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Environmental Impact of Air Pollution: A Review of Industrial Areas in Nigeria

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Abstract

As a consequence of its growing negative impacts on the environmental circumstances of living organisms in the vicinity, polluted air has become a widespread topic of concern in industrialized regions. The above research focuses on the growing industrial regions of Kano Metropolis, Kano State, Nigeria, while assessing the environmental consequences of air pollution. This research assesses the overall environmental effects of air pollution affecting industrial regions in the metropolitan area, primarily focusing mostly on the types, causes, effects, and remedies of air pollutants in the region. This research used a survey methodology to gather data from three of Kano's most significant industrial sectors. Four hundred respondents were given questionnaires as the main data-gathering tool. The collected data was encoded and analyzed using descriptive statistics to determine the primary and most consistent source, influence, and type of environmental pollution, which occurred primarily in metropolitan areas. The findings of this study indicate that, of the various anthropogenic and natural causes of air pollution in the industrial zones of the Kano metropolitan area, fossil-fuel emission is the primary cause; the most common environmental impacts of air pollution are dark smoke and crop/forest destruction, respectively; and that dust filters and scrubbers are indeed the necessary remediation methods. This research suggests that the industrial districts in the metropolitan region of Kano are negatively impacted by the industrial operations in the area to the extent that they represent an environmental concern to the local population. Therefore, this research offers an internal environmental policy framework for enterprises to provide exhaust control mechanisms that safeguard the environment from dangerous emissions.

Keywords: *Air pollution, Environment, Industrial area, Kano metropolis.*

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Background to the Study

Air pollution is one of the challenges associated with growing activities in cities, which is due to the interactions within the ecosystem (Ityavyar and Tyav, 2020). This type of pollution, over time, has increased tremendously with the urbanization processes which are associated with industrial growth and development. These interactions and mobility have deteriorated air quality by a way of intensifying air pollution in industrial areas (Fagorite, Anifowose and Chiokwe 2021). Across the world, the industrial revolution was a great success in terms of society and the provision of multiple services, however such development also introduced huge quantities of pollutants into the atmosphere that are harmful to the environment. The extent and severity of air pollution challenges affects the speed and extent of cities' development, and most of these pollutants are emitted from sources such as products emission, evaporation of solvents, leaks at industrial facilities, incinerators, flare stacks and other atmospheric emissions (Grutter, Arellano, Bezanilla, Friedrich, Plaza, Rivera and Stremme, 2014).

Air pollution is either a result of natural and/or anthropogenic processes (Ityavyar and Tyav, 2020). The natural forms of pollution are those that result from naturally-occurring phenomena, that is, periodic activities that result from a non-human activity such as dust storms, volcanic eruptions and wild fire among others (Nnamani, 2021). The anthropogenic forms on the other hand, are by far the greatest contribution to air pollution as a result of human impact such as emissions from mechanical equipment, animal activities, industrial wastes, landfill and construction activities among others (Odogun and Georgakis, 2019). As a result of numerous socio-economic activities going on in major commercial cities in Nigeria, polluted air has become widespread concerns in industrialized regions. As a consequence of its growing negative impacts on the environment, the effects of air pollution such as eutrophication, haze, acid rain, ozone depletion, climatic change among others, have become a great source of concern for major and developing commercial cities in Nigeria (Fagorite, Anifowose and Chiokwe 2021).

It is against this backdrop, this study focused on the most commercial city in Northern Nigeria, that is, Kano metropolis where there are several economic and industrial activities going thereby constituting additional air pollution challenges (Hashim, Gobi, Ho and Li, 2020). The environmental issues in Kano State as a consequence of air pollution significantly depend on the industrial activities in the State. Hence, this study considers the types, causes, effects and remedies for air pollution in the industrial areas of Kano metropolis.

Problem Statement

Air pollution is an acute problem in developing countries especially their growing cities, with rapid industrialization, and abundant natural resources and diverse sensitive ecosystems that requires the needs to protect the environment as well as natural resources conservation (Hashim, *et al.*, 2020). The interactions between humans and their social and physical surroundings have been extensively studied, as multiple human activities influence the environment (Ityavyar and Tyav, 2020). However, there is lack of empirically-based study on the analysis of environmental issues resulting from air pollution in industrial areas of growing

cities and economies. As such, this study which focuses on the growing industrial regions of Kano Metropolis considers evaluating the environmental issues of the resultant air pollution eminent in the area. This research assesses the overall environmental effects of air pollution affecting industrial regions in the metropolitan area, primarily focusing on the types, causes, effects, and remedies of air pollutants in the region from the perspectives of environmentalists, environmental stakeholders and partners.

Literature Review

Environmental - Air Pollution

The environment consists of the abiotic (lithosphere, hydrosphere and atmosphere) and the biotic (microorganisms and living organisms) (Ityavyar and Tyav, 2020). As such, the environmental pollution is seen as means that introduce or release any biological, physical, chemical or radiological substance into any of the components of the environment (i.e air, land, water or soil) at a faster rate than at which the environment can accommodate naturally through dispersion, absorption or breaking down (decomposition); and which threatens the system (biotic) of the environment (Ukpere, Clifford, Ojule and Ottah, 2018).

Air pollution is the introduction of certain undesirable chemicals, biological materials or particulate matters that may cause damage to either the natural and/or built environments, into the atmosphere (Fagorite, Anifowose and Chiokwe 2021). Similarly, air pollution is considered as the presence of certain pollutants (i.e hydrocarbons, dusts, inorganic gases, suspensions etc) in the air in such a significant quantity long enough to distort the balance of the environment (Manisalidis, Stavropoulou, Stavropoulos and Bezirtzoglou 2020). Furthermore, air pollution is seen as the presence in either indoor or outdoor atmosphere of particulate contaminants in certain characteristics, quantities and duration long enough such as to unreasonably interferes with the comfortable enjoyment of life and property or natural state of the environment (Nnamani, 2021).

Similarly, Ukpere *et al.*, (2018) posit that air pollution is the presence of one or more substances at a concentration for duration up and above their natural levels with the potential of producing adverse effects. From the foregoing, air pollution, based on this study, is therefore the presence of pollutants in the atmosphere in such a quantity and duration that impair the quality of air, and which is harmful to other materials in the environment.

Empirical Review

Nnamani (2021) examine the basic concepts of air pollution and the various ways in which human activities and their interactions affect nature and quality of the air in Nigeria. The study used conceptual analysis obtained from the secondary data in relation to air pollution and was analyzed using latent analysis. The finding reveals that there are problems of air pollution which include the release of harmful substances into the environment especially in the developing countries and this has continued in much larger scales on daily basis thereby increasing the air pollutants. The study concludes that the atmospheric air pollution by human activities possess some serious problems both now and for the future. It was therefore recommended that legal framework and policy formulation should be provided to ensure that air pollution is put to check especially in commercial city centres.

Fagorite, Anifowose and Chiokwe (2021), analyze the causes and remediation of air pollution in Nigeria and to also identify the challenges to air quality in the Niger Delta region. The study carried out conceptual reviews which were analysed using systematic content analysis. The findings of the study revealed that air pollution in the area is either caused by natural or anthropogenic process and it has significantly affects the sustainability of the environment. It was further revealed that there are new practical alternatives to traditional ways to remedying air pollution; for instance, combustion of fossil fuels for space heating need to be replaced by using seasonal thermal energy storage and ground source heat pumps. The study concludes that there are numerous challenges facing air quality such as lack of equipment, lack of infrastructure, inadequate expertise and weak policy framework, as such, measures should be taken by government to reverse all those hitches in order to save the environment.

Other similar literature reviewed presented that air pollution has posed threats to socioeconomic development and sustainability (Manisalidis, Stavropoulou, Stavropoulos and Bezirtzoglou 2020; Odogun and Georgakis, 2019). Also, it has been revealed that air pollution can be reduced significantly should the governments across all levels create the enabling environment for effective cleanliness through legislative framework and ensure the implementation and monitoring of same (Hashim, *et al.*, 2020; Odoh, Akpi and Anyah 2017). In addition, the level of awareness on causes and effects of air pollution around commercial cities is still comparative low among the general populace (Efobi, 2018) as such the need for literature exploration on the causes, effects and remedies of air pollution across industrial areas in developing economy. As such, this study identifies this as a gap in knowledge that the study will cover.

Methodology

This research used a survey methodology to gather data from the key environmentalists and stakeholders in Kano State. The study purposively selected a sample size of four hundred, as such, four hundred respondents were administered the questionnaires which was used as the main data gathering instrument. The collected data were encoded and analyzed using descriptive statistics to determine the primary and most consistent types, causes, effects and remedies of air pollution, which occurred primarily in Kano metropolitan areas.

This study focused on the frequency of the responses to determine the positions of the stakeholders which are management staff of Kano State Departments and Agencies under environment, environmental partners both local and international and environmentalists in Kano State. The finding of this study is therefore premised on the empirical analysis of the responses from the respondents. Out of the 400 questionnaires administered, 275 representing (68.75%) were returned validly filled, upon which the results and analysis of this study are presented.

Results and Discussion

Types and Causes of Air Pollution

The prominent types of air pollution in Kano metropolis according to the respondents are presented in table 1.

Table 1: Types of Air Pollution

S	Types		Frequency	Percent
1.	Natural		55	(20.0)
2.	Anthropogenic		220	(80.0)
		Total	275	(100.0)

In the table above, the respondents revealed that most common types of air pollution in Kano metropolis anthropogenic in nature which indicates is caused by human activities such as industrialization and other economic activities. The findings of this study on the nature of air pollution are supported by (Odogun and Georgakis, 2019; Fawole, Cai and Mackenzie 2016; Ladan, 2013). However, there are other areas parts of the world where natural causes as wild fire and volcanic eruption are prominent based on the findings by (Chen and Jin 2018; Grutter *et al.*, 2014).

Causes of Air Pollution

The causes of air pollution in Kano metropolis according to the respondents are presented in table 2.

Table 2: Causes of Air Pollution

S	Types	Causes	Frequency	Percent
1.	Natural	Dust storms	39	(14.2)
		Wild fire	1	(0.4)
		Volcanic eruption	0	(0.0)
		Animal digestion	13	(4.7)
		Vegetation	2	(0.7)
2.	Anthropogenic	Fossil-fuels emission	80	(29.1)
		Industrial wastes	53	(19.3)
		Construction activities	35	(12.7)
		Agriculture wastes	40	(14.5)
		Landfill	12	(4.4)
		Total	275	(100.0)

The table 2 indicates the various causes of air pollution which is sub-divided into natural and anthropogenic causes. Under the natural causes, dust storms (14.2%) is the major cause of air pollution followed by animal digestion (3.7%). In the natural causes, fossil-fuels emission (29.1%) is the most common causes of air pollution, closely followed by industrial wastes (19.3%), agricultural wastes (14.5%) and construction activities (12.7%) respectively. The analysis reveals human activities account for air pollution in the metropolis with majority of that activities being from fossil fuel emission from vehicles, generators and other mechanical equipment that use energy from hydrocarbons such as gas, diesels, petroleum, kerosene among other. This finding is in agreement with Nnamani (2021); Fagorite, Anifowose and Chiokwe (2021), Manisalidis, *et al.*, (2020) who also indicates that air pollution is either caused by natural or anthropogenic process. In addition, Ityavyar and Tyav, (2020) further advanced that pollutant from the exhausts of cars, lorries, mechanical plants and generators and the likes account for significant amount of air pollution in the commercial/industrial areas.

Effects of Air Pollution

The effects of air pollution in Kano metropolis according to the respondents are presented in table 3.

Table 3: Effects of Air Pollution

S	Items	Frequency	Percent
1.	Acid rain	19	(6.9)
2	Eutrophication (gaseous pollution of water bodies)	102	(37.1)
3	Haze (tiny particles in the air)	85	(30.9)
4	Ozone depletion	40	(14.5)
5	Crop and forest damage	3	(1.1)
6	Climatic change	14	(5.1)
7	Distortion of ecosystem	12	(4.4)
	Total	275	(100.0)

In table 3, the effects of air pollution indicate that eutrophication (37.1%) account for the major effect of air pollution in the metropolis which is followed by haze (30.9%) and ozone depletion (14.5%) to some extent. However, there were no significant changes in ecosystem and the climate just yet, but the continuous release of the air pollutants into the atmosphere will degenerate to the level. This finding is supported by (Hashim, 2020: Odoh Akpi and Anyah 2017, Marais, *et al.*, 2014), who also revealed that water contamination and haze are the common effects of air pollution in the metropolis. However, unlike this study, Fagorite, Anifowose and Chiokwe (2021) indicate that dark smoke and crop/forest destruction are the most prominent effects of air pollution in Nigerian cities.

Remedies of Air Pollution

The remedies of air pollution in Kano metropolis according to the respondents are presented in table 4.

Table 4: Remedies of Air Pollution

S	Pollution control devices	Frequency	Percent
1.	Bag house	19	(6.9)
2	Scrubbers	62	(22.5)
3	Dust filters	85	(30.9)
4	Mechanical collectors	50	(18.2)
5	Chemical neutralizer	40	(14.5)
6	Gas shields	3	(1.1)
	Total	275	(100.0)

In the table 4, the proffer remedies for air pollution in the cities are provided by the environmental stakeholders, majority of the respondents (30.9%) believes dust filters is the best remedy for air pollution control, other pollution control devices suggested are scrubbers (22.5%), mechanical collectors (18.2%); chemical neutralizers (18.2%) among others. This study is clearly supported by the findings of the following studies (Nnamani 2021; Manisalidis, *et al.*, 2020; Odoh, Akpi and Anyah 2017).

Policy Implication of the Study

In order to rebuild and rejuvenate the natural environment and as such design air quality control strategy(ies). Several environmental aspects must be taken into consideration to improve the engineering factors, ambient air quality conditions, air pollutants characteristics and economic operating costs for administrative/legal costs and technological improvement of the society. In terms of the socio-economic factors, significant competitiveness through neo-liberal analyses are considered to offering solutions to the myriad of environmental challenges. The policy responses must therefore include a robust, rigorous and well-informed strategy of reducing the environmental, social and health impacts of air pollution in the industrial areas and metropolitan cities unlike the pollution control policy and forestry control law which did not really focus on social lives of the people.

Conclusion

Air pollution is by far the most challenging of all environmental problems and as such poses a significant threat to the global ecosystems. This research indicates that the industrial areas in the metropolitan cities in Kano are impacted negatively by the commercial and industrial activities in the area to the extent that they present such a huge environmental concern not just to the locals but to the overall environmental sustainability of the State. Such environmental concern includes eutrophication, haze and ozone depletion. In addition, it was revealed that certain pollution control devices which include dust filters and scrubbers can be used to reduce the effects of air pollution.

Therefore, this study suggests an internal environmental policy framework for businesses and commercial enterprises to provide exhaust control mechanisms that will safeguard the environment from their dangerous emissions. In addition, there should be public awareness in addition to multidisciplinary approaches by experts at national and international levels to address the emergence of these threats. In addition, there is drastic need for the development of robust monitoring and management systems, which will ensure high quality information on the extent and impact of air pollution and upon these, legislations to curtail air pollution and development mechanisms can be enhanced in Nigeria.

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