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THE IMPACT OF MAKESHIFT REFINING SOOT ON HEALTH SECURITY IN RIVERS STATE

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ABSTRACT

This paper examined the impact of makeshift refining soot on health security in Rivers State. Makeshift refining, a prevalent practice in Rivers State, Nigeria, has led to the release of massive amount of soot into the environment, posing significant threat to human health and the ecosystem. The objectives of the paper were to ascertain the effect of makeshift refining soot on health security and investigate the influence of government response on the impact of makeshift refining soot on health security in Rivers State. While adopting the Relative deprivation theory, the paper revealed that makeshift refining soot affects health security in Rivers State. Hence the paper concludes that makeshift refining soot is responsible for health security degradation in Rivers State. Therefore, the paper recommended that Government and oil companies should implement programs to provide alternative, legitimate livelihoods for individuals involved in makeshift refining, such as vocational training and support for small businesses, to reduce dependency on illegal refining activities. They should establish and equip local emergency response units specifically trained to handle explosions and fires from makeshift refineries, ensuring they have the necessary tools and resources to respond quickly and effectively. They should develop and implement an integrated strategy that combines strict enforcement of laws against illegal refining with community engagement and support for sustainable economic development.

Keywords: Makeshift refining soot, environmental impact, health security, Government response, Rivers State.

1.0 Introduction

Over time, there has been a growing need for health security. Health security guarantees that people have access to necessary medications, clean water, sanitary conditions, and sufficient healthcare services. The COVID-19 pandemic has created a current global health catastrophe, emphasizing the importance of strong health security protocols. The World Health Organization (2020) reports that nations with robust health infrastructure fared better during the epidemic than countries with weaker systems, which resulted in greater death rates and protracted economic impacts. Protecting people from both current and new health hazards requires strengthening health security via investments in disease prevention, healthcare infrastructure, and health education.

Health security is critical because it encompasses the proactive measures required to protect populations from health threats, ensuring community stability and resilience (World Health

Organization, 2019). It involves the prevention, detection, and response to infectious diseases, environmental hazards, and bioterrorism, thereby safeguarding public health and socio-economic stability (Gostin& Friedman, 2020). Effective health security systems mitigate the spread of diseases, reduce the burden on healthcare infrastructure, and enhance national and global security (Katz et al., 2018). Access to healthcare services, as well as the prevention and treatment of illness, are all aspects of health security (WHO, 2007).

Makeshift refining soot is a type of air pollution produced by the informal and unregulated processing of crude oil. This practice often referred to as "artisanal" or "illegal" refining, involves crude oil being refined in rudimentary facilities without proper equipment or adherence to environmental regulations. The process generates significant amounts of soot, a fine particulate matter consisting of carbon particles, hydrocarbons, heavy metals, and other hazardous substances. Addressing the multifaceted impacts of makeshift refining soot requires comprehensive regulatory frameworks, environmental monitoring, public health interventions, and community education to mitigate exposure. Developing alternative livelihoods for those involved in artisanal refining is essential to reduce dependence on this harmful practice and protect both health and the environment. However, numerous studies have explored the relationship between artisanal refining and health security, yet only a handful have scrutinized the impact of makeshift refining soot on health security in Rivers State. Therefore, in order to fill this gap, the present research was carried out on the impact of makeshift refining soot on health security and how government response influence the makeshift refining soot on health security in Rivers State.

Statement of the Problem

Polluted air and black soot, which goes deep into the lungs and have been connected to conditions including heart attacks, strokes, cancer, and worsening asthma, expose people to a variety of health concerns. Businesses have collapsed, investments are plunging, multinationals are closing their doors and leaving the country, unemployment is skyrocketing, and the public is fearful. Every day, fire accidents from the illegal refining sites claim lives, leading to population depletion. It is obvious that it is a danger to the region's economic growth (Stewart, 2004). This affected households and their health systems. Among these consequences loss of long life spandue to illness and diseases (Ikelegbe, 2018). The danger still poses a risk to the region's development and governance, as well as to Nigeria overall. Despite the government's expanding expenditures on internal security at the federal and state levels, people spend a lot of money on medications on illness and loss of lives. Therefore, this paper was carried out to examine the impact of makeshift refining soot on health security in Rivers State in order to provide suggestions that will help government and oil companies to prevent of makeshift refining soot on health security in Rivers State.

Aim and key Objectives

The aim of the paper was to examine the impact of makeshift refining soot on health security in Rivers State. The objectives of the study were to:

1. Ascertain the effect of makeshift refining soot on health security in Rivers State
2. Ascertain the causes of makeshift refining soot on health security in Rivers State
3. Investigate the influence of government response on the impact of makeshift refining soot on health security in Rivers State.

Significance

The relevance of this paper is to contribute to the expanding literature on artisanal refineries in Rivers State. Practically, policy makers, civil society organizations, military architectures, students and further researchers would benefit from this paper. In the case of policy makers, they should draw attention to formulating new laws on the issue of illegal refining or the existing laws should be reviewed to make the punishments for artisanal refiners more stringent. The students and future researchers would benefit because this paper work will become a reference material for them. It will also show the steps the Nigerian government is taking to address the security issues caused by artisanal refineries in the study area. The results of this qualitative exploratory study will provide light on the dangers that the militancy and other organizations represent to development and national security.

2.0 LITERATURE REVIEW

Conceptual of Makeshift Refining Soot

Makeshift refining soot is a type of air pollution produced by the informal and unregulated processing of crude oil. This practice often referred to as "artisanal" or "illegal" refining, involves crude oil being refined in rudimentary facilities without proper equipment or adherence to environmental regulations. The process generates significant amounts of soot, a fine particulate matter consisting of carbon particles, hydrocarbons, heavy metals, and other hazardous substances. The incomplete burning of precursor molecules results in the formation of soot, which then goes through many chemical and physical Soot formations, is another health and environmental concern related to improvise refining. A tiny particulate substance known as soot, or black carbon, is created when the hydrocarbons in crude oil do not burn completely. It is made up of tiny particles that have the ability to enter the respiratory system deeply, aggravating pre-existing medical illnesses and producing respiratory issues. Communities close to temporary refineries may be more exposed to soot and other air pollutants, according to studies published in Environmental Health Perspectives (EHP, 2020). These activities' emissions have an effect on the nearby public health as well as the immediate environment by adding to local air pollution.

In Rivers State, soot pollution from artisanal crude oil is growing. This is a worsening of an already fragile biosphere brought on by years of oil and gas exploration. It is not news that crude oil that has been pilfered is used in Nigeria's artisanal refineries. According to The Guardian (2023), oil theft and illegal refining were expected to cause Nigeria to lose between N30 trillion and N60 trillion annually in 2022. In a country with fragile economic roots, the concerning cash loss from oil theft pales in comparison to the short- and long-term health consequences of sulfur buildup in the air, land, and water. Anxiety has increased lately in Port Harcourt, the most populous city in the South-South, as a result of indiscriminate oil drilling operations and unpredictably high exposure to impure carbon particles created by incomplete combustion of petroleum hydrocarbons. This has been especially severe after the soot pollution incident in 2016 (The Guardian, 2017; 2023). This image illustrates the haphazard refinement that compromises health security.

Fig. 1 Scene of an explosion in Rumuekpe community in Emohua local government area of Rivers State

Concept of Health Security

Health security, a critical component of human security, involves ensuring access to healthcare services, preventing disease outbreaks, and promoting overall physical and mental well-being. In regions like the Niger Delta, where makeshift refining of crude oil is prevalent, health security faces significant challenges. Makeshift refining, also known as artisanal refining, involves the illegal and unregulated processing of crude oil, which leads to substantial health hazards for local communities. This practice has dire consequences for health security, affecting air, water, and soil quality, and subsequently human health.

The process of makeshift refining releases a variety of toxic substances into the environment, including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals. These pollutants have been linked to respiratory problems, skin disorders, and cancers among the local population (Nriagu et al., 2016). Prolonged exposure to these toxic substances can lead to chronic respiratory diseases such as asthma and bronchitis, significantly impacting the health and well-being of individuals living in these areas. Moreover, the smoke and particulate matter from the refining process exacerbate air pollution, further deteriorating respiratory health. Water contamination is another critical issue stemming from makeshift refining. Untreated waste and oil spills discharge into rivers and streams, contaminating the primary sources of drinking water for many communities. According to UNEP (2011), oil spills and the associated pollution have led to the contamination of groundwater and surface water, posing severe health risks. Consuming polluted water can cause gastrointestinal problems, liver and kidney damage, and an increased incidence of waterborne diseases such as cholera and dysentery. The lack of access to clean drinking water directly undermines the health security of affected populations, particularly children and the elderly, who are more vulnerable to waterborne diseases.

Makeshift Refining Soot and Health Security

UN Secretary General Kofi Annan said in his laudatory message to the consultation on health and human security that health is one of the fundamental pillars of society and that it is a prerequisite for hope as well as for social fairness, economic progress, and the decrease of poverty. The citizens of Port Harcourt and the surrounding areas are at danger for a number of health problems as a result of the illicit oil refining operations. The current problem of soot, a tiny particle that can enter the lungs deeply, has an impact on the environment. It has been linked to numerous fatal health effects in children, such as heart attacks, strokes, acute bronchitis, and worsening asthma. These minuscule particles, which are about 1/30 of the diameter of a human hair, are even smaller than dust and mold. It is composed of many pollutants floating in the air after they are discharged, including chemicals, acids, metals, soils, and dust. Three forms of soot are possible: solid, liquid, and gaseous (also known as "aerosols"). Our rivers' water could not be utilized for anything because Kpo-Fire's activities were so terrible that the whole water supply was poisoned. It is remembered that by the time you returned, your clothing will be stained black from washing and hanging them to dry. As a consequence, several patients had respiratory tract infections.

When someone is poisoned systemically, soot causes inflammation in the lungs and a host of other symptoms. When exposed to soot or carbon black particles (CBs), lung epithelial cells produce inflammatory mediators (chemokines and cytokines) that boost the immune system. Inhaling CB particles may also induce coughing because they irritate the lungs. Carbon black may irritate the throat, nose, and eyes. Long-term exposure to high concentrations of carbon black may cause the particles to lodge deeply in the lungs of humans. This is because, according to the National Cancer Institute of America, "soot is a result of the incomplete combustion of organic materials, such as wood, fuel oil, plastics, and domestic garbage." The air is contaminated by the handling and boiling of crude oil. The locations exude a poisonous aura, and the effects on employees' health are incalculable. Poisonous gasses are a constant risk to communities, resulting in respiratory issues and coughing.

Cadmium, chromium, and arsenic were a some of the carcinogens found in the fine black or brown powder known as soot. Soot is a dark, tarry powder or flaky material that is mostly made up of amorphous carbon that is created when organic matter burns incompletely. The public health of people living in Port Harcourt and other parts of Rivers State is at risk due to soot pollution. These people have experienced years of severe health issues as a result of gas flaring from local multinational oil companies, illegal crude oil refining operations, and the illegal burning of goods that government security agencies have seized. Constant exposure to carbon dioxide causes pneumoconiosis. It is a general term used to describe bronchitis brought on by inhaling dust that is not biological. Extended exposure to grit causes items to start lining the divider of these air gaps (alveoli), which reduces the typical strength for vaporous exchange. Pneumoconiosis develops instances prone to distinct respiratory illnesses like pneumonia, asthma, and so on, he noted, citing Akutu, Geraldine (The Guardian Newspaper, May 27, 2018). The following are the main health dangers posed by soot and carbon black: The primary danger is cancer, which may result from DNA adduct formation, strand breaks in DNA, or gene mutation. The second kind of respiratory toxicity is brought on by immune system activation of mast cells and eosinophils. Cardiovascular toxicity, which includes coronary heart disease, is the third research field. Apart from these consequences, soot harms body organs via unclear ways. Because soot is so large, it may readily enter your

bloodstream and alveoli and hurt you in a variety of ways. This is why soot has such a profound effect on humans.

The influence of government response on the impact of Makeshift Refining Soot on Health Security in Rivers State

The influence of government response on the impact of makeshift refining soot on health security in Rivers State, Nigeria, is critical. Makeshift or "artisanal" refining of crude oil, a common practice due to economic desperation and lack of regulation, has led to significant environmental pollution, notably soot that blankets communities. This pollution has severe health implications, including respiratory problems, cancer, and other chronic conditions among the local population. The government's response has been mixed, with periodic crackdowns on illegal refining activities but insufficient long-term strategies and enforcement to address the root causes and health impacts. Studies indicate that inconsistent and often corrupt enforcement has allowed these practices to persist, exacerbating public health crises (Ede et al., 2021). The Nigerian government has initiated programs such as the Hydrocarbon Pollution Remediation Project (HYPREP) to clean up polluted areas, but progress has been slow and criticized for lack of transparency and effectiveness (UNEP, 2011). Effective government intervention, including robust enforcement of environmental regulations, economic alternatives for local refiners, and comprehensive health interventions, is essential to mitigate the health security risks posed by makeshift refining soot in Rivers State.

3.0 Theoretical Framework

Relative Deprivation Theory: A transdisciplinary theory called relative deprivation looks at social relationships in certain situations. Based on observations he collected during World War II, Samuel A. Stouffer (1900–1961) was credited with establishing the concept. The American Soldier (1949) was another name for this relative deprivation theory. When someone feels deprived of what they are entitled to yet others are the ones who gain the most, this is known as relative deprivation. The following fundamental presumptions underpin the relative deprivation theory: This paper's connection to the relative deprivation theory is based on the federal government's and the multinational oil and gas firms' denial of benefits to Rivers State, the people living in the Niger Delta, and themselves from the petrodollar money generated in the region. The notion of relative deprivation has shown its usefulness in many situations, especially when individuals feel mistreated and irritated by the government and feel that there is a system of lawlessness and impunity that fuels conflict. The people living in Nigeria's Rivers State believed that the federal government and the state's multinational oil and gas companies had cheated them out of the opportunity to benefit from petrodollar money. The socioeconomic growth of the area has suffered as a result of the arbitrary creation of illicit crude oil refinery. The people living in this area feel cheated and denied of these advantages derived from the crude oil that is produced from their localities.

4.0 Empirical Review

In the Niger Delta, Nwanna-Nzewunwa (2016) investigated the spatial epidemiology of diarrhea in children. Examining the frequency of diarrhea and identifying the regional distribution of the illness in children under five years old was the primary objective. The Niger Delta University Teaching Hospital (NUDTH) pediatrics department newborns were included in the research sample, and demographic factors such the mothers' age, sex, and educational attainment were taken into account. The findings, along with those of other

comparable research, demonstrated an inverse relationship between the age of the kid and the mother's educational attainment and the prevalence of diarrhea in children. The majority of occurrences of diarrhea affect younger babies and the offspring of moms with just an elementary education. As a result, the prevalence of diarrhea in children decreased and vice versa with increasing maternal education. A total of 55% of the instances included children whose moms had only completed elementary school. Just 9% of baby diarrhea cases were found to have been caused by women with college education or above, compared to around 23% of instances involving children whose mothers had completed secondary school. The study on diarrhea in children focuses on epidemiology and demographic factors but lacks a deeper exploration of environmental determinants. Including data on water quality, sanitation practices, and proximity to polluted areas would strengthen the study's ability to link environmental pollution (specifically oil pollution) with health outcomes. Moreover, investigating the direct pathways of exposure (e.g., ingestion of contaminated water or food) would provide more robust evidence of the environmental health impact.

Dairo (2017) study interviewed mothers on other personal hygiene issues, she discovered that handling and disposing of child feces, hand washing with soap, and 25 immunization practices were all significant possible risk factors contributing to the high frequency of diarrhea in children. While Dairo identifies risk factors for diarrhea in children related to hygiene practices, the study could benefit from specific data linking these practices to oil pollution. Exploring how contamination affects water sources used for hygiene, or how contaminated soils contribute to health risks, would provide a clearer link between oil pollution and health outcomes.

Potential health effects on humans from exposure to petroleum hydrocarbons in the Niger Delta were evaluated by Whanda et al. (2018). The study revealed that the most notable routes of exposure were linked to the usage of rural agricultural land via ingestion of homegrown products, direct contact with contaminated soils, and inhalation. Additionally, they imply that populations impacted by oil spills likely to have worsening health due to extended exposure to hydrocarbon components. The study identifies routes of exposure to petroleum hydrocarbons but lacks specific data on the magnitude of health impacts. Quantifying health outcomes (e.g., prevalence rates of diseases) linked to different levels of exposure would strengthen the study's findings and provide clearer guidance for health interventions.

An investigation of the effects of oil spills on child health and neonatal and infant mortality in Nigeria was published by Bruederle and Hodler (2017). They compared the death rates of children conceived before to an oil spill with the mortality rates of new-borns conceived after the reported oil disaster using data on the birth histories of 2,477 women who lived within 10 km of the oil spill area. Their research showed that babies born after an oil spill had a higher neonatal and infant death rate. Put differently, pre-conceptional oil 27 spills raise the risk of neonatal death. Additionally, they note a strong relationship between the distribution of new-born death and the sites of oil spills; the rates of new-born and infant mortality were greater in areas near oil spills than they were in areas farther away. They provide further evidence that oil spills before conception raised the risk of low birth weight, particularly during the first 12 months of life. While the study on oil spills and infant mortality provides valuable insights, it could benefit from a more comprehensive analysis of confounding factors. Considering

socio-economic status, maternal health conditions, and access to healthcare as potential confounders would help isolate the specific impact of oil spills on infant mortality rates.

According to San Sebastian et al (2002), because of high levels of exposure to oil pollutants, the risk of spontaneous abortion was twice as high for women living in villages adjacent by oil fields in the Ecuadorian Amazon Basin as it was elsewhere. They disclose that the communities' rivers are severely contaminated by hydrocarbons from oil chemicals, and they point out that even though the women in these communities are aware of the contamination, they frequently lack access to clean water sources and choose to use the tainted river water. It seems that there is a dearth of study on the environmental risk factors linked to child health and death in the Niger Delta as a result of oil spills, and further research is necessary. By examining the geographic distribution and frequency of baby diarrhoea in relation to oil spills in the Niger Delta, this research aims to close this gap in the literature. Comprehending the fundamental reasons behind infant mortality in the research region is contingent upon the completion of this investigation. Numerous federal, state, municipal, and international relief organizations are now concentrating their intervention programs on the Niger Delta due to the region's severe environmental and health risks. It is expected that the research's findings would shed light on the problems surrounding child health and death as well as give crucial geographic data that may be used to drive policy decisions and organize health intervention initiatives in the area. The study identifies high rates of spontaneous abortion linked to oil pollution but lacks data on the specific pollutants causing these health effects. Including chemical analyses or bio-monitoring data to identify the specific contaminants responsible would provide a more direct link between exposure and health outcomes.

Izionworu et al (2021) assessed the impacts of black soot from artisanal crude oil refining and process modification in the Niger Delta. The research also examined the effects of artisanal refining on the local economy and health, as well as on Nigeria as a sub-Saharan African country and the international community. The studied literatures show how the extreme air pollution has killed individuals and made life miserable for those who reside in the most affected region. The study proposes a modified artisanal refining process as a feasible solution to replace the ongoing artisanal refining that produces soot and its associated fatal consequences in the area with modular refining in the event that political will and funding are not available. This modified process would also improve product specifications and maximize product yield in response to the ongoing challenge. The updated process, which considers chemical engineering processes, consists of an enclosed system with a fume closet and furnace chimney, four optimized heat exchangers, a Counter Current Flow Packed Tower (CCFPT), a force draft fan, a flue gas tank, and a black soot slurry tank. The soot slurry waste water is collected in the redesigned process and sent to a water treatment facility for further separation and treatment. This allows for effective equipment control strategy and process instrumentation, including temperature and pressure gauges. Crude oil is heated using the collected vent gas as fuel. The research assesses the consequences of black soot from artisanal refining and suggests a redesigned refining procedure, but it doesn't address the viability of putting these modifications into practice or other obstacles like financial difficulties or regulatory issues.

Omisakin (2022) conducted a study on soot pollution in Port Harcourt, Nigeria, and found that soot pollution is an air pollution type that may seriously harm the environment and public health.

According to the author, since the fourth quarter of 2016, people living in Port Harcourt, South South, Nigeria, and the surrounding areas have been experiencing the detrimental consequences of soot pollution on the environment. He critically understood the function of environmental governance (various stakeholders) and leadership about soot pollution in Port Harcourt, Nigeria, using the research to examine soot pollution as a major social issue in the city. According to the study's empirical results, soot pollution in Port Harcourt, Nigeria, is a complicated issue that endangers people's health as well as the political, economic, and social environments. The study on soot pollution in Port Harcourt lacks detailed data on the sources and composition of the soot, which could provide more insights into effective mitigation strategies.

According to a follow-up research by Ihesinachi et al (2019), they examined exposure to heavy metals in soot samples and cancer risk assessment in Port Harcourt Rivers State. According to their results, the research location (Port Harcourt) has a high incidence of cancer, and the prevalence of the disease is correlated with soot exposure. The study does not delve deeply into the biological mechanisms through which soot exposure, possibly exacerbated by heavy metals, may lead to increased cancer risk. Understanding these mechanisms is crucial for developing targeted interventions and elucidating the specific pathways by which soot contributes to cancer development.

Ewubare and Okadigwe (2018) conducted study on how black carbon emissions and their dispersion affect rural farmers' income in Port Harcourt's Etche district, which is known for producing a wide range of high-yielding agricultural items. According to their analysis, the amount of black carbon in agricultural goods decreased by 2.45 Naira for every unit increase in oil leakage. Furthermore, a 3.69 percent decrease in agricultural revenue was incurred with each percentage rise in black carbon emissions. The study on soot pollution lacks detailed data on the sources and composition of soot in Tombia Community, which could inform more targeted mitigation strategies.

Onwuna et al (2023) investigated how people in the Tombia Community, Rivers State, Nigeria, felt about the effects of soot pollution from artisanal oil refineries. Residents were given questionnaires totalling four hundred and twenty (420) in order to ascertain how they felt soot affected them. Descriptive statistics (frequency and percentages) and inferential statistics (chi-square) were used to analyse the obtained data. Only 54.6% of respondents said that artisanal crude oil refineries were to blame for the presence of soot in the region, despite the fact that 79.9% of respondents were well educated about the effect of these facilities. The majority (67.3%) reported experiencing pain either while inside the facility or immediately after. The most common health issues reported by participants were breathing difficulty, sneezing, nasal discomfort, eye irritation, and coughing. According to the Chi-square analysis, there is a significant correlation ($p < 0.05$) between the respondents' age and gender and the impact of soot pollution. However, there is no discernible correlation between the soot impact and marital status, educational attainment, or length of stay. Most (65%) of the participants noted alterations in the plants during the soot pollution period. 95.4% of respondents said that during the dry season, soot pollution was more noticeable. This research has shown the harmful effects of soot pollution on both the environment and humans. To safeguard the people of the Niger Delta, artisanal crude oil refining has to be opposed to the point of collapse. The study on soot pollution lacks detailed data on the sources and composition of soot in Tombia Community, which could inform more targeted mitigation strategies. While they

measure air emissions from artisanal refineries, the study lacks detailed data on the health impacts and community perceptions related to these emissions in the Niger Delta.

5.0 Conclusion

After a critical examination of the effect of makeshift refining soot on health security in Rivers State, this paper found that makeshift refining soot has become a threat to health security with far-reaching consequences for the well-being of its residents. The physical health effects like respiratory problems, and the psychological impacts such as anxiety are equally concerning. Furthermore, the social and economic implications, including reduced economic productivity and strained healthcare resources, are significant. Therefore, this paper proposes that it is essential to address the root causes of makeshift refining to mitigate the effects. There should be a multi-faceted approach involving government, civil society, and community engagement to transit from makeshift refining to more sustainable and healthy alternatives, ensuring a safer healthier future for the people of Rivers State.

6.0 Recommendations

Based on the findings, the paper made the following recommendations:

i. Government and oil companies should implement programs to provide alternative, legitimate livelihoods for individuals involved in makeshift refining, such as vocational training and support for small businesses, to reduce dependency on illegal refining activities that affect health security in Rivers State
ii. Government and oil companies should implement regular health screening for communities in affected areas to detect and manage health issues early in Rivers State.
iii. Government and oil companies should collaborate and enhance healthcare infrastructure to treat respiratory and cardiovascular diseases in Rivers State.

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