the farm products such as cassava, yam, cocoyam maize, plantain, etc., and despoils most of the farmland. The results are in line with the submission of Plessl *et al.,* (2017) who pointed out that within the period 1976–2015, a total no of 16,476 spills occurred on different occasions, and a total quantity of approximately 3 million barrels spilled into the environment. Unfortunately, more than 70% was not recovered, 69% of these spills occurred off-shore, a quarter was in swamps and 6% spilled on land. Odjuvwuederhie et al (2006) posit that oil spills have degraded most agricultural lands in the state and have turned hitherto productive areas into wastelands. However, oil spill into swamp has affected fish ponds, vegetation, and surface water. Elum et al., (2016) posit that oil production has increased the rate of environmental degradation and has perpetuated food insecurity as a result of the death of fish and crops as well as the loss of farmlands and viable rivers for fishing activities leading to the loss of livelihood.

iii. The results of this paper also revealed that the main factors responsible for oil spillage include sabotage/theft, corrosion, equipment failure, and operational error. The results align with what Michel and Fingas (2016) Opines, they identified the rate of spillage has decreased in the past 10 years, even with increased oil production, transportation, and consumption. Despite this, spill experts estimate that 30%–50% of oil spills are either directly or indirectly caused by human error, with 20%–40% of all spills caused by equipment failure or malfunction. However, according to Hunga (2017), reasons responsible for spillage of oil include oil theft, illegal bunkering, and pipeline vandalism, all of which occur at various degrees and volumes in the Niger Delta. These findings also support the finding of Ndinwa *et al.,* who claimed that oil spills in the Niger Delta region were caused by 50% of all oil spills due to corrosion of oil pipelines and tankers. According to Amnesty International (2018), the proportion of oil spills in the Niger Delta that are caused by sabotage or theft is keenly contested by communities and cannot be determined with any degree of accuracy because of flaws surrounding the collection of spill data.

3.6 Effect of oil spill on Agricultural products.

Oil spills are typically caused by recurring sabotage, corrosion equipment failure, etc., which kill aquatic life and contaminate the environment to the point where farming is impossible in the affected areas. According to Osuagwu and Olaifa (2018), an oil spill's long-term effects are typically linked to decreased agriculture productivity and fish mortality. Nnabuenyi (2012), mentioned the detrimental effects of oil spills on agriculture, the majority of farmlands have been damaged, rivers have been contaminated, killing fish, and most farmers and fishermen are now jobless.

4.0 Conclusion and Recommendations

The new research shows that individuals in the area of study may be in danger of food insecurity as a result of the considerable amount of oil that has been spilled nearby. To reduce the exposure to the amount of spilled oil that caused food insecurity in Delta, effective strategies for minimizing the frequency of oil spills should be employed.

5.0 Recommendations

Based on these results, the paper recommends that remediation policies should be put in place to boost farmers' productivity, the government on the other hand should work together with oil companies to

mitigate and reduce the oil spill area to enhance food security. The risk of an oil spill on Delta's land and swamp should be evaluated holistically.

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