

Black Soot Menace and its Impact on Residential Buildings in Rivers State, Nigeria¹

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Abstract

As far back as mid 2016, Rivers State residents particularly those resident in Port Harcourt began noticing deposits of black soot in their homes, public places, on their clothings, cars, streets, plants and even on their bodies. Despite wide cries against it, the menace has continued unabated and in increasing densities and spread over the years except that the rains that last for a greater part of the year seem to reduce the deposit level of this soot apparently by washing some away. Several sources of black soot have been identified and include smoke generated from local, illegal refineries engaged in illegal production of diesel and kerosene, smoke from petrochemical industries, gas flaring from flow station of oil companies, smoke from industrial and domestic generators, smoke from exhaust of vehicles of all types, smoke generated from burning of vehicle tyres either at abattoirs or for other purposes, smoke from burning of confiscated illegally refined petroleum products (though this act by the military has reduced as a result of widespread condemnation), smoke from fertiliser companies and smoke generated from burning of solid waste in dumpsites located in and around Rivers State. Of all these sources, black soot generated from the activities of local, illegal refineries have been identified to be the major culprit. This paper employed the use of e-questionnaires to elicit data from about 340 registered Estate Surveyors and Valuers resident or practicing in Rivers State. The data generated was subjected to further analysis using the one-way ANOVA to test the impact of soot in the City while F-ratio test was used to test for significance. The results revealed that black soot has significant impact on residential buildings in Port Harcourt. Amongst recommendations made were the need to immediately halt further illegal refining of crude, standardize local crude refining processes which must cover soot management and disposal systems before considering issuing of refining licenses to local refiners.

Keywords: Black Soot, Pollution, Residential Buildings, Illegal Crude Refining, Black Soot-Generation Activities

Historical Review of Black Soot Pollution in Rivers State

Soot is described as a deep black powdery or flaky substance consisting largely of amorphous carbon produced by the incomplete burning of crude oil, organic matter, fossil fuels and coal. It

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is said to contain a number of pollutants including acids, metals, soils and dust. According to the 2019 Rivers State Governments's Report, black soot is the common term for a type of particle pollution called PM 2.5 – particulate matter with diameters that are 2.5micrometers formed by the incomplete combustion of hydrocarbons and are capable of floating in the air for several months. Using air as its medium of movement, it moves about and settles on animate and inanimate objects and due to its tiny size, it can easily penetrate the lungs and bloodstreams of humans and animals. The US Environmental Protection Agency (EPA) describes black soot as one of the deadliest forms of air pollution.

Black soot deposits which began to be noticed in homes and surrounding environment in Rivers State in 2016 has become a serious environmental issue for not just the residents of the state but also for the country and international community. The soot first appears as clouds laden with dark particulate matters on the skyline in several parts of the state. But for their blackish nature and the fact that they are not characterized with cooler temperatures, these soot-laden clouds would have been mistaken for harmattan haze. This sight is easily noticed in the morning and evening hours and particularly, between the months of November and March when the rains subside. The menace of the soot is not discriminatory neither is it a respecter of persons and locations as its deposits and particles filter into homes and other closed areas just as it settles on cars, streets, water bodies, wetlands, plants and animals – there is virtually no safe place against soot in the state. This perhaps lays credence to the April 2018 ranking of Port Harcourt as the worst polluted city in the world with an air index of 188. Similarly, in December 2020, AirVisual ranked Port Harcourt as “very unhealthy” for sensitive groups having attained an air index of 207.817. In what appears to be a trend, AirVisual's ranking of air quality in Port Harcourt for July, 2021 threw up an air index of 152 far above the standard (0-50) and moderate (51-100) levels. Currently, AirVisual Air Quality Index for Port Harcourt is 150 US AQI and classed as unhealthy for sensitive groups. It went further to state categorically that PM2.5 (Black Soot) is the major pollutant with concentration more than 10.7 times above the WHO annual air quality guideline value (Air Quality AirVisual, 2022).

After 76 years of oil exploration and exploitation in the Niger Delta particularly in Rivers State, it is expected, and this has formed the basis of major public outcries, that a comprehensive environmental audit to ascertain how the environment has fared is long overdue. Sadly, this is yet to be successfully done. For this reason, the environmental impact assessment of 76 years of oil exploration and exploitation in Rivers State is somewhat unknown hence not much appreciated. This, perhaps, explains why the issue of black soot pollution in Rivers State which has lingered for about six years is yet to receive the desired attention.

The Rivers State Government set up a scientific work committee to conduct an investigative study on the prevalence of black soot in the state in 2018 and subsequently, a technical team in 2019 to implement the recommendations of the scientific work committee. Amongst the findings of this study was that illegal bunkering and gas flaring remain the two major sources of soot in the city. It was also found out that the spike in medical conditions in the state is traceable to the

prevalence of soot. Besides putting a halt to the burning of illegally refined petroleum products and confiscating old and expired tyres, not much has been felt or seen by Rivers State residents on fighting the black soot menace.

Study Area

This study was conducted in Rivers State located in the Niger Delta region of Nigeria (Figure 1). It lies on the coastal plain of the eastern Niger Delta and is characterized by a maze of effluents, rivers, lakes, creeks, lagoons and swamps crisscrossing the low lying plains in varying dimensions. Applying a growth rate of 2.96% to the 2006 population census figure for Rivers State, the state has a current estimated population of 9,567,892.

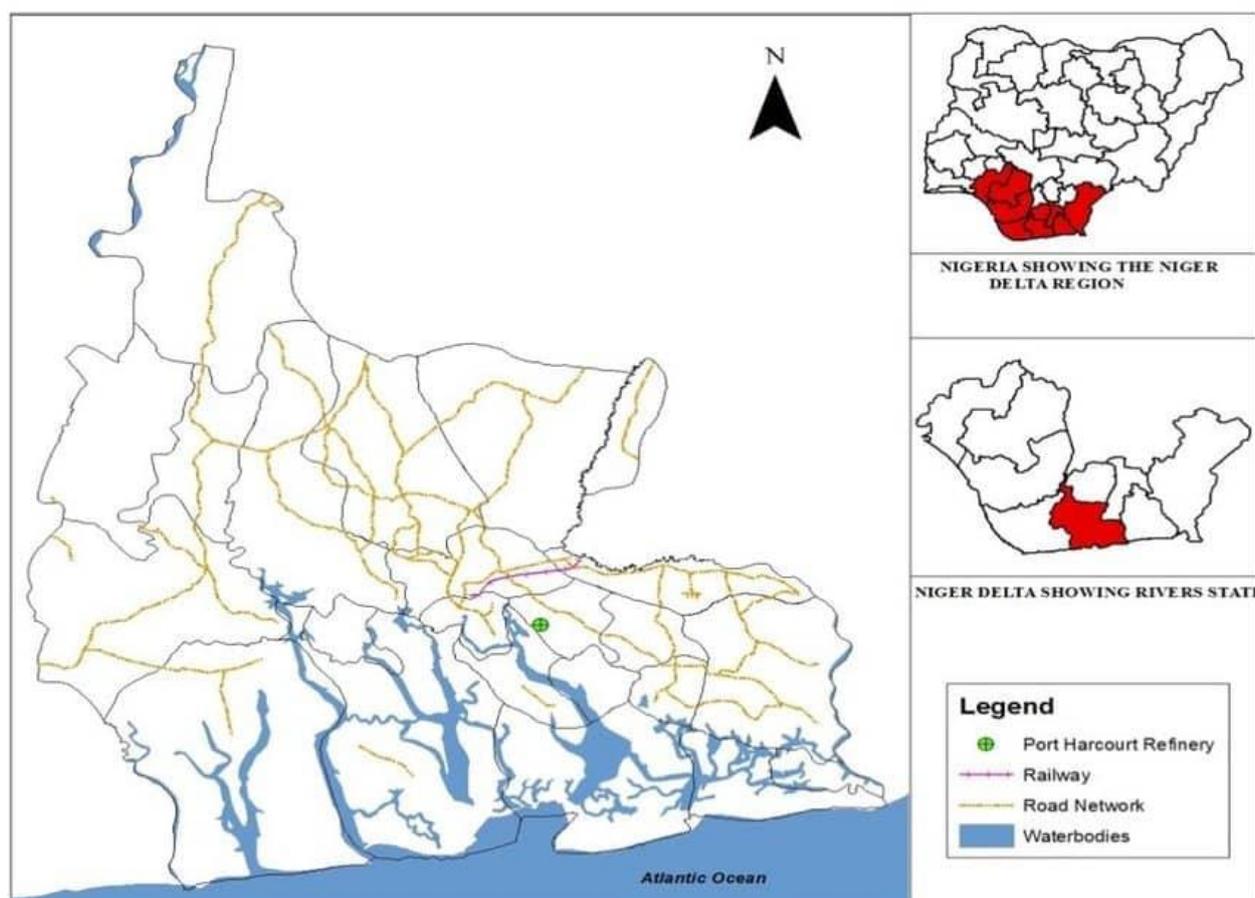


Figure 1: Map of Rivers State
Source: Library of Congress (LOC); 2020

Though black soot was first noticed in parts of Port Harcourt and neighbouring local government areas of Eleme, Oyigbo, Ikwere, Obio/Akpor in 2016, deposits of the soot have been noticed in almost all areas of the state even on the islands, water bodies and wetlands. It seemed that the more the observations of the soot gained currency, the more the soot spread to other locations.

Presently, black soot is noticeable in virtually all local government areas of Rivers State howbeit, in differing densities and intensities. (see figures 2 – 4 below)



Figures 2 – 4: Images of black soot in Rivers State
Source: Google – [medium.com images.app.google](https://medium.com/images.app.google)

Understanding the Concept of Residential Buildings

A residential building is described as a building made up of one or more rooms used for housing with the necessary facilities and utilities that satisfy the living requirements of a person or a family. Craighead (2013) defines a residential building as a building containing separate residences where a person stays or lives regularly. He further opined that a residential building will usually include fittings, equipment, services including security and parking facilities. This is similar to Jinadu (2004) definition of residential housing wherein housing was defined to include the physical structure for residence (building), ancillary facilities and services within and around the physical structure as well as the general environmental amenities that surround the physical structure. Efekalam (2016) viewed residential buildings as being synonymous with housing structure and are thus considered as the built environment, a stimulant of the national economy and a set of durable assets which account for a high percentage of a country's wealth and in which households dwell and consequently spend a substantial part of their income to own or rent. Residential buildings are therefore aptly considered as the physical structure (the roof, the walls, the floors and the fittings and facilities attached to these structures such as windows, carparks and fences) that houses the residents which in Jinadu (2004) opinion is only but a part of the house.

Various categories of residential buildings abound and range from tenement buildings to self contained apartments and blocks of flats. Others include include bungalows (either fully or semi-detached), single storey houses (otherwise referred to as duplexes) and maisonnettes. Whatever the building category is, one thing stands out – namely these buildings are designed and built for the residential or housing needs of individuals or households.

Residential buildings just like other building classes require professional management if such buildings must continue to fulfil their objectives and satisfy the aims of the owner, builder and/or investor. Property management helps to lower risks associated with property investments by maximising returns and reducing costs associated with residential buildings, improving quality of life of those residing in the property and ensuring safety of life of both those resident in the building and the building itself. It also promotes healthy relationships between stakeholders in the property (the owner or investor, the residents, the property manager and other parties such as law enforcement agents and housing authorities) and ensuring proper planning for future actions. This explains why a good property manager is seen as a manager of both real property and people.

Management Tasks involved in Managing Residential Buildings

The task of professionally managing residential building investments and indeed other types and classes of real property investments in Nigeria rest squarely on Estate Surveyors and Valuers (Cap E. 13 LFN 2007). Managing residential buildings basically entails running an income-producing residential property on behalf of the owner. Traditionally, the tasks involved in managing residential buildings include tenants selection, rent collection and making appropriate

remittances, service charge administration, attending to tenants requests, issues and problems and acting on behalf of the owner or investor in matters relating to the building. Working for owners of the residential buildings, property managers take responsibility for day-to-day maintenance, repairs, general upkeep and security of the building. In recent times however, several changes including changes in policies, laws and environment have spelt out greater tasks for the property manager. Changes in the Rivers State environment as occasioned by black soot have led to increasing management tasks and improvement on approaches to carrying out already identified tasks.

Black soot attacks residential buildings in the form of dark matter that appear and settle on roof tops, floors, walls and ceilings, gathering intensity over time thereby becoming more prevalent and extensive and more costly to clean up and manage. Some areas susceptible to gathering soot in residential buildings include:

- The base of doors – this mostly occurs in homes with carpets. These carpets tend to filter the soot from the air and get them trapped at the base of doors particularly doors that open outside the building
- On light switches and outlets including lamp holders and chandelier, fans and airconditioners – this is simply because static electricity tend to attract soot. Cleaning of these require professional cleaning and supervision
- On walls – this is the most prevalent and poses the greatest management task and cost. It is often due to temperature differences in different parts of the wall leading to “ghosting” (the creation of black spots and areas on walls). Walls constantly get dirty soot making the building appear unkept
- On floors – generally, all floors are susceptible to gathering soot in homes irrespective of the finishing. Also, in buildings where the floors are covered with carpets and rugs, these also trap and accumulate black soot over time especially in situations where cleaning is not carried out regularly. Black soot has been observed to discolour floor tiles causing them to appear dirty and darker than normal
- On roof tops – black soot settle on roof tops and when it comes in contact with moisture becomes acidic and capable of reducing the life span of roofing sheets while increasing their maintenance costs as they become more susceptible to rust and other forms of damage (see figure 5 and 6 below).



Figure 5 and 6: Black soot on the roof top of a residential building in Rivers State

An understanding of the areas in residential buildings that are prone to attack by soot bring to limelight the growing need to enhance and improve property management tasks in such areas in order to keep abreast with achieving the aims of property management.

Gap in Literature

Several studies on the effects of black soot have been conducted however, these studies were focused mainly on determining the effect or impact of black soot on humans and the environment.

Apart from the most common irritation to the eyes, nose and throat, black soot has been associated with upper respiratory infections such as asthma, pneumonia, coronary heart disease, bronchitis and some other respiratory illnesses (Yakubu, 2017). According to the Rivers State

Government (2019a) report, laboratory analysis revealed that black soot has a severe level of toxicity capable of reducing the absorption of folic acid by fetuses in pregnant women thereby leading to birth defects. Ede and Edokpa (2017) were emphatic in stating that black soot is capable of causing skin and lung cancer which may lead to premature death.

Whyte, Numbere and Sam (2020) in their study opined that soot which contain sulphur dioxide and nitrogen dioxide combine with moisture to cause acidity and acid rains which is capable of negatively affecting all components of the environment. The trio asserted that black soot has also been found to cause water turbidity leading to water pollution and death of flora and fauna.

Informative as all the studies above are, none has been found to ascertain the effect of black soot on residential buildings. Herein lies the gap which this study seeks to fill.

Study Methodology

This study centres on determining the impact of black soot on residential buildings in Rivers State. Literature on black soot and residential buildings were reviewed extensively thereby revealing the gap which this study seeks to fill.

Given that two sets of data (qualitative and quantitative) were obtained in the course of this study, the researcher adopted the use of mixed-methods research design which allows for the combined use of both quantitative and qualitative analytical methods in carrying out studies of this nature.

An e-questionnaire was developed using the Google Form and subjected to reliability and viability tests using pre-testing tools as suggested by Tonglet, Phillips and Bates (2004). Our population of study which equals our sample size is given as 340 and comprise all registered Estate Surveyors and Valuers practicing or residing in Rivers State (Branch Directory 2020 – 2022). The 340 questionnaires distributed contained questions aimed at determining the impact of black soot on residential buildings. Of this number, 305 representing 89.71% were returned, correctly filled out. Data generated were then subjected to statistical tests using the one-way ANOVA F-test which is suitable for use in studies where test of differences between means is required for samples or populations larger than 30. The analysis was done using SPSS, version 22. The results of the analysis backed up with literature review formed the basis for the outcome of this study.

Data Analysis and Results

From the aim of this study, the following hypothesis was formulated:

H₀: Black soot does not significantly impact on residential buildings in Rivers State

H₁: Black soot impacts significantly on residential buildings in Rivers State

In testing this hypothesis, one-way ANOVA F-test was employed to determine the significance level of the impact of black soot on residential buildings in Rivers State based on data generated from Estate Surveyors and Valuers who are considered professionals in real property management. Table 1 below is a one-way ANOVA F-test table which showed that the p-value (0.000) is low (being lower than 0.05) suggesting that the null hypothesis be rejected in favour of the alternative hypothesis.

Table 1 – ANOVA F-test results of the impact of black soot on various locations in Rivers State

Source	Sum of Squares	Df	Mean Square	F	Sig
Between locations	348486.388	2	174243.194	580.797	0.000
Within locations	3209.720	114	300.007		
Total	351697.110	116			

Source: SPSS, Version 22

The analysis and results above give strong justification for rejecting the null hypothesis and accepting the alternate hypothesis. It is therefore correct to state that black soot impact significantly on residential buildings in Rivers State.

Discussion of Findings/Results

Preliminary observations, physical inspections and literature review revealed some level of impact of black soot on residential buildings in Rivers State. To further explore the significance level of this impact, a statistical analysis was undertaken to check whether this impact was significant enough to be a source of worry to government and other stakeholders in the built industry. The test was based on hypothesis as stated above. The analysis indicated a significant impact thus the null hypothesis was rejected and the alternate hypothesis adopted as the outcome of this study.

In rejecting the null hypothesis that black soot does not significantly impact on residential buildings in Rivers State, we accept the fact that black soot significantly impacts on residential buildings in the study area and should therefore be a serious source of worry to government and other stakeholders in the built industry in Rivers State in particular and Nigeria as a whole.

The result of this study throws up an inverse relationship which manifests in the increasing tasks facing the Estate Surveyor and Valuer in carrying out the task of managing residential buildings. This relationship also manifests in increasing costs associated with managing residential buildings which invariably translate to increased cost of buying or building or renting a residential building in Rivers State. This study revealed that prospective tenants and residential property developers seek for accommodations or land for residential property developments in neighbouring states where the impact of the soot is either not felt or at its barest minimum. It is envisaged (though subject to further studies) that this scenario is capable of leading to very many voids in residential buildings, reduction or loss of returns on investments and a reduction

in the gross earnings of the state as occasioned by loss of or reduction in revenue earnings from this source.

Conclusion

In what appears to be a drift from the norm, this study has shown that black soot not only impacts human health and air as many researches have shown but also impacts significantly and negatively on residential buildings.

It is about time that the black soot menace which has lasted for almost six years in Rivers State be given the desired attention and fight that it deserves. Observations over the last six years show that the deposit and impact of black soot in Rivers State get more intense with passage of time confirming the fact that very little or nothing is being done to fight the menace.

Considering the fact that human and animal health, plant health, air and even residential buildings have been found to be significantly and negatively impacted by black soot, all efforts by individuals, groups, cooperate organisations and government should be intensified and geared towards consciously reducing and gradually eliminating black soot pollution in the state.

Recommendations

It is hereby recommended that conscious, deliberate and intense efforts on creating awareness of the adverse effects of black soot pollution be carried out in Rivers State especially among those locals who engage in illegal refining. Yes, they may be enjoying the money got from this illegal refining without knowing that the monies so generated can not be equated to the damage pollution from this source is causing to human health, components of our environment and residential buildings.

On managing residential buildings, it is recommended that periodic cleaning and maintenance of walls, floors and other parts of the building that require cleaning be intensified and carried out more regularly to reduce the attack and impact of black soot on them.

It is also recommended that government refineries be fully refurbished and put to optimal use. In this way, sufficient quantities of petroleum products will be produced such that markets for illegally refined petroleum products will stop thriving and gradually die off.

One of the recommendations of the technical team on black soot set up by the State Government in 2019 is the need to integrate local and artisanal refiners into cooperatives for the formal refining of petroleum products. It was envisaged that a modular refinery that will come on stream in 2021 to curb this menace. If this recommendation can be fully implemented, it is believed that black soot menace will reduce drastically.

Suggestions for Further Studies

The foregoing is a study on the menace of black soot in Port Harcourt and its impact on residential buildings. The findings and results of the study threw up new areas that can be subjected to further studies and researches.

First of all, residential buildings are just one out of the over six classes of real property. There is therefore the need to study the impact of black soot on other classes of real property and to further compare the impact of black soot on one class in relation to another class.

Secondly, it is also possible that black soot pollution has significant negative impact on other areas or things such as housing development in Rivers State, increasing voids, decreased income and revenue earnings to mention only a few. These should be subjected to further studies in order to make research-based conclusions.

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