Framing air pollution as a major health risk in Lagos, Nigeria

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Abstract

This paper provides an overview of the emergent public health risks attributable to air pollution in Lagos and solutions to reduce them. Growing evidence has substantiated a causal relationship between air pollution and mortality, hospital admissions for respiratory or cardiovascular disease and an associated increased risk of myocardial infarction. Lagos, the former capital of Nigeria with a population of 15 million has been identified as one of the fastest growing megacities with annual mean concentrations many times higher than the thresholds recommended by the WHO. Given the urban conglomeration of Lagos, this paper shows that differential traffic density, socio-economic conditions, access to healthcare and proximity to sources of emissions create differential susceptibility of communities to ill health attributable to air pollution, especially within vulnerable groups including children, the elderly and pregnant women. The paper therefore argues that an understanding of the scale and spatial variation of air pollution is not sufficient for reducing the risks posed to public health. An effects-based approach needs to be adopted in order to frame air pollution problems in the city within a public health context, rather than as an environmental nuisance.
Keywords: Lagos, Nigeria, public health, air pollution, traffic-related emissions.

1 Lagos: population and pollution

Lagos is a port city located in the south-western region of Nigeria (Figure 1). It was the capital of Nigeria from 1914 to 1991. Since the mid-1970s, urban landscape development in Lagos has been characterised by the rapid growth of residential and business settlements around busy and often congested road

WIT Transactions on Ecology and The Environment, Vol 157, © 2012 WIT Press
www.witpress.com, ISSN 1743-3541 (on-line)
doi:10.2495/AIR120421

networks [1]. It is estimated that 75% of Nigerian industries are located in the city [2]. Lagos attracts large numbers of the Nigerian population which has led to rapid urbanisation with limited infrastructural capacity [3]. Lagos has a growing population of 15 million, which makes it the fastest growing city in Africa and one of the world's largest megacities [4]. The urban sprawl of Lagos consists of two major regions: the Island and the Mainland area. The Island is the commercial district surrounded by slums with high population density. The mainland is made up of expansive and growing settlements which join Lagos with other neighbouring states in Nigeria. The climate is tropical, hot and wet with an average temperature of 27 °C.

Figure 1: Map of Nigeria showing the location of Lagos (national geographic).

Lagos covers an area of 356,861 hectares of which 75,755 hectares are wetlands, sandy barrier islands, tidal flats and estuaries [4]. According to the official state record, 85% of the city's population live on 37% of the land, resulting in an average population density of 20,000 persons per square km in the urban areas [2]. The demographic trend forecasts a population growth rate of 8% [2]. The attendant demand for mobility therefore has had dire implications for land-use, public transportation systems and the capacity of the city to meet the need of the growing population for basic resources. Poor land-use planning, poverty and an inadequate health care system have created high socio-economic disparities and environmental vulnerabilities between high and low income groups within the city.

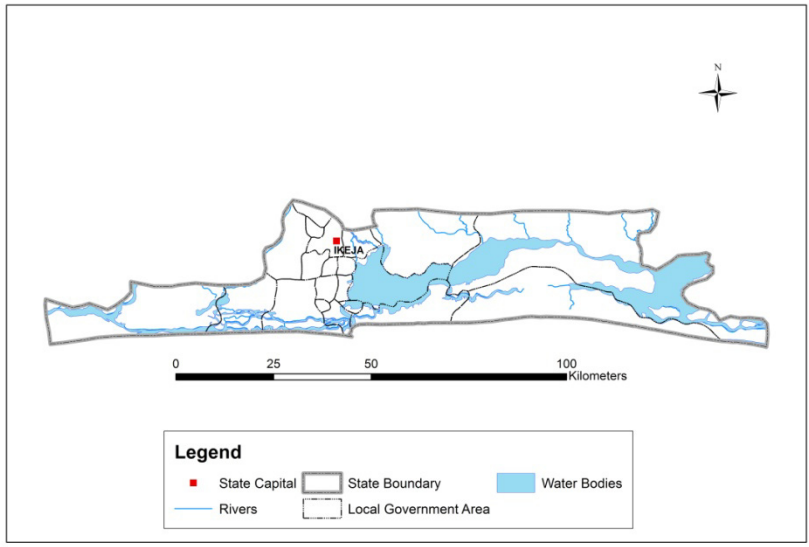

Figure 2: Map of Lagos showing the local government areas (GIS map by Mofoluso Fagbeja).

However, the cost of this population growth is not limited to the demand for water, food and energy resources, but also includes an increased impact on public health and quality of life. Poor air quality has been linked to respiratory health effects [5], especially among sensitive groups such as young children, elderly, and those with respiratory problems. The lack of a framework for the review, assessment and management of air pollution in the city implies that Lagos residents are exposed to significant ambient air pollution and therefore subject to attendant public health risks.

Ambient air pollution in Lagos is caused by both natural and anthropogenic factors. These include a significant natural contribution from desert dust transported from the Sahara to the Gulf of Guinea by north-easterly trade winds [6]. However, the focus of this paper is on anthropogenic contributions from mobile, industrial and domestic sources. Vehicular traffic, petrol and diesel-fuelled power generators, and uncontrolled open incineration of waste and major thermal power stations are the main emissions sources within the city. The city typically experiences smog events caused by elevated levels of particles in the city e.g. the 12th October 2005 smog episode. These smog episodes further highlight an imperative need to evaluate the public health risks of air pollution in addition to identifying pollutant sources. This paper provides an overview of the emergent public health risks attributable to air pollution in Lagos and solutions to reduce them.

2 Exposure, health risks and variation in vulnerabilities

A World Health Organisation (WHO) study in 2007 indicated a growing trend in vehicular-derived air pollution in Lagos due to the high volume of old imported vehicles and 2-stroke engine motorcycles, which have higher emissions of particulate matter and un-burnt hydrocarbons than other types of engines [7]. Other similar studies have also indicated high concentrations of aromatic hydrocarbons, carbon monoxide (CO)and particulate matter (PM) attributed to evaporation of fuels, mobile combustion and natural gas activities around the city [8, 9]. Monitoring studies undertaken in Lagos indicate significant exceedences in monitored concentrations of pollutants such as CO, SO_2 and nitrogen oxides (NOx) in comparison with WHO standards [10].

Growing evidence has substantiated a causal relationship between such pollution and mortality, hospital admissions for respiratory or cardiovascular diseases and an associated increased risk of myocardial infarction [5]. Studies have shown that a corresponding increase in ambient concentrations of pollutants such as benzene, 1,3-butadiene, CO, lead, nitrogen dioxide (NO_2), ozone, sulphur dioxide (SO_2), and PM pose a significant risk to public health and quality of life [5].

Although a lack of consistent public health data makes it difficult to estimate the scale and impact of health risks attributable to air pollution in Lagos, various studies have provided plausible and growing evidence which indicates that residents are vulnerable to such risks. High concentrations of PM_{10} have been attributed to a rise in the incidence of diseases such as wheeze, cough and catarrh, eye infections, skin diseases, asthma, chronic bronchitis and cardiovascular diseases in densely populated areas of the city [10, 11].

Given the variability in the urban conglomeration and socio-economic conditions of Lagos, it is therefore estimated that air pollution exposure will have inequitable impact on low income communities with high population density and among sensitive groups such as young children, the elderly, and those with pre-existing respiratory problems. These impacts are exacerbated by the proximity of dwellings in these communities to sources of emissions and a lack of access to good health care.

3 Lessons from other countries on effects-based management approaches

Research on the health effects of air pollution has contributed to the establishment of air quality standards and guidelines to protect public health. In countries where consistent assessment and management of air quality exists, the approach to such management has shifted from source control to an effects-based and risk-management approach. Since the 1980s, the European Union have established a series of limit values relating to specific pollutants, requiring member states to transpose these limit values into objectives within their national regulations [12]. The standards are set as concentrations below which health effects are unlikely even in sensitive population groups, or below which risks to

public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The objectives therefore set out the extent to which the national government expects the standards to be achieved by a certain date. In setting the objectives, the government takes account of economic efficiency, practicability, technical feasibility and timescales for achieving them.

Similarly in the US, the legislation has been designed to protect public health from the risk of ambient air pollution. The increasing importance of the health effects from vehicle emissions was acknowledged by the authorisation of the Public Health Service to study these effects via an amendment to the Act in 1963 [13]. The Clean Air Act Amendments of 1970 established National Ambient Air Quality Standards, new stringent standards for motor vehicle emissions, and New Source Performance Standards, that strictly regulated emissions from a new source entering an area. In New Zealand, the introduction of the Resource Management Act (1991) shifted the focus of environmental management away from regulation of potentially polluting activities, and towards the management of the effects (including health effects) of those activities on the surrounding environment [14].

A similar effects-based approach needs to be adopted in order to reduce the public health risk attributable to air pollution in Lagos. This will frame air pollution problems in the city within a public health context, rather than as an environmental nuisance. This approach requires assessment and balancing of risks between observed and potential health impacts, alongside the political, economic and technical issues [12].

4 Reducing public health risks in Lagos through effects-based air quality management

Unlike water, drug or food quality, the impact of urban air pollution in Lagos is non-discriminatory, and disproportionately affects vulnerable groups in the community. Managing such a problem requires a cyclic and continuous process. Immediate and proportionate air quality management policy and practice need to be developed to reduce this risk. An effects-based management approach would reposition urban air pollution problems in the city to the forefront of the political agenda as a public health issue rather than as an environmental nuisance. This approach should include the following three elements.

4.1 Identification and assessment of public health risks in vulnerable communities within Lagos

Although there are still uncertainties with regards to the science of atmospheric pollution, there is sufficient evidence to link poor air quality to significant public health risks [10]. Public health risks attributable to air pollution in Lagos should be identified and assessed based on vulnerabilities of specific communities in the city. This paper has established that variability in the socio-economic conditions and access to healthcare in the city creates differential susceptibility of

communities in the city to ill health attributable to air pollution. Therefore, such variability needs to be considered and adequately accounted for in the formulation and implementation of air quality management policy and practice. The assessment needs to be initiated and facilitated by the national and state government in order to further identify the geography, scale and consequences of air pollution problems in Lagos.

4.2 Setting effects-based standards and objectives for specific pollutants

The primary outcome of the initial assessment should be the determination of relevant standards and objectives against which ambient air quality in the city can be measured. This should be based on the best available epidemiological information from other countries and identified health impacts in Lagos. This will provide the government with the necessary tools to establish a set of numerical air quality standards and objectives for individual pollutants with the potential to compromise public health and specified timeframes for their achievement [12].

4.3 Implementing management policy and practice

To protect public health based on the standards and objectives a suite of proportionate and cost-effective evaluation and management programmes will need to be undertaken at the state and local level. Management actions with identified roles and responsibilities for the government, industry and the public will need to be established, for example, specific measures for managing and mitigating emissions from vehicles and diesel-powered generators. This management framework will need to take account of economic efficiency, practicability, technical feasibility and timescales for achieving legislated air quality objectives.

5 Conclusions

Various studies have indicated the scale and spatial variability of public susceptibility to air pollution in Lagos. However, this knowledge is not sufficient to reduce the risks to public health posed by the problem. An effects-based and risk-management approach for Lagos needs to be employed in order to provide a dynamic solution to public health issues associated with elevated concentrations of specified air pollutants such as PM_{10}, VOCs and NO_2 from traffic and domestic energy sources in Lagos. This approach should therefore be based on a clear understanding of the public health risks posed by elevated levels of air pollution in order to prioritise a set of options available for minimizing the health risks especially in vulnerable communities. It will also consist of risk assessments based on identifiable economic costs and benefits to public health and quality of life and will facilitate new regulations, policies and processes that are informed by scientific evidence.

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